SCIENTIFIC AMERICAN

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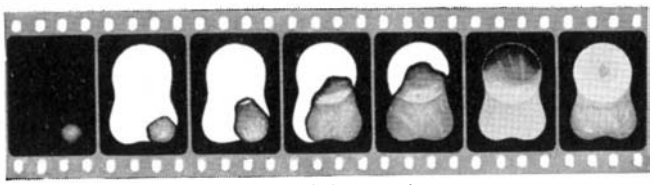
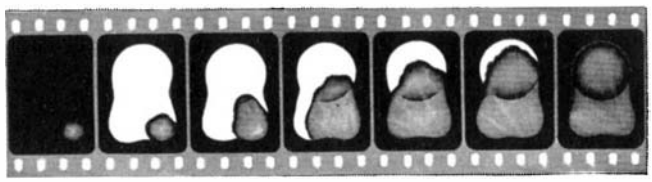


ORDINARY GASOLINE is in the cylinder. You see the spark in the picture at the left. In the next the gasoline vapor starts to burn. More—more—more burns. Then suddenly, in the sixth picture—BANG! The remaining gasoline explodes. That is KNOCK. The last picture shows nothing but after glow. Knock wasted the gasoline that should be working now.



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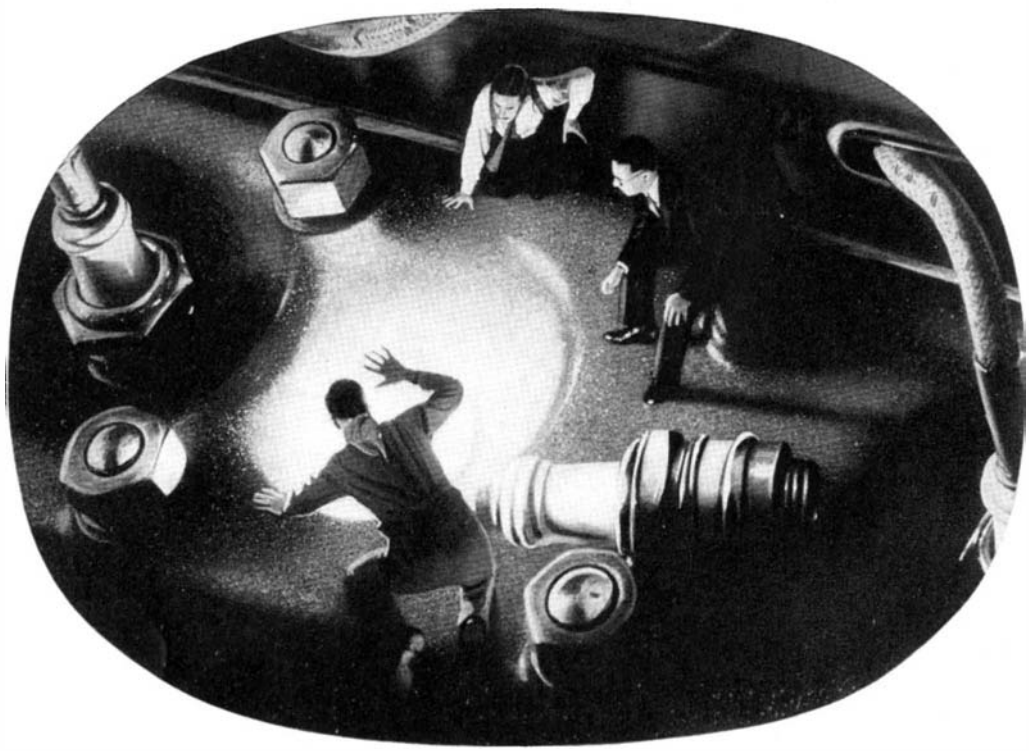

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EIGHTY-EIGHTH YEAR • ORSON D. MUNN, Editor

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ACROSS THE EDITOR'S DESK

PROBABLY every reader of the SCIENTIFIC AMERICAN has at some time or other found his thoughts drifting more or less idly through the channels laid out by modern science, in a vain endeavor to answer the question "What is it all about?" Life; human, animal, vegetable—the earth, sun, moon, stars—whence came all these? Why are they here? Where are they going? In just this manner, from time immemorable, have philosophers pondered on the universe and all that it contains. It is good for human minds to speculate in this way, and get away for a while from the routine of more material things. It was with such a thought that we accepted for publication an article by Hiram Percy Maxim, and as we re-read it before writing this paragraph, we were still more impressed by the manner in which he leads the reader through a searching analysis of present knowledge to predictions of what is to come. Mr. Maxim's article is scheduled to lead our April issue.

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Aircraft as an adjunct to sea power has grown to be a tremendously important factor in the military affairs of our country. Some authorities even contend that aircraft have rendered battleships obsolete, but whether that is so, perhaps only another major war can show. Without awaiting the calamity of war, however, the position of aircraft in a well-rounded treaty fleet must be determined and an aircraft program worked out accordingly. Essentially, this is the theme of an article by Charles L. Lawrance, famous inventor of the Whirlwind engine and an important figure in the aircraft industry. This article is now in hand and will be published soon.

•

Shall milk be pasteurized before use, or shall it be left raw? This is a question which never fails to elicit arguments on both sides. When pasteurized milk first came into more or less general use, many people spurned it, claiming that the process of pasteurization destroyed health-giving, body-building elements in the milk; even today thousands hold the same ideas. This theory has been proved fallacious, but those who stand against the use of pasteurized milk find support in a published report, favoring the use of raw milk, which has since been proved to be based upon an unscientific series of experiments. Medical science says today that pasteurized milk is the safest form in which milk can be consumed, and an article soon to be published gives the unvarnished facts of both sides of the case.

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Before the Revolutionary War, there was only one kind of road in this country—bad. After the War, turnpikes were built and travel became more extensive. Then came the railroad, with still a different kind of road, and finally the automobile. The latter called for more and better highways, and they were built and are being built. Then started the fight between the railroads and the motor vehicle, which now has boiled down to the fact that we must have and must use both. An article which deals in an effective manner with this important phase of our national welfare is now in hand and will be presented in the very near future.

•

Forty tons of coral have been ripped loose from the heart of a submarine forest, bleached and packed, and sent to a large museum where a huge display is now being set up for the enjoyment of visitors. Some idea of the magnitude of this work will be gained from an article, illustrated with a remarkable set of photographs, which will be presented in our next number. The underlying idea of the exhibit is that the spectator shall be transported, mentally, to the beautiful depths of the sea, without any of the discomfort that would attend such an actual experience.

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To the art collector and the student of the arts, the validity of a supposed old master or other work of art is of vast importance. For some time, science has been of great assistance in establishing or disproving the supposed character of statuary, paintings, and so on, making use of the microscope, photography, chemistry, and the X ray. Now a new tool has been tried out and the results have been all that were anticipated. Ultra-violet light is the working element of this tool, and by its use the expert is enabled to pass upon the identity of works of art, as well as to recognize fraud and point out repairs that have been made since the original was completed. The story of this work will be told in an article scheduled for next month.

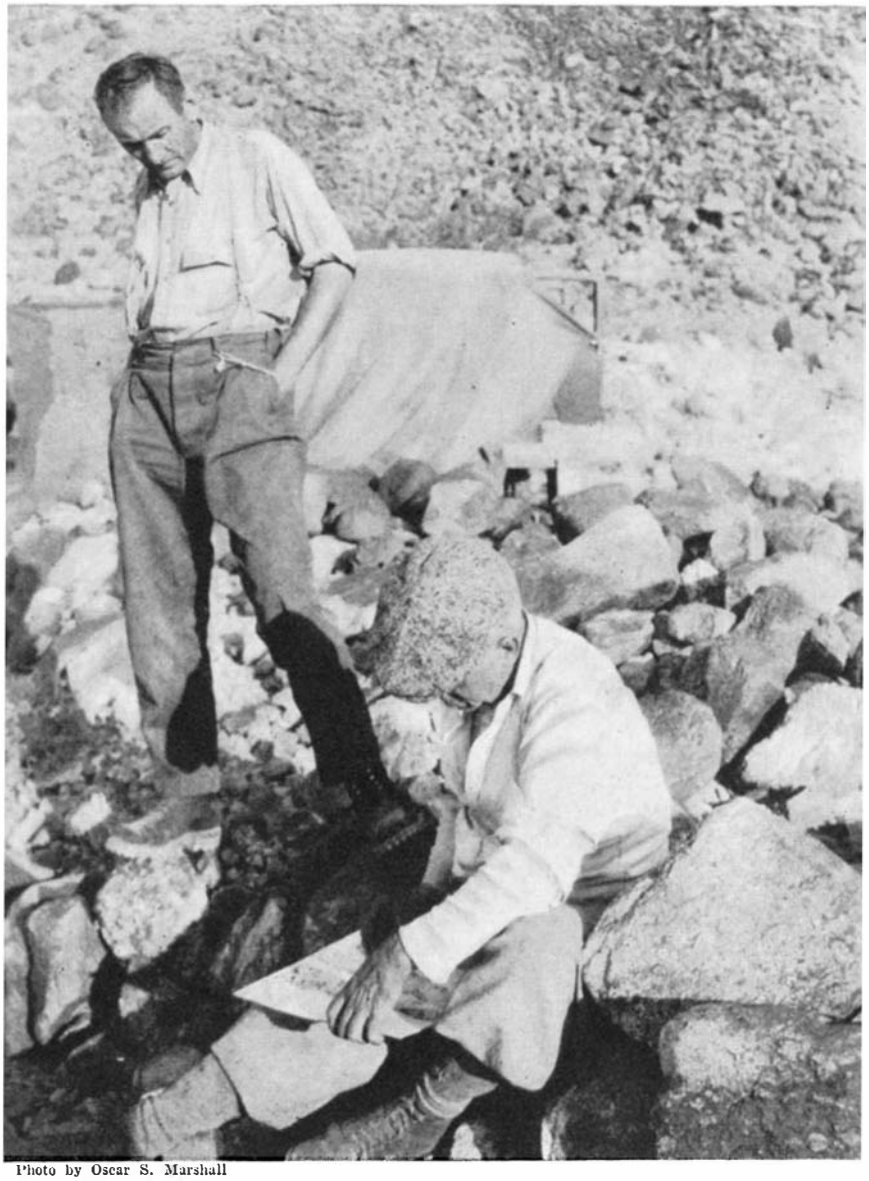
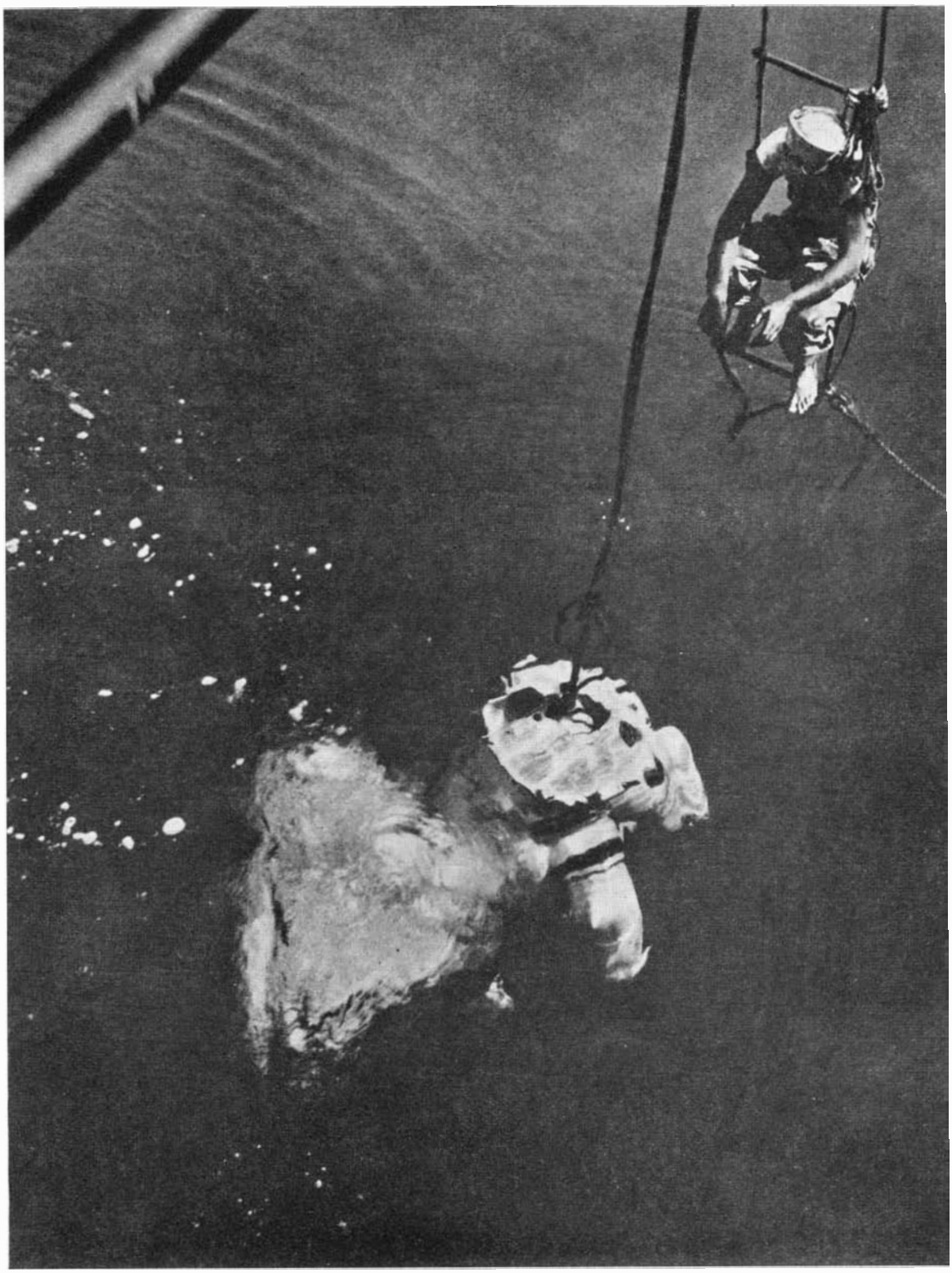


Photo by Oscar S. Marshall

FRITZ ZWICKY

MEN of science, whatever their rank and standing, have their moments of relaxation and their hobbies like the rest of us, and mountain climbing is the hobby of the German Swiss Dr. Zwicky, associate professor in theoretical physics at the California Institute of Technology, in Pasadena. Dr. Zwicky is seen with Russell W. Porter of the same institution, the former standing in heavy hobnailed boots, the latter seated and sketching. Though he is still in his early thirties, Dr. Zwicky's name has figured prominently in discussions of cosmology among the most noted men of science. Professor Einstein has said that he considers him one of our most promising young physicists. His work has been done mainly in the structure of matter. He has emphasized the importance of co-operative actions of great numbers of atoms and molecules, actions which have the most decisive influence on the behavior of matter in the solid and liquid state and may play an important rôle in some of the fundamental phenomena of biology.

It was Dr. Zwicky and some of his colleagues in Zürich who introduced short, broad skis (summer skis) for mountain climbing, making the first winter ascent of the Aiguille du Goûter ridge of Mt. Blanc. He also improved the technique of climbing steep ice slopes with crampons. Slopes up to 60 degrees may be climbed without chopping steps, by backing up.



THE "UNDERWATER FOREMAN" DIVES TO HIS WORK

QUITE a commotion attends the descent over the side of the salvage ship *Artiglio II* of the steel diving chamber, described on page 147, in which one man sits in comfort, observes the underwater operations of devices that tear away the obstructions on the *Egypt* to get at her treasure, and telephones minute directions to the surface. Divers in the ordinary sense are not used, the tearing away work and placing of explosives being done by cable, all underwater maneuvering of which is done according to the instructions of the "foreman" below.

MANY who remain unconvinced of the validity of that class of psychic phenomena which involves tangible physical objects are willing to accept the validity of thought transference or "mental telepathy." But to some persons such a position seems inconsistent. They assert that the validity of (honest) psychic phenomena must be accepted or rejected as a whole. However, it may turn out when the causes and nature of the several phenomena are discovered—if they ever are—that they have little or nothing in common. One class might then be valid and others the reverse. In other words, our present tendency to lump together several kinds of phenomena may merely reflect our present ignorance of them. Practically all that science knows about them now is that, apparently, some of them work. The cause—the underlying "force" if there is a force—and the actual method of operation remain hidden and unknown. Therefore our investigations must at present be only empirical; we perform experiments and try to make deductions from the end-products, but the intermediate parts of the chain are blank. An empirical science is only half satisfactory.

Some day the fundamental nature of the causes of psychic phenomena may be discovered. The more precise sciences, such as physics, may then be able to fashion a tool to work with, and the investigation may be taken up in the manner science likes best and is most accustomed to. It is mainly the lack of knowledge of the cause and method of the phenomena, and the lack of a satisfactory scientific tool for investigating them, which causes most scientists at present to regard their investigation as unlikely to prove very profitable. Mainly, it appears, this is a job reserved for future scientists. Men like Dr. Prince will then be regarded as pioneers who worked indefatigably against great difficulties.

In the meanwhile, even the empirical tests such as Dr. Prince here describes with such interest are more than sufficient to claim our attention. In the final analysis, acceptance or rejection of such tests must remain largely a matter of individual mentality. If the reader accepts, we shall not criticize him. If he rejects, we shall not quarrel with him. In our own opinion telepathy, standing alone, is at least tentatively acceptable. —*The Editor.*

MRS. SINCLAIR'S 'MENTAL RADIO'

By WALTER FRANKLIN PRINCE, Ph. D.
Research Officer, The Boston Society for Psychic Research

ABOUT a year ago I first opened "Mental Radio," a book by the well-known novelist, Upton Sinclair. In 239 pages it outlined the story of the discovery and development of what appeared to be a supernormal faculty in Mrs. Sinclair, and rehearsed a large number of experiments in which she seemed to have achieved a large and convincing percentage of successes as a telepathic "percipient," the "agent" generally being Mr. Sinclair, but sometimes her brother or another person. I confess to misgivings as I began to read, first for the very reason that the writer is a novelist (unmindful of Wells and certain other writers of fiction who, nevertheless, have shown themselves capable of serious and even scientific thinking), and secondly because I had suspected that once or twice in the past he had failed to discover the devices of certain clever professionals. To be sure, his wife was not a professional, and all the conditions could be under his own hand, but sometimes through sheer confidence people are deceived by their own relatives.

This, to be frank, was my initial attitude—one of cautious interrogation and alertness to find signs of credulity, failure to appreciate the possibilities of chance, or lack of data by which the calculus of chance coincidence could be determined. But as I read on and studied the reproductions of drawings it became more and more evident that something besides chance had operated, that the conditions of many of the experiments had been excellently devised, and that where the conditions were relaxed Mr. Sinclair had been quite aware of the fact and was candid enough to admit it. He stated that such relaxation did not increase the percentages of success, and it certainly so appeared from the examples given. He reported the total number of experiments, and estimated the percentages of successes, partial successes, and failures. In 290 experiments, he made these percentages: successes, approximately 23 percent, partial successes 53 percent, failures 24 percent. He admitted that judges probably would not agree upon exactly the same ratios. In fact I personally think that certain examples which he did not publish are better than a few which he did, but have not yet found reason to quarrel with his general estimates.

AFTER considerable study of the book, becoming interested beyond any expectation, I wrote to Mr. Sinclair, stating that I had become favorably impressed, and making the somewhat audacious proposal that he should send me all the original materials for a fresh study by the individual standards and through the particular methods of a professional investigator. One can think of several reasons which might make the most honest and confident man hesitant to assent to such a proposal, coming from one whom he had never seen, and who might for all he knew have a set of prejudices which after all would cause him to make a lawyer's argument against the case. I was really surprised that the bundle of materials was sent as quickly as it could be got together.

AMONG the objects in mind were: (1) To study the materials in strict chronological order, day by day. The mode of presentation in "Mental Radio" was to give some of the most striking results first, then many more that were more or less classified according to subjects and aspects. This is effective for popular reading but not satisfactory to the serious student. (2) To see if there were signs, in any part of the results, of profiting from normal knowledge, whether consciously or subconsciously acquired, of what the "agent" had drawn. Mr. Sinclair took this theory into account and quite decidedly killed it, but it was my duty to try it out anew by my own processes, with the same rigor shown in relation to my own wife and my daughter in "The Psychic in the House." Later and in another place these tests will be set forth in detail; here suffice it to say that they determined to my satisfaction that no deceit, conscious or subconscious, was practiced at any point. (3) To see whether the telepathic faculty was constant, vacillating, progressively stronger, or what. If at one period results are better than at another it is hard to tell whether the reason is to be found in the percipient or the agent. But apparently the capacity for getting the thoughts of another by the percipient, while it varied from day to day, on the whole was more evident in the first

months of the entire series, rather than in the last months.

Before examples are presented let there be some understanding of the method of procedure. It varied from time to time but at its best the agent made drawings of objects, to the number of six or more, each on a separate paper at a safe distance, and fixed his attention upon each in turn until the percipient, having prepared her mind so that its conscious tempo, so to speak, was lowered (her own way of putting it is that she made her mind a "blank"—which in fact no one can do), had received her impression, drawn it on paper, and announced the fact. Then the two drawings were compared, and other tests followed in like fashion. Sometimes Mr. Sinclair wrapped his drawings, singly, in green opaque paper, enclosed each in an envelope, and sat by his wife as she held each in turn in her hand. Let it be understood that in this article, a figure standing alone designates a drawing made by the agent, usually Mr. Sinclair, while the same figure accompanied by the letter *a* designates the corresponding drawing by the percipient. Any writing appearing with any drawing was made by her.

I find five tests made February 20, 1929, and present them in order.

Mr. Sinclair moderately calls the first a "partial success." And so it was, as the two drawings compare. It may in fact have been a complete success, since as he gazed upon it he may have fixed his attention upon the nozzle and thought how water would issue from it. Oddly,

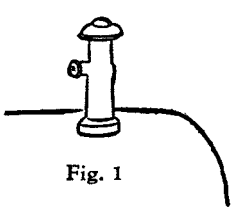


Fig. 1

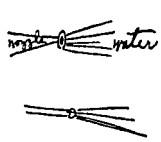


Fig. 1*a*

there was written above Figure 1*a*, "peafowl," which is quite out of congruity with Figure 1, but not with Figure 2, already prepared, which actually was a peafowl! Here she not only said "peafowl again," but she drew what seems likely are impressions of the peacock's long neck and the "eyes" or spots which his wings actually have.

Next the agent drew an hour-glass with running sand (Figure 3). As in this series the percipient held the concealed drawing in her hand as she waited for impressions, she is likely to have held it upside down, and we so present it.

Fig. 2

Fig. 2*a*

The resemblance of the tree (Figure 3*a*) to the upper half of the hour-glass

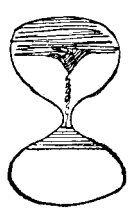


Fig. 3

Fig. 3*a*

is evident, and "white sand" is seemingly a reflection, not from the drawing as such, but from the agent's thoughts about it.

The next result had no reference to an agent's drawing. Mr. Sinclair had opened a book and was reading. His wife asked, "Are there any flowers in what you are reading?" She had just drawn two flowers, which pressed upon

Fig. 4*a*

Fig. 4*b*

her attention. While she was drawing the "red flower" (Figure 4*a*) he was reading about "red clover." Soon after he read about "the flowering aloe."

The next pair is Figure 5, 5*a*. This is indeed a most extraordinary "coincidence." Both animals, of similar

Fig. 5

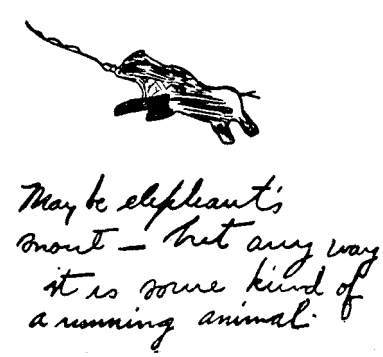


Fig. 5*a*

though not identical configuration, both running, both facing a "long thing" with very nearly the same slant! The extreme unlikelihood that these five consecutive results could have come about without any causal relation to the agent's drawings and thoughts ought to evidence itself. But there is a way by which to demonstrate it, and that way I shall later and elsewhere pursue.

Let us now see the complete and long series of February 15, 1929. It contains no such brilliant success as No. 5, but out of 13 experiments there is but one absolute failure, the first. In this the agent drew a rat, the percipient two crossed objects like keys. (Not illustrated.)

In Figure 6, agent's drawing represents a door with lattice on the upper

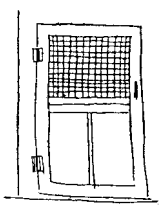


Fig. 6

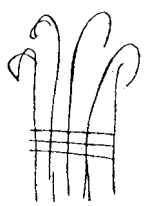


Fig. 6*a*

half; it is made up of perpendicular and horizontal lines only. Percipient's drawing, Figure 6*a*, consists of four perpendicular lines finishing at the top in curves like fishhooks, and these lines are crossed by three horizontal lines. There is therefore a suggestion of agent's drawing, a resemblance greater than to any other of the thirteen.

In Figure 7*a*, Mrs. Sinclair first seems to have got the notion of a sun, which

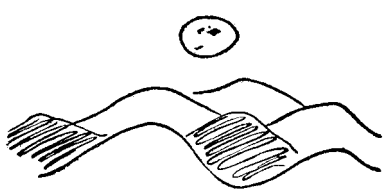


Fig. 7

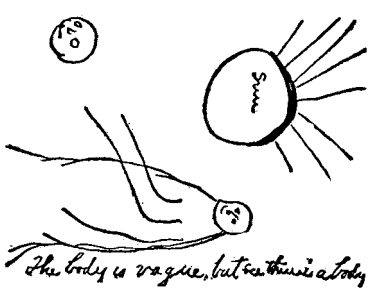


Fig. 7*a*

was right. Then she made another circle and put features in it, as will be seen suggested in agent's drawing (actually, in the original drawing, the features are plain). Then she got the idea of something stretching out below it with curving lines, interpreted it to be a body, so, probably from mere inference, clapped her sun with features on to it.

Figure 8 is a butterfly but percipient did not get the idea of a butterfly. However, the divergent lines and the spots, five instead of four, and similarly placed, do seem to bear a relation to it.

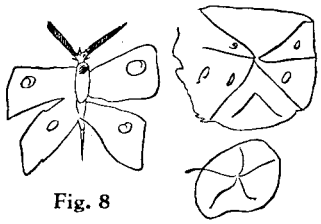


Fig. 8 Fig. 8*a*

In Figure 9*a*, Mrs. Sinclair's drawing resembles a part of her husband's

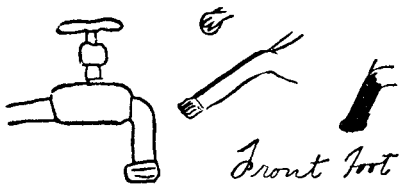


Fig. 9 Fig. 9*a*

(Figure 9), although she misinterpreted her mental picture.

In Figures 10 and 10*a*, compare the

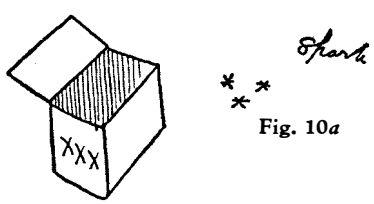


Fig. 10*a*

Fig. 10

three "sparks" with the three crosses on the box.

The shape of 11*a* is like that of 11 reversed, and there is a suggestion of the

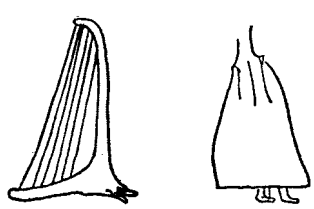


Fig. 11 Fig. 11*a*

strings, while the feet represent the pedals of the harp.

The percipient in the case of Figure 12*a* did not get the picture of the whole

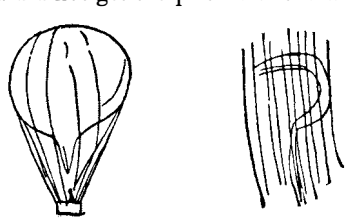


Fig. 12 Fig. 12*a*

balloon bag, but she did of half of it, with a strong suggestion of the cords.

In Figures 13*a*, *b*, *c*, bad as the percipient's drawings are, regarded as reproductions of Figure 13, they do contain suggestions of it. In 13*a* we may suppose that an impression of the leaf-stem (but badly twisted) was expressed with the leaf-lobe directly below the stem, together with the idea of the veining, that in 13*b* the stem is corrected, and that in 13*c* a notion of the veining alone is conveyed. Exactly so would the attention of the agent, when

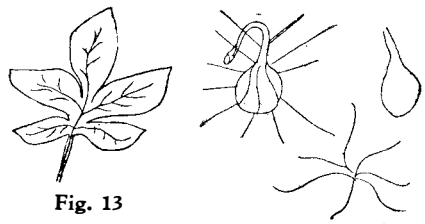


Fig. 13 Figs. 13*a*, *b*, *c*

drawing the leaf, or afterward looking at or thinking of it, pass from and to, or at least stress, one part of the leaf after another.

Comment on Figures 14 and 14*a* is superfluous. It cannot be denied that here we have a remarkable hit. But

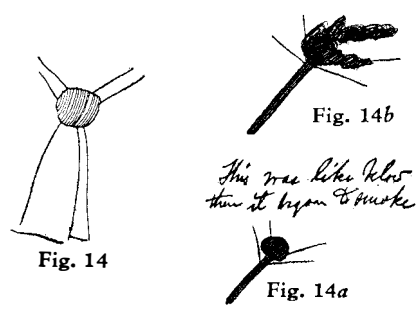


Fig. 14 Fig. 14*b* Fig. 14*a*

"then it began to smoke," and another drawing (Figure 14*b*) was made almost precisely the same as 14*a*, except that smoke now curls from the knot of the necktie. One would suppose that the knobby extremity and the diverging lines suggested a burning match. But no, the alteration appears to have been an anticipation of the agent's next drawing, already prepared! (Figure 15.) In this case Mrs. Sinclair achieved

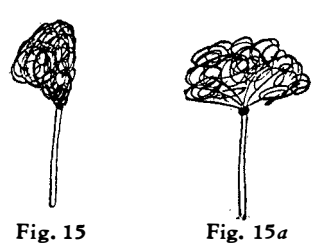


Fig. 15 Fig. 15*a*

a complete success, though she distrusted it, writing beside the drawing, "Must be memory of the last one."

In Figure 16*a* the percipient got the

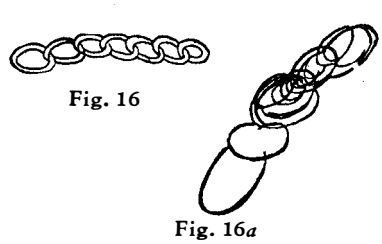


Fig. 16 Fig. 16*a*

first two links fairly well. The succeeding ones are suggested by a series of partially superposed ovals, owing to misinterpretation of her impressions. She wrote: "An egg-shaped thing smoking? Anyway, curls of something coming out of end of egg." Note that her combined "egg" and "curls" shows nearly the same length and curve as the agent's chain.

The 13th and last experiment of this date resulted in two percipient drawings, one shown as 17*a*, the other, 17*b*, about the same except that Figure 17*b* ends at bottom with the "strings" only, which are more nearly parallel with each other.

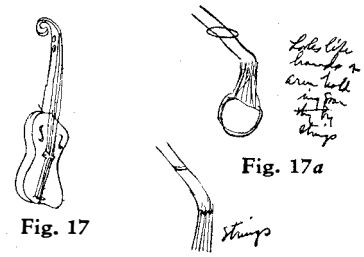


Fig. 17 Fig. 17*a* Fig. 17*b*

Presumably the "arm" of 17*a* is a reflection of the neck of the violin, the "hand" of its bridge, the "strings" of the violin strings, while the "something" very imperfectly stands for the body of the instrument. The bracelet (?) on the arm may result from an obscure impression of something on the violin neck, really the keys. Drawing 17*b* stops with the strings, but makes them more nearly parallel, like those of the violin.

No exact mathematics can be applied to such experiments as these. But, considering the multitude of objects and shapes which must have been familiar to both experimenters, do you believe that there was 1 chance in 16 of the successes in experiments 14, 15, and 16? Or more than 1 chance in 4 for Numbers 9, 10, and 11? Or more than an average of 1 in 2 for such small degree of success as is discoverable in the rest, excluding the failure of the one between 5 and 6? Multiply accordingly, and divide the product, let us say, by 2 for this failure. The result, on what I think a moderate basis, is 1 chance in 16,777,216. Figure any other way you like, but be reasonable.

Or try substituting 6*a* for the percipient drawing of any one of the other 12 of the series and see if you get as much correspondence with the agent's drawing. Then take drawing 7*a*, and try to fit it in as well anywhere else. And thus with the others, if your patience holds out to the end of the 133 exchanges. Have you found a single one which will suit as well as in its actual position?

There is room for but one more series, and that a short one. Here the agent was Mr. Robert L. Irwin, brother-in-law of Mrs. Sinclair, the percipient. They agreed that at a specified hour, on each

of a number of days, they would try an experiment for thought transmission. Accordingly he sat and drew some object, and then steadily gazed at it, while she lay on her couch in semi-darkness, with eyes closed, "suggesting to her sub-conscious mind to bring her whatever was in the mind of her brother-in-law." He was in Pasadena, and she at Long Beach, some 25 miles away as the crow flies. Here are his drawing and her results for July 8, 1928 (Figures 18, 18*a*).

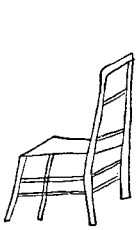


Fig. 18

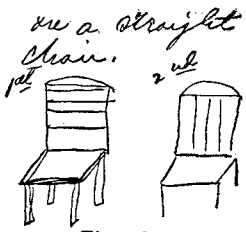


Fig. 18*a*

Not only did Mrs. Sinclair get the chair, but she wrote that Bob's drawing was on "green paper," which was the case. She also wrote: "Tho not sure of the second drawing, it does not seem to be on paper. It may be his bed-foot. I distinctly see a chair like 1st on his paper." And in fact the chair Bob drew had its bars horizontal as in her "1st," while he in fact gazed at the actual chair used as his model, through the vertical bars of his bed-foot!

The next day, July 9th, Bob drew his watch (Figure 19).

First she had drawn a chair, but wrote, "But do not feel it is correct." After Figure 19*a* she wrote, in part: "I

Fig. 19

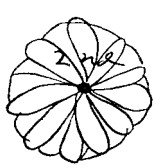


Fig. 19*a*

think it is not flower but wire (metal, shining). The 'petals' are not petals but wire, and should be more *uniform*. . . . I see it shining as if it is metal. Later a glass circle." And she added an ellipse, a drinking glass, and a glass pitcher. In fact Bob had before him (unfortunately, as it complicated the conditions) a glass bowl. "Wire" is wrong but metal right, and the dot in the center is significant, and the word "uniform" should be eloquent.

Next day, July 10th, Bob drew a pair of scissors (Figure 20), and certainly Mrs. Sinclair's drawings (Figures 20*a* and 20*b*) seem to sense its parts.

Next day, July 11th, there occurred what appears to have been a compound

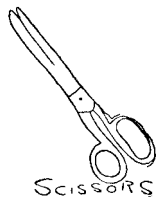


Fig. 20

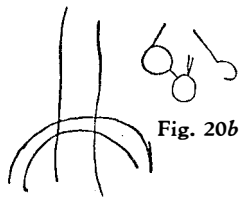


Fig. 20*b*

Fig. 20*a*

impression, traceable not only to Bob's drawing, but to certain other thoughts of his as he gazed at it. He made a circle with a compass, of course producing a hole in the center. But he had also discovered that he had a hemorrhoid and, to use his own language, "couldn't put my mind on anything else but the thought 'My God, my lungs—my kidneys, and now this!'" A hemorrhoid is apt to bring on hemorrhage, and Bob would naturally think of blood. And this is what Mrs. Sinclair got. (Figure 21*a*.) The written com-

Fig. 21*a*

ment reads: "All this dark like a stain —feel it is blood; that Bob is ill—more than usual."

I do not know whether or not there was an experiment on the 12th—it matters little in view of such successes, but on the following day came the drawing by Bob and the contemporaneous writ-

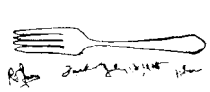


Fig. 22

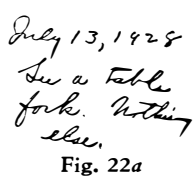


Fig. 22*a*

ten note by Mrs. Sinclair shown in Figures 22 and 22*a*.

I have frequently heard the glib suggestion that relatives and friends are likely to think of the same things, but have never discovered any psychological law requiring a man and his sister-in-law to think of a chair at a given hour one day; her to think of a round metal object with a spot in the center and something "uniform" about its divisions, when *he* drew a watch on the next day; him to think of a pair of scissors and her of shapes like parts of scissors the next day; her to picture concentric circles with a dot in the center when he has made a circle with a hole in the center, and to have a very pertinent impression that he is ill while he is dwelling upon a new symptom the next day; and both to think of a table fork at the same hour, the next day but one. Somehow a generalization is often less satisfactory when put into concrete terms. For certain of these tests there are four witnesses.

Mr. Sinclair very sensibly says, concerning some other experiments described in his book:

"I think that if you will go back and look over those drawings as a whole, you must admit that the objects were as varied as the imagination could make them. I do not see how any one could choose a set of objects less likely to be guessed than the series which I have numbered from 5 to 12—a bird's nest full of eggs and surrounded by leaves, a spiked helmet, a desert palm-tree, a star with eight double points, a cocoanut palm, a puppy chasing a string, a flying bat, a Chinese mandarin, and a boy's foot with a roller-skate on it. None of these objects has any relationship whatever to my life, or to Craig's (Mrs. Sinclair), or to our common life. To say that a wife can guess such a series, because she knows her husband's mind so well, seems to me out of all reason."

Among other drawings of his followed by measurable successes I find a volcano, a swastika cross, a row of pillars, an hour-glass, an arrow, and a skull and cross-bones, none of which, probably, is intimately related to the Sinclairs' daily thoughts. Perhaps psychoanalysis, after noting his script Y followed by her excellent Y in print, could show that both persons are peculiarly affected by that letter, but it may be permissible to doubt it.

I am tempted to present one more example, the sixth of the series of February 8, 1928 (Figures 23 and 23*a*), and

Fig. 23

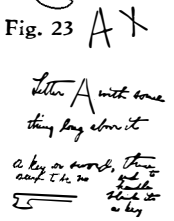


Fig. 23*a*

wish there were room for the other tests of the same date.

After years of experience in solving hundreds of human riddles—cases of conscious and unconscious deception, delusion, and illusion—and with a due regard for my reputation for caution and perspicuity, I here register my conviction that Mrs. Sinclair has amply demonstrated the phenomenon known as telepathy. The grounds for this conviction will later be set forth in detail. While doubtless the proposed Bulletin[1] will encounter much learned scepticism I also here predict that no serious attempt at refutal will ever be made.

[1]The author refers to a proposal to devote one of the series of *Bulletins* of the "Boston Society for Psychic Research" to this subject. —*Editor.*

OUR POINT OF VIEW

Rear Admiral Winslow

KNOWN before his retirement as "a deepwater sailor who has no superior in the Navy as a navigator," Rear Admiral Cameron McRae Winslow, U. S. N., died January 2 at his home in Boston, at the age of 77, as the result of a heart attack. With his passing, SCIENTIFIC AMERICAN has lost a lifelong friend; and the country, one of the few remaining fine old sailors in whom the tradition of "iron men and wooden ships" was inbred.

Admiral Winslow won a reputation for extraordinary heroism in the war with Spain by cutting underwater cables under fire until and after he was wounded. His promotion was rapid and when he retired in 1916, he was in command of the Pacific Fleet. In 1929 he was Chairman of the Committee of Award of the SCIENTIFIC AMERICAN Competition for Safety of Life at Sea and gave enthusiastic and detailed effort to make the competition a success.

Out of Adversity

AT the end of the business slump of a decade ago, there boomed forth a totally new industry which rapidly took up the slack, gave thousands and thousands of *new* jobs to workers and executives alike, and grew in a few years to be one of the giants of American business. At first a fascinating new toy, this new business of radio put hundreds of millions of dollars into active circulation, was one of the biggest factors in reviving the country and creating an era of unparalleled prosperity.

Is there in the offing today some new business capable of growth into an enormous industry, one that will not create technological unemployment but will instead give new jobs to the jobless? We have in mind one which we believe exactly fits these specifications. It is that which is being slowly built around the science of air conditioning, or "manufactured weather."

Already, theaters throughout the country are "refrigerated," railroad diners carry their own equipment to keep the temperature and humidity at comfortably low figures, entire passenger trains on the Baltimore and Ohio manufacture their own inside weather and some office buildings do the same, while experiments are now being carried on to determine the effectiveness of such equipment in residences. The systems vary from one which is essentially a current of air blown through a spray of water, to those using gas in a manner somewhat like that of the gas refrigerator and the latest one for trains which utilizes steam from the locomotive (see our November, 1931, issue).

There is a practically untouched field for the expansion of this industry and the demand is limited only by the cost of the equipment. In localities where the summer months are insufferably hot or humid or both, the high standard of living now traditional in America should be the governing factor, and comfort will be considered above mere questions of cost in most cases. For residences, however, it would seem that a "Flivver" type of air-conditioning equipment is indicated. The manufacturer who first reaches the field with such equipment will cool the first million or so homes.

Perhaps, also, there is a field for a truck-mounted apparatus, the operators of which, like the familiar exterminators, will go from house to house, close all the windows, and give an entire house or apartment a cooling-off that will last for the night and insure comfortable sleep in sultry weather.

Interstate Truck Regulation

ONE of the biggest surprises which those interested in the integrity of the railroads have ever received came in January in the form of certain recommendations in a report to the Interstate Commerce Commission by Leo J. Flynn, one of its examiners. Federal regulation of motor vehicles in interstate commerce and modification of the anti-trust laws to permit acquisition by the railroads of established bus and truck lines were the most important of the recommendations.

"If present conditions continue," Mr. Flynn said, "the diversion of traffic from railroads will grow, and constant losses may so seriously affect passenger travel as to make it impossible economically to operate adequate train service at present fares, and the progressive loss of freight traffic will make unprofitable the operation of many local merchandise cars and trains that now radiate from principal cities. . . . The public is entitled to the best transportation service, and no carrier by rail, motor vehicle, or air has a vested right in the transportation of a single passenger or a pound of freight."

Mr. Flynn recommended the extension of the Commission's jurisdiction to include all interstate buses and trucks except taxicabs, sight-seeing and school buses, and trucks used in the businesses of their immediate owners. Rates, services, acquisitions, and extensions would be regulated, with all other phases of operation which in the case of the railroads are already subject to the Commission's authority.

This is the first time such an opinion has come directly from the Interstate Commerce Commission; hence it falls like a bombshell in the thick of the fight for fair treatment of the railroads. When Congress finally acts upon it, as we confidently expect it will do at a not far distant date, the railroads will in truth become what they should have been from the beginning: transportation agents.

The Country's Good Health

FROM all the gloom and chaos of the past year of adversity, there shines out one bright light that compensates, in a measure, for the many troubles through which we have passed, and that is the excellence of the country's health. Despite the fact that industry was at its lowest ebb and consequently poverty was rampant, men and women skimped on their food in order that children might be fed, and the living conditions were the worst in decades, 1931 was one of the healthiest years we have ever had.

In both the cities and the country at large, the death rate decreased. In 82 large cities, the rate dropped from 11.9 in 1930 to 11.7 in 1931. In New York state, the death rate was lower than in any other year to date. Even in New York City, where undernourishment and privation would be expected to take a much larger toll in such a year, the death rate was 10.92 in 1931 compared with 10.86 for 1930—a negligible increase. Tuberculosis deaths and infant mortality rates for the city dropped to a new low point.

No one is able to say just what is the cause of this splendid showing, although it has been attributed, in part, to the absence of unpreventable diseases, to the increased interest in public and personal sanitation, and to the mild weather during the last part of the year, with the possibility that the slowing down of the tempo of American life has helped. Whatever the cause of the favorable health conditions, the record the country has made is meritorious and worth repetition in 1932—or bettering!

GEORGE WASHINGTON, INVENTOR

By JAMES HAY, Jr.

BEGINNING on Washington's Birthday, February 22, and continuing until next Thanksgiving Day, all sections of the country will celebrate the George Washington Bicentennial, this year being the two-hundredth anniversary of the birth of "The Father of Our Country." Plans for the celebration follow suggestions made by the United States George Washington Bicentennial Commission, of which President Hoover is Chairman.

Congress, in providing for the Bicentennial observance, stated that its object is to bring this generation and its posterity into such intimate knowledge of Washington's personality and career that they would be inspired to better citizenship and deeper love of country. In the interests of the success of that purpose we present here and on page 154 articles which discuss two little-known sides of this versatile man.

The Bicentennial Commission has decreed that the celebration shall last for nine months; that there shall be no big exposition or other entertainment to attract people to one place exclusively; and that every city, town, and village in America shall set aside, within the nine months, a number of patriotic dates on which it will stage festivities and ceremonies appropriate to the Bicentennial.

If any community has been backward in making its plans for the celebration and desires help in this work, it can secure invaluable assistance by applying to the United States George Washington Bicentennial Commission, Washington Building, Washington, D. C., for its comprehensive list of suggestions as to how these programs can best be developed and produced.—*The Editor.*

ONE of the most amazing things about George Washington, whose bicentennial the entire United States is about to celebrate, was his tremendous versatility. It included, for example, the field of invention, in which he achieved the same notable enterprise and success that characterized his activity in many other lines of endeavor.

Being a man of method and unusual efficiency, Washington had little patience with poor workmen or with crude implements. When at the age of 21 he began farming at Mount Vernon, the agricultural machinery at his disposal was cumbersome, heavy, and inadequate. As the years went by, and while he was increasing his home estate from its original 2700 acres to more than 8000 acres, he invented and developed several pieces of farm machinery.

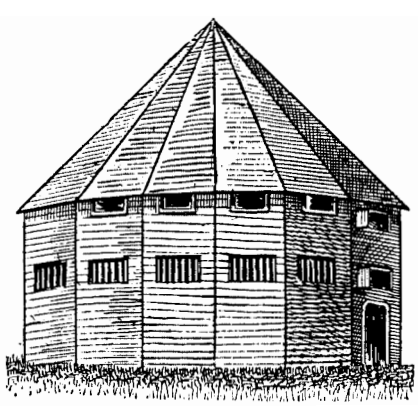
His first venture in invention was in March, 1760, when he undertook to improve the plow of that time. Toward the end of the 18th Century the owner of a plantation as large as Mount Vernon had to employ all sorts of workmen and artisans. Washington, for example, had, among his slaves and hired men, brick masons, carpenters, gardeners, wheelwrights, millers, blacksmiths, tailors, weavers, shoemakers, machinists, and tinsmiths. His workshops were always busy, and, by reason of his foresightedness and efficient planning, the work of the plantation was mapped out in such a way that all these servants and employees were kept busy from year's end to year's end.

CONSEQUENTLY, when George Washington wanted any sort of mechanical labor done, he had the proper workman to do it. Beginning his first venture in inventing farm tools, he took his blacksmith with him to a neighboring field, whither he had already sent a pair of his carriage horses. With the smith's help, he put together parts of a "two-eyed plow" with other parts of a "duck-bill plow" and tried out the result behind the carriage horses.

Neither he nor the blacksmith succeeded in constructing that day anything that was satisfactory. They kept at it, however, and a week later Washington wrote in his diary: "Spent the greater part of the day in making a new plow of my own invention." On the day following this, he recorded that he had put the plow to work "and found it answered very well."

His most important invention, however, and the one in which he took the most pride, was what he called a "barrel plow," although it was in fact a drill. At that time all seed that was sown was scattered by hand and covered over, usually with a hoe, but sometimes with a harrow—a tedious and time-wasting process. Washington's barrel plow was the result of his determination to improve on the old method of sowing.

This drill is described in Paul Leland Haworth's "George Washington, Country Gentleman." It consisted of "a barrel or hollow cylinder of wood mounted upon a wheeled plow and so arranged that as the plow moved forward the barrel turned. In the barrel were cut or burned holes through which the corn or other seed could drop into tubes that ran to the ground. By decreasing or increasing the number of holes, the grain could be planted at intervals that could be varied as desired for thicker or thinner planting. To prevent the holes from choking up he found it expedient to make them larger on the outside than on the inside, and he also found that the machine worked better if the barrel was kept not quite full of seed. Behind the drills ran a light harrow or drag which covered the seed, though in rough ground it was necessary to have a man follow after with a hoe to assist the process. A string was fastened to this harrow by which it could be lifted around when turning at the ends of the rows, the drill itself being managed by a pair of handles."



Washington's experimental many-sided barn, on Dogue Run Farm

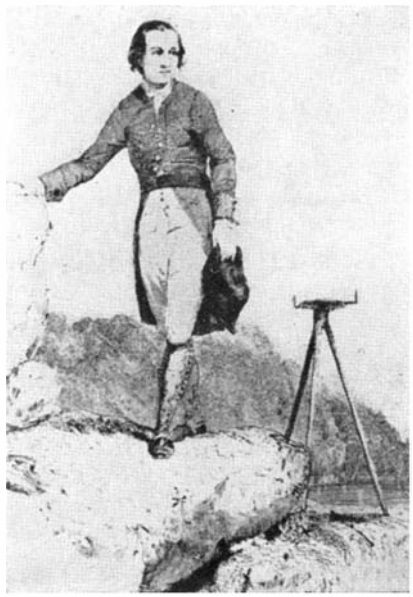
AFTER thoroughly testing the machine, the inventor in a letter to a friend declared that it would "not work to good effect in land that is very full either of stumps, stones, or large clods; but, where the ground is tolerably free from these and in good tilth, and particularly in light land, I am certain you will find it equal to your most sanguine expectation, for Indian corn, wheat, barley, pease, or any other tolerably round grain, that you may wish to sow or plant in this manner. I have sown oats very well with it, which is among the most inconvenient and unfit grains for this machine. . . . A small bag, containing about a peck of the seed you are sowing, is hung to the nails on the right handle, and with a small tin cup the barrel is replenished with convenience, whenever it is necessary, without loss of time, or waiting to come up with the seed bag at the end of the row."

Haworth, in discussing the drill, says it had features which "would incline, I have no doubt, to make its operator swear at times." There was a leather band that ran about the barrel with holes corresponding to those in the barrel, the purpose of the band being to prevent the seeds issuing out of more than one hole at the same time. This band had to be "slackened or braced" according to the influence of the atmosphere upon the leather, and sometimes the holes in the band tended to gape and admit seed between the band and the barrel, in which case Washington found it expedient to rivet "a piece of sheet tin, copper, or brass, the width of the band, and about four inches long, with a hole through it, the size of the one in the leather."

ALL in all, however, Washington took great pride in the drill and had it so perfected that he made great use of it, even for sowing very small seed. In the summer of 1786 he wrote in his diary: "Having fixed a roller to the tail of my drill plow, and a brush between it and the barrel, I sent it to Muddy Hole and sowed turnips in the intervals of corn."

Washington had pronounced talent for architecture. In fact, so great was his gift in this direction that he planned, and drew up the specifications for, all the barns and other farm buildings which he erected on his estate, for additions to the Mount Vernon Mansion, and for old Pohick Church.

One of his accomplishments as an architect was his 16-sided barn, a brick structure which a neighbor of his described as "the best and most conveniently arranged barn on this side of the Atlantic Ocean." In his era the threshing of wheat was done by throwing it on a hard surface, usually out of doors, and having the grain trodden out by the feet of slaves or the hoofs of horses. This was immensely costly because it destroyed some of the grain and mixed the remainder with dirt and trash.



An old print depicting the young Washington as a civil engineer when our first President did considerable surveying. This early interest in engineering was carried forward into his maturer years

Consequently, in his 16-sided barn, Washington included a specially designed threshing floor, containing interstices or cracks through which the grain, when trodden out, dropped down to a second and perfectly clean surface.

But he was not satisfied with this, and in 1790, while in New York, he drove out in the country to watch the operation of "Baron Poelnitz's mill," modeled after that of the Englishman, Winlaw. This machine was run by two men and at maximum capacity threshed only two bushels of wheat an hour. Moreover, the grain had to be winnowed or fanned afterward to get rid of the chaff. The mechanism so little impressed Washington that he had no desire to buy one for Mount Vernon.

It was a different story seven years later when, having studied the plans of a thresher invented by the American, William Booker, he employed that gentleman to come to Mount Vernon and set up the machine. But again he was disappointed. The following April, in 1798, he wrote Booker that the thresher "has by no means answered your expectations or mine."

It must have been a rather sorry affair. At the beginning, when it worked best, it threshed only some 40-odd bushels a day. Soon its output was less than 25 bushels a day, and it broke down completely before it had threshed a total of 500 bushels. While accomplishing that, it had worn out two bands that cost Washington nearly 50 dollars.

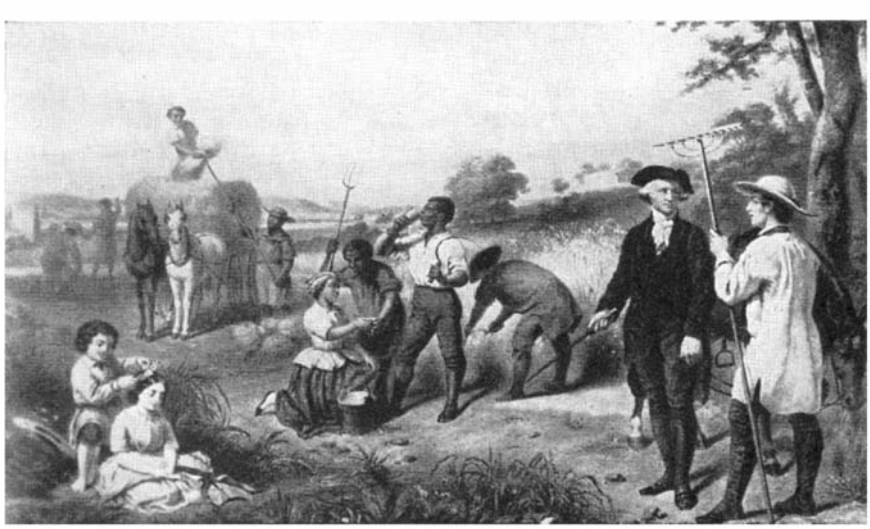
Informed of all this by the disappointed farmer, Booker with the optimism of the professional inventor immediately replied by letter that he had improved the machine immensely and would be glad to return to Mount Vernon to fix it up satisfactorily. The chances are that Washington did not share his optimism. At any rate there is no record of Mr. Booker ever having gone back to Mount Vernon.

NEVERTHELESS, not long after the Booker failure the farmer had two threshing machines on his plantation, which, built somewhat on existing models, combined the best points of all such mechanisms that Washington knew about. He had corresponded at great length with both English and French agriculturalists, not only about the rotation of crops and the fertilizing of land, but also about the latest types of threshers and other farm implements that could be procured in Europe; and he had once more used his inventive faculty to good effect.

Washington had, in fact, the scientific mind, which is amply proved by the voluminous notes he left describing the results he obtained in experimenting with rotation of crops and his use of different combinations of soils and fertilizers. Nor did his scientific interest cease with his own activities.

When James Rumsey, a noted engineer of that time, developed a steamboat, Washington helped and encouraged him in every way possible. In fact, it was through letters of introduction given by Washington that Rumsey interested Englishmen in his vessel and made a successful demonstration of it on the River Thames near London.

Although Rumsey never developed his boat into a practical business proposition, he undoubtedly invented the steamboat years before Fulton sailed the *Clermont* on the Hudson; and it was largely due to Washington's friendship and assistance that he got as far with the project as he did.



A painting by Thomas P. Rossiter showing Washington as a farmer at Mount Vernon, his home showing in the background and the Potomac far to the left

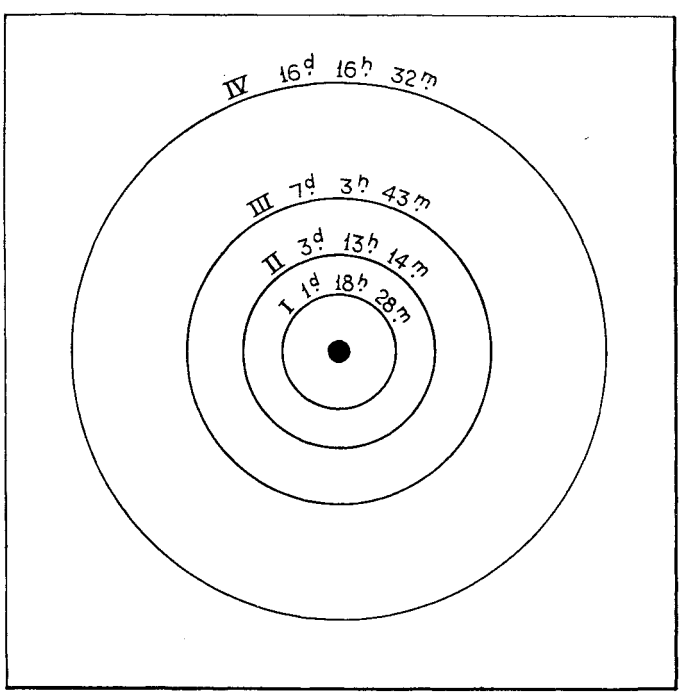
A MINIATURE SOLAR SYSTEM AND ITS PROBLEMS

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

SINCE the invention of the spectroscope 70 years ago, astronomers have tended more and more to become physicists. Yet, despite the fascination and the amazing success of the study of the nature of the heavenly bodies, there has always been a small group of very able men who have preferred to devote their lives and labors to the investigation of their motions. It is fortunate that tastes differ in science as well as elsewhere, for the problems presented by the motions of the members of our solar system are very far from being solved. This seems strange when it is realized that the principles which govern these motions were clearly and exactly stated by Newton more than 200 years ago. (The changes introduced by relativity are in practice so small that they need to be considered only in a few special cases, and are then readily calculable.)

FOR seven generations the ablest mathematicians have worked upon the problem. It is not their fault that it is not nearer a solution; the trouble lies in the extreme complexity of the motions themselves. When we have only two bodies to deal with, things are very simple. The orbits are fixed in shape, size, and position and it requires hardly more than the traditional "half sheet of note paper" to write the full solution. But when three or more bodies attract one another, the influence of each one alters the relative motions of the other two, and these changes react on their attraction toward each other and their neighbor in a fashion which taxes the highest analytical skill to follow.

Luckily for us the planets are very small in comparison with the sun, so we can start with each planet by forgetting about the others in working out its orbit, as if nothing but the sun attracted it. The relatively small influence of the attractions of the other planets can then be allowed for by supposing that the orbit slowly changes its position while the planet itself is set a little forward or back, out or in, up or down, as these attractions change. The calculation of these perturbations is intricate and laborious, especially for the larger planets Jupiter and Saturn, and becomes more and more complex as higher precision is sought. But solutions have been made for all the major planets, which suffice to calculate their past positions in the heavens with an accuracy greater than that of the observations with which the theory has to be compared, and to predict them in the future for a century or two—by which time some future investigator can make a still more accurate solution.



Jupiter and the orbits and periods of his four Galilean satellites, all to scale. The remaining five are much smaller

The motions of satellites about a planet present a harder problem. Although the moon "stands alone," with no other satellite to disturb its motions, the influence of the sun, and even the minute attraction of the distant planets, produce changes in its motion so intricate that it is only after many years of work by the most competent mathematicians that we at last possess tables which suffice to predict its position as closely as we can observe it. If there were two moons disturbing each other's motions the problem would be appalling to contemplate—and Jupiter has four, not counting the small ones!

These Galilean satellites of Jupiter, as they are often called after their discoverer, present a planetary system in miniature which is curiously similar to that of the four inner planets, or again to the five major planets. Jupiter's first satellite makes 50 revolutions for one of Mercury, its second 63 for one of Venus, the third 52 for one of the earth, and the fourth 41 for one of Mars; so that, in general terms, as much happens in Jupiter's system in a week as among the inner planets in a year.

For the major planets the periods average 3500 times as long as for the satellites, so that one day with the latter matches 10 years for the former. The satellites have been under observation for more than 320 years, and during that time they have made as many revolutions as the inner planets would make in 17,000 years, or the major planets in more than a million years.

THIS gives the theoretical astronomer a better chance to follow the gradual changes in the orbits than he would have with the planets even if the ancient Chaldeans and learned men ever since had had telescopes and left records of abundant and precise observations. But for this very reason it compels him to carry his analysis much further than he need do for the planets which have been observed for only a few hundred revolutions at most. Many notable men have worked on the problem, beginning with Lagrange in 1766. The most complete discussion is just being completed by Professor de Sitter, the dean of Dutch astronomers, who is better known to most people by his equally distinguished contributions to the theory of relativity.

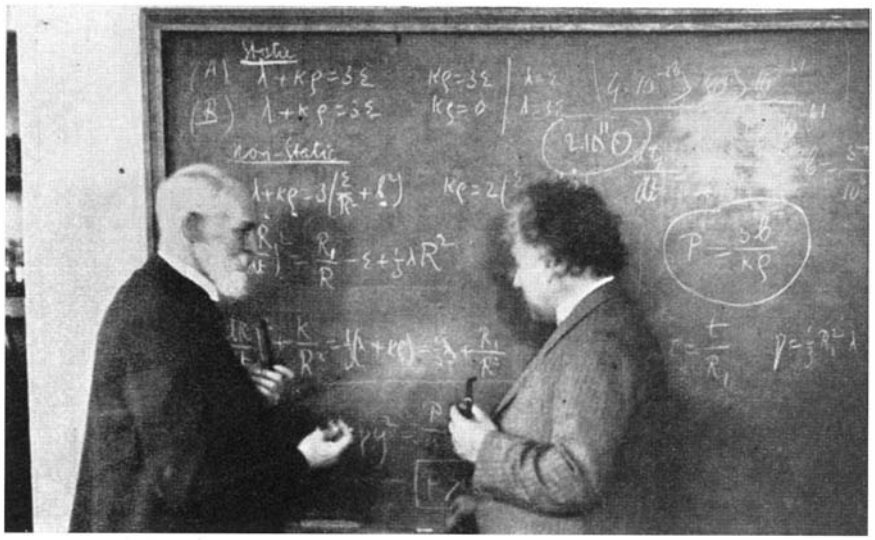
The third satellite of Jupiter goes

around the planet in 7d 3h 42m 33s and the second in 3d 13h 13m 42s, catching up with the other at intervals of 7d 1h 15m. When these two satellites are in line with one another on one side of the planet the first satellite is to be found in the same line but on the opposite side. During the interval the second satellite catches up with the third one, the first with the second twice, and the first with the third three times. This remarkable relation has maintained itself exactly for more than 10,000 revolutions. Laplace late in the 18th Century proved that the natural attractions of the three bodies would not merely keep them moving in this way if they were once started so, but would compel them, if they should be started moving in nearly though not quite this way, to alter their periods so that, on the average, the relation was exactly satisfied with a slow oscillation or "libration" of all three satellites about the average motions. According to de Sitter, the libration should have a period of six years, but its range is so small that even the best observations give no conclusive evidence of it. The line of conjunctions of the three satellites works slowly backward around the planet, completing a revolution in 487 days. Meanwhile Jupiter is moving forward around the sun, and in consequence the conjunction line passes through the sun every 437 days. After this interval the relative positions of the sun and of all three satellites closely repeat themselves, and the largest perturbations of the motion, which shift the second satellite by a degree in its orbit and the first by about half as much, have this period.

THE fainter satellite, which has a period of 16d 16h 32m, does not come into any similar arrangement—which makes the calculation of its motion a simpler problem.

Readers who may be interested in the further developments of the theory will find a full and remarkably lucid account by Professor de Sitter in the *Monthly Notices of the Royal Astronomical Society* for May, 1931. From his numerous conclusions we may pick out the viewpoints of general interest.

The masses of the four large satellites can of course be found from the perturbations. The third, which is the largest, has a mass 1/12,200 of Jupiter's or 2.2 times the moon's. Next comes the fourth with 1.3 times the moon's mass. The first is very nearly as massive as the moon, and the second two thirds as massive. The diameters of the satellites can be determined with precision from the length of time it takes them to disappear when entering the planet's shadow during eclipses. The second is 2000 miles in diameter, 90 percent of the moon's size; the first 2300, and the third and fourth nearly equal at 3200 miles. From this it appears that the first three are all about 2½ times as dense as water, as might be expected if, like the moon, they are masses of rock. The fourth is only about half as dense and resembles Jupiter in this respect. So small a body so far from the sun is probably cold clear through and we may recall Jeffrey's suggestion that it may be composed largely of ice.



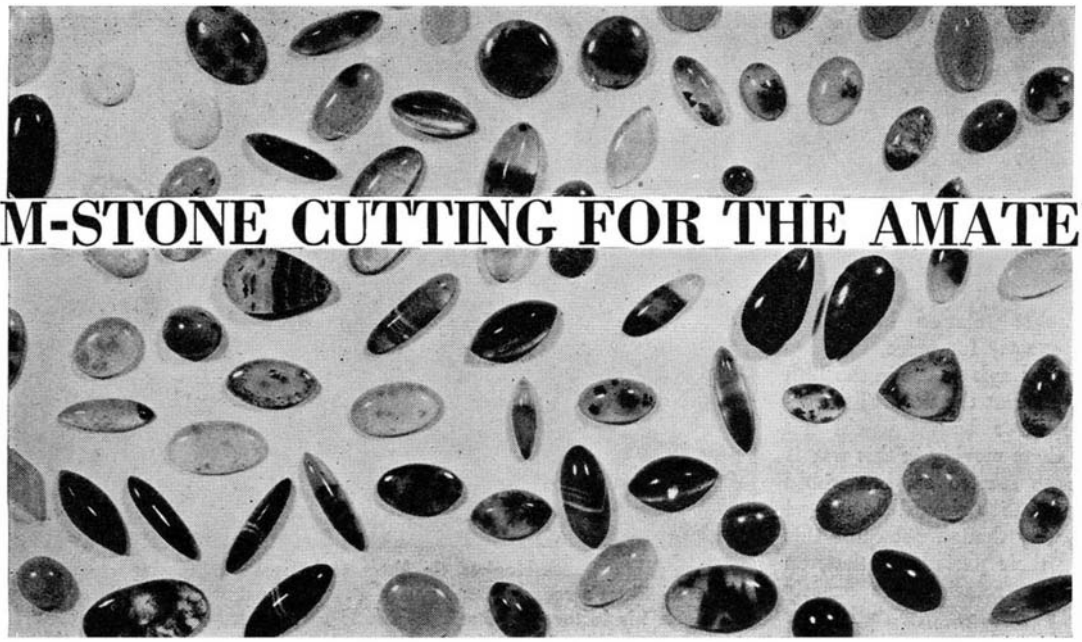
Two famous cosmologists, de Sitter and Einstein, "talking it over" at the end of de Sitter's recent discussion of cosmological theory at Pasadena. When he began his lecture Professor de Sitter waggishly said, "I must start by assuming you all understand everything about relativity." Professor Einstein, who is himself something of a wag at times, was heard to say "Ach" from his seat

When the full theory of the satellite's motions has been developed the final test comes in the comparison of the observed and calculated times at which the eclipses and other phenomena occur. Here observers have met in an unexpected disappointment. Careful measures of the brightness of a satellite as it enters the planet's shadow, made at Harvard for many years, should have given very accurate determinations of the times when it was half way in. But comparison with the calculated movements, first made by Sampson in England, show that they came sometimes early and sometimes late, in a fashion which seems to demand for its explanation the assumption that the size of the shadow, and hence of Jupiter itself, alters irregularly by about one tenth of the satellite's diameter, that is, by two or three hundred miles each way. As the visible surface appears to be a layer of clouds this hypothesis is reasonable enough in principle. But the amount of the change is surprisingly great and it is to be hoped that more observations will be made.

Averages over a term of years, however, give reliable values in modern times and tolerably good ones back to the year 1680. Professor de Sitter has calculated these, and finds definite evidence that our astronomical system of time-measure, which depends on the rotation of the earth, is not quite uniform. This confirms the conclusion reached years ago by Brown from a study of similar apparent irregularities in the motion of the moon, and since substantiated by similar discrepancies in the observations of the sun and the inner planets. The new data for the satellites are in good agreement with the others. According to de Sitter the earth, compared with an ideal (and wholly imaginary) clock, ran on the whole rather well from 1680 to 1896. There were small and irregular changes but it was never more than ten seconds fast or slow. Just before the end of the last century something happened, so that by 1920 the earth clock had run 15 seconds slow. It is still running slow but at a more gradual rate.

IF we could only observe the satellites from some nearby planet, instead of from a distance which is never less than 360 million miles, we might be able to determine the disturbances of our time scale more accurately. But if intelligent beings could inhabit Jupiter, or its satellites themselves, their theoretical astronomers would indeed be kept busy. The distance of the largest of the satellites from Jupiter is but 1/700 of its average distance from us. Could we observe it from the planet we could determine its position in the orbit 700 times more precisely than we can now. The extent and complexity of the calculations which would be required to predict the motions of the satellites with this accuracy would daunt the stoutest mathematical heart—unless our imaginary investigator should be endowed with a life which exceeds the human span in the same ratio in which the motions of the planets are slower than those of the satellites.

GEM-STONE CUTTING FOR THE AMATEUR



Two months work (play) at one hour a day. Practically all stones are agates

By J. H. HOWARD

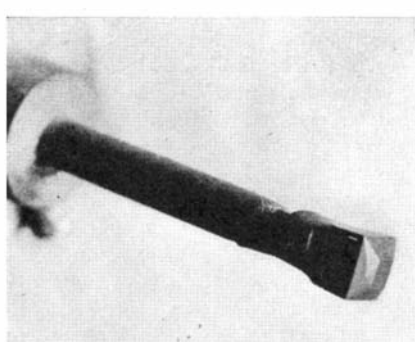
CUTTING and polishing gem stones would not be nearly so alluring if every library were full of text books explaining how the job is done. But, while the lapidary has been working thousands of years, and while many volumes have been written about his raw material and about his finished product, almost nothing has been written about the job of actually converting this raw material into finished gems. Even at that, what little has been written on the subject is intended for the professional and has no practical value for the rank amateur.

There is nothing more beautiful nor more satisfying than a collection of cut stones. Many people spend years and fortunes building up such collections by outright purchase. But the collector's pride of ownership and joy of contemplation must be mild compared with that of the man who has actually taken the raw, crude, dirty stones from the earth and cut them to the shapes he likes best, polishing them to that smoothness which displays to the fullest their latent sheen and color.

IT is entirely practicable for the lover of stones to fulfil his longing for a gem collection and at the same time to satisfy his creative urge, doing the work in spare time. Also, an especially favorable feature of the gem-stone cutting hobby is that gems are admired and desired by almost everyone. The product of the work therefore brings the pleasure of contemplation to all of one's acquaintances. As a gift to a special friend nothing is more appreciated than a beautiful gem, cut by the giver. Of course, too, every deep-dyed hobbyist likes to "show off," and is not a case of gems a prime "show off" medium having universal appeal?

It is remarkable how fast such a collection will grow. After some degree of proficiency has been attained, the whole time required to saw, cut, and polish a cabochon stone of ordinary size will not exceed one hour. The 200 to 400 stones that a worker may easily cut in one year, working an average of about an hour per day, will make a display of which any one may be proud.

Rough stones in a great variety of colors and combinations of colors can



Top of gem, showing the facets all ground. Stone ready for polishing

be obtained at moderate prices from dealers.[1] Agate, carnelian, tiger eye, jasper, chalcedony, and the many other varieties of quartz as well as dozens of other stones are plentiful, cheap, beautiful, of medium hardness and generally suitable for cabochon cutting. Specimens may be had at prices from 10 to 50 cents each and often a single specimen will yield several gems. The writer has probably not spent more than 25 dollars for raw material, yet from his purchases he has cut several hundred stones and has enough on hand for several hundred more. He is now working on a rope of rose quartz beads to consist of 60 beads one half inch in diameter. The cost of the rich rose quartz used was less than two dollars.

Doing this work in a basement or other work shop is a fascinating hobby. Fortunately it requires only a small initial investment, and the maintenance cost is negligible. For the man who has none of the needed equipment and material the whole cost of setting up ready for work need not exceed 50 dollars, but many who already have shops will have, or can make, much of the equipment.

TECHNICALLY, any one can do the work if the work appeals to him or her. Certainly it is true that one person will do better work than another, but in this fact lies a great deal of the fascination of it. There is no limit to the skill that may be displayed in the finished product, nor to the ingenuity that may be used in getting desired results. But the only technical requirements are fairly strong thumbs and forefingers and an eye for symmetry.

Some very detailed and practical instructions are now available, so the amateur need not work entirely in the dark.[2]

All photographs, except at top of page, taken by V. Akers, courtesy of Prof. Charles Palache and Peter Zodac

[1] Ward's Natural Science Establishment, Rochester, New York or The Gem Shop, Wolf Creek, Montana, for example.—*The Editor.*

[2] *Editor's note:* "The Working of Semi-precious Stones," by J. H. Howard, price one dollar, published by the magazine *Rocks and Minerals*, Peekskill, New York, is especially recommended; in fact, it was the accidental discovery of this practical little manual which led to the extension of an invitation to Mr. Howard to introduce his hobby to our readers through his present article. It is hoped that enough of the readers will become amateur gem workers to make the new hobby a worthy rival of telescope making which 10,000 of our readers have taken up. It would seem to be equally fascinating fun.

The work is not standardized nor "cut and dried." Each professional has his own system, some better, some worse, but each getting results. There is room for many variations and there is room, too, for some improvement over any present method. The work is not easy enough ever to become monotonous; on the contrary it is difficult enough to require the most intense attention. It is almost axiomatic that the degree of satisfaction received from a job well done is in proportion to the difficulty of the task. This being the case the beginner is given fair warning that the satisfactory completion of some of his first jobs should bring a rare thrill!

ONE general class of shapes is "en cabochon." All exposed surfaces of this cut are curved. This cut is generally used on opaque stones, which depend for their beauty on color or sheen. The other general class of cut is called "faceted." In it the stone is entirely bounded by flat planes symmetrically arranged, like the conventional diamond. This is used in general on transparent stones, and the facets are arranged so that they will reflect light from the back of the stone and give it life and sparkle. Quite obviously this latter class is much more difficult than the first, and we as amateurs must pass it up until a great deal has been learned of the general principles of cutting.

The purpose of this article is to set down briefly the system used by one amateur in his home shop. It is not intended to be explicit. Space does not permit this. The system described is not represented as being the "only way" nor the "best way." It is desired only to point out a general way for the interested beginner.

The equipment needed is quite simple, almost crude. The following is a tentative list of requirements, their approximate costs, and sources:

A one quarter horsepower, 1800 r.p.m. motor. About ten dollars, from any motor dealer or mail-order house.

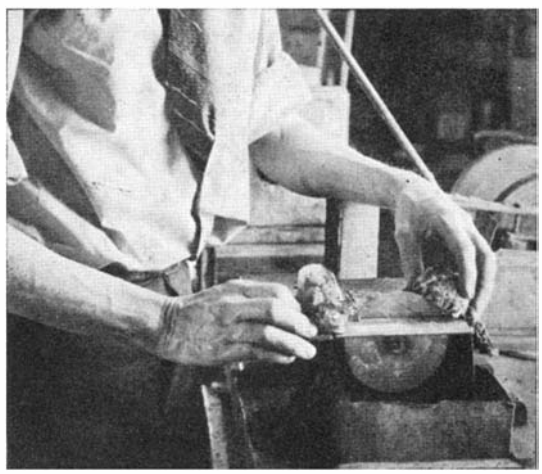
A bench grinder about 18 inches long, with three-quarter-inch shaft. About five dollars. From mail-order house.

Two or three Carborundum wheels. Average price about two dollars each. From the Carborundum Company, Niagara Falls, New York.

Five pounds No. 100; two pounds No. 150; two pounds No. F, and two pounds No. 330 Carborundum grains, all at about 50 cents a pound. From the Carborundum Company.

Two medium hard felt wheels one inch by six inches, $3.50 each; one pound chasers cement, 40 cents; five pounds of medium powdered pumice stone at 10 cents a pound; four or five wood wheels of poplar, one inch by eight inches, at 75 cents each—all from Wm. Dixon, Inc., 32 East Kinney Street, Newark, New Jersey.

One pound tin oxide, at $1.25; or zinc oxide at 50 cents a pound. From any wholesale druggist.



Sawing a crystal with a copper disk charged with wet abrasive dust, running at high speed

One or more sheet iron disks, 20 or 22 gage, 10 inches in diameter at 50 to 75 cents each, (for sawing). Get at any sheet metal shop.

Several sheets of tin such as builders use for roof flashing. Get at any sheet metal shop; cost about 30 cents a sheet.

The tin is for making a reservoir for the paste used in sawing and a reservoir for water used in grinding, for splash guards, and for grinding laps. The reservoirs and guards may be made at home if a soldering outfit is available, or any tin shop will make them to order.

Assume that a bug shaped ring set is to be cut of agate, and the agate is a nodule or slab large enough for several finished pieces. It is first sawed, using as a saw a sheet iron disk revolving with its edge in a reservoir of paste made of Carborundum grains and oil. The stone, having been fastened with chasers cement to a holder, is fed against the edge of the disk by the weight of the stone and the holder.

A disk of 20- or 22-gage galvanized iron 10 inches in diameter, running at a speed of 300-400 r.p.m., is right for this. After some experience has been gained this speed may be increased to 800-900 r.p.m. The cutting speed will be increased in direct proportion, but the lower speed should be used at the beginning.

The next step is to flatten, smooth, and polish the side that will be the base of the finished stone. Put a wooden wheel on the arbor and a tin disk against this wooden wheel. Flat the base by grinding it against the tin lap, using a paste of water and No. 150 Carborundum grains as an abrasive, daubing it on frequently with a brush. Grind until the base is level and free from the ridges and scores left by the sawing. Then repeat the operation, using a new wooden wheel and tin lap and a paste of No. 330 Carborundum grains. Then remove the tin lap and smooth the stone on the wood wheel, using a paste of No. F Carborundum. Then, to give the base a fair polish, finish it on a felt lap with a paste of powdered pumice-stone and water. Use the periphery of the felt lap, not the flat side. When changing from each of these operations to the following one great care must be taken that the coarse abrasive does not get into the finer mix. The work must be carefully washed at the end of each operation.

THE stone is next held by hand and roughed out to correct shape by grinding on a No. 100-J G5 Carborundum wheel kept wet. This wetting may be done by letting water drip on the wheel, or by feeding the water to the wheel by means of a sponge partially submerged in a reservoir of water and riding against the bottom of the wheel. A shield should be provided to prevent slinging of the water. Grind a small uniform bevel all around the base to prevent chipping at the edge.

At this point it is best to cement the base of the stone to a holder. This makes holding much easier and enables the operator to move the stone more quickly; also to see better what he is doing and therefore to attain a more perfect symmetry with fewer flat spots. This holder is a round wooden peg about three sixteenths of an inch in diameter, three to four inches long. The end of the stick is anchored to the center of the base of the stone with a "wad" of chasers cement applied hot. The stone and the stick should both be warmed and the cement formed to a

The first grinding is to square the top face and is done with Carborundum on a lead lap

funnel shape, covering all of the base of the stone.

The stone is next ground on a finer Carborundum wheel, No. F. On this wheel the stone should be formed to exact shape and nearly to exact size, as this is the last fast cutting operation.

Many operators next do the same operation again on a still finer Carborundum wheel, about No. 330, though this operation may be omitted. The grinding is then continued on a wooden wheel with a paste of water and No. F Carborundum grains. The wooden wheel for this job should have grooves of varying radii turned on its side, to present a greater grinding surface to the curved stone as well as to retard somewhat the slinging of the paste.

As an alternative to this operation some workers use a cloth lap with the Carborundum powder glued on it; some use a rubber lap with Carborundum cloth glued on it, and some use a cloth lap with the Carborundum paste daubed on with a brush.

One condition is requisite—the surface should have some yield to it in order that the finished surfaces may have true curves instead of a series of flats. After this operation is completed the stone will have quite a bit of "shine" and will have taken considerable polish. Nevertheless, when looked at through a magnifying glass it will be seen to have countless small scratches.

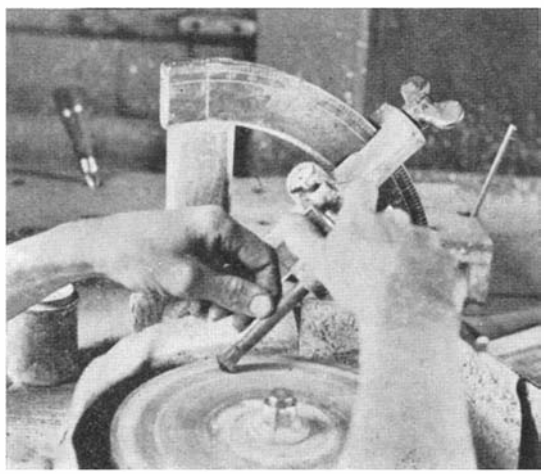
It is next smoothed on a hard felt wheel, using a paste of powdered pumice and water. At the end of this operation it must be entirely free from scratches, scores, and pits, and appear perfectly polished.

IT is then actually polished on another hard felt wheel, using a paste of tin oxide and water. The only difference in appearance after this polishing operation is that the polish now seems to have a velvety, thick "body," instead of the ordinary thin "shine" apparent when it comes from the pumice stone operation.

The stone is then taken off the stick, the cement scraped off the back and the back polished, if this is desired.

The coarse Carborundum wheel should be about eight inches by one inch and is to be operated at about 1800 r.p.m. The other Carborundum wheels may just as well be six or four inches in diameter, as they are used comparatively little. Use the same speed, 1800 r.p.m. The smoothing wheels of wood and of felt work better at a lower speed, about 900 r.p.m. The polishing speed may be stepped up again to 1800 r.p.m.

The operation of sawing has been described first in this paper, because that is where it logically belongs. But it is strongly urged that the first grinding efforts be directed at stones of such size that they do not require sawing. Sawing, when once the knack of it is acquired, is a perfectly simple job, but it is more likely to give trouble than the grinding operations. For that reason it is best not to attempt the sawing until a few stones have been completed and the urge to continue the work is firmly fixed in the mind.



Polishing the facets, aided by a goniometer. Most faceted work is beyond amateur capacity

After one or two stones have been cut, all work should be done in batches of several stones, as the work of changing wheels, washing up, cementing to sticks, and so on, is most annoying and time-consuming if only one or two stones at a time are being worked.

There are many precautions and detailed instructions that cannot be touched on in a single article. But there are a few that must be mentioned.

Carborundum wheels must be kept wet or they will burn the work.

Be careful in using felt wheels to lift the work off them frequently and keep plenty of paste on them. They can readily burn the stone or get it hot enough to melt the cement.

Keep fingers and finger nails away from Carborundum wheels. A finger nail will cut faster than an agate.

Do not be in too great a hurry to change from any grind to the succeeding one. Each operation is slower cutting than the previous one and it will take a great deal of extra work to make up for a slighted step. Determining when a step is completed must be learned by experience.

It is very difficult to keep coarse abrasives out of the finer mixes, and one grain of coarse Carborundum can ruin a whole batch of finer paste, as well as the work in progress. When changing from one operation to another carefully wash the arbor, the hands and the work, and brush the clothes. Ruining a few stones when nearly finished will teach this lesson.

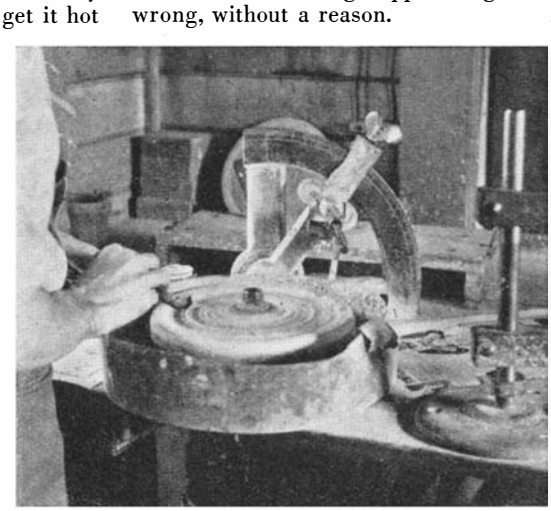
The time given below will not be attained on the first few stones cut, but they represent a fair average at the end of a little practice:

First roughing	10 minutes
Second roughing	3 minutes
First wooden wheel	5 minutes
Second wooden wheel	5 minutes
Pumice-stone	5 minutes
Polish	5 minutes
Total	33 minutes

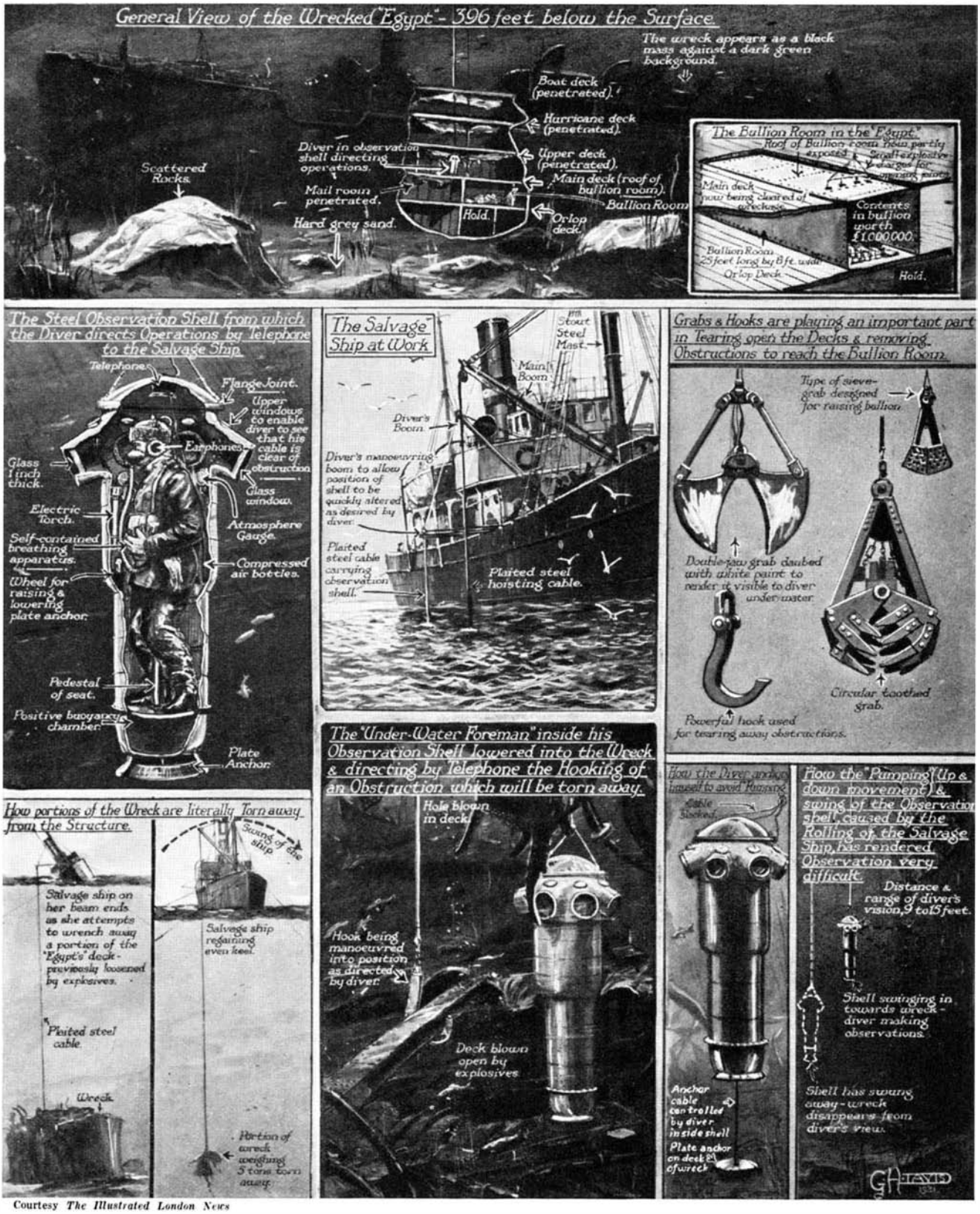
A small pocket magnifier must be used for examining the work and judging its progress.

Do not give up too easily. If the work is not progressing it is because the worker is doing something wrong, and there may be a bit of fun in finding out what it is.

THE writer was once instructed to use a mix of clay, Carborundum grains, and water for sawing. From a creek bed he obtained some nodules of white clay and made up the paste. He sawed for four hours on a piece of jasper and had cut less than one square inch. Then he began to suspect the reason. He got some screened clay flour and made a new mix. This cut the jasper at the rate of one square inch in 20 minutes. The first clay had in it grains of sand. These adhered to the edge of the sawing disk and rolled across the face of the stone, making it impossible for the Carborundum-charged disk to come into contact with the jasper. Result—no cutting. This is mentioned just as an example of the "fool" things that can be wrong, yet hard to find. Nothing happens, right or wrong, without a reason.



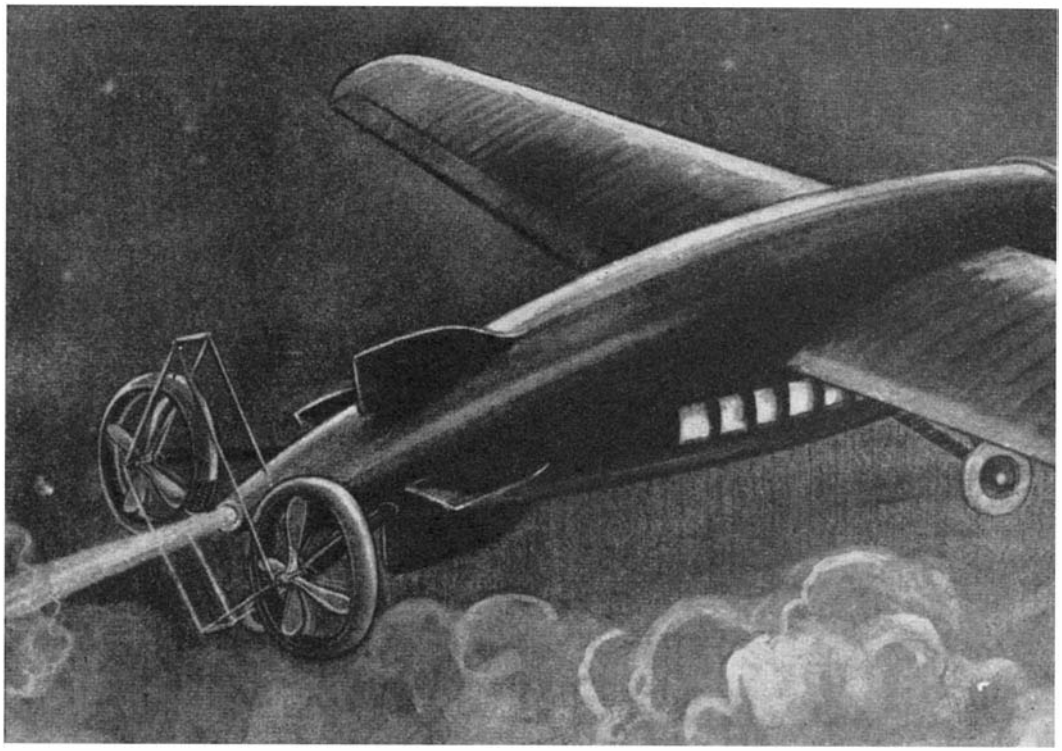
Final polishing is done on a felt lap, holding the spindle in the hands without the meter



Courtesy *The Illustrated London News*

TO SALVAGE A SUNKEN LINER'S TREASURE

THE work of tearing open the strong room of the British liner *Egypt* in order to salvage its 5,000,000-dollar cargo of gold, silver, and coins, has kept the Sorima Company of Genoa busy for many months. The *Egypt* was sunk in collision on May 20, 1922, 25 miles off the coast of England. Rough seas and the 396-foot depth at which the liner lies have made necessary the use of many new types of salvage gear, details and operation of some of which are shown on this page and in our frontispiece. Because of the depth, steel diving suits of German make were first used. These proving inadequate, the Sorima engineers devised a one-man diving chamber with windows and telephone. In this, a "foreman," who does no work, directs the lowering and placing of explosive charges and the operation of grabs and hooks which tear away the hull to expose the treasure. Early last December, bad weather caused suspension of operations until spring.



The author's combination drive for a stratosphere plane. As shown, the propellers are out of operation and the blast of the rocket drives the plane by reaction. In the lower, denser atmosphere the two propellers are moved toward one another, and the blast impinges on a turbine, causing the propellers to turn and beat the air, as in the ordinary conventional plane. In the one case the drive is direct and in the other case it is indirect

A NEW TURBINE ROCKET PLANE FOR THE UPPER

By R. H. GODDARD, Ph. D.
Director of the Physical Laboratory at Clark University

THE rocket turbine for airplanes, recently patented by the writer, is designed to solve a major problem in the use of rocket propulsion of craft carrying or capable of carrying human beings. The object of this rocket plane is to provide highly efficient transportation at ordinary airplane speeds and at the same time to make travel possible at great altitudes through the stratosphere, where propellers and ordinary airplane engines are useless.

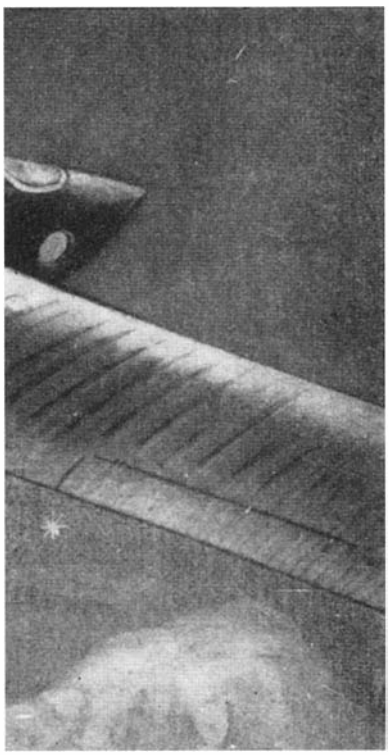
It is fairly evident that the conventional airplane is not man's last word on high-speed vehicles. But, so far as general principles are concerned, the airplane has remained unchanged since the days of the Wright brothers, notwithstanding a quarter of a century of intensive development throughout the world. The question arises as to whether the present principles of aerodynamics are best suited for the attainment of high speed and high altitudes, for we know within reasonable limits the ultimate speed of airplanes and the probable limit of altitude they will be able to reach.

There has been of late widespread interest in experiments with rocket automobiles and planes. Why? Because a certain number of scientists believe that speeds of thousands of miles an hour and heights of at least hundreds of miles, if not interplanetary flight itself, will ultimately be possible and therefore attained. However, direct rocket action at low speeds is practically useless at all altitudes. This has been recognized by many aeronautical experts, and it has been convincingly shown that the best possible direct rocket action, for all ordinary airplane speeds, is necessarily much less effective than the usual motor and propeller.

We shall understand why direct rocket action is so inefficient at low speeds and so efficient at high speeds and great altitudes if we compare the principles of the two methods of propulsion. In the case of a propeller driven by an internal combustion engine the air is thrown out of a circular path by the action of the revolving blades, causing a rather large volume of air to travel rearward with moderate speed. The reaction caused by setting this large amount of air in motion accounts for the forward speed of an airplane in powered flight. It is obvious that the greater the density of the air the greater the efficiency of the propeller, and that this efficiency varies in ratio to the air density. Loss of density at high altitudes means a corresponding loss of propeller efficiency and also a loss in engine efficiency. The greater the height the greater the loss of efficiency, until at some given height, varying with different types of airplanes and propellers, the craft can rise no more. It has reached its "ceiling," or its maximum altitude.

Now, with direct rocket action the efficiency is increased inversely to the density of the atmosphere. In other words, if we could operate a rocket in a vacuum, it would be 22 percent more efficient than it actually is in air at sea-level density. Ergo, the higher the rocket goes, the more efficient it is, up to a point where, theoretically, a uniform maximum efficiency is attained. We may also emphasize the advantages of direct rocket action, as regards other methods of aerodynamic propulsion, when we say that a rocket fed by a mixture of liquid oxygen and gasoline is 60 percent efficient at speeds in excess of 600 miles an hour, as compared with a fuel-power efficiency of 22 percent for a steam engine and 33 percent for the ordinary Diesel engines.

The principle on which the rocket



ATMOSPHERE*

operates involves the force generated by the expansion of gases. What happens when gases are heated? The gas expands very rapidly. Analyze this expansion and you find that it is caused by the extremely rapid collisions of its constituent molecules. Fire the rocket and the molecules stream out in all directions, hundreds of billions of them pounding against each other every second, with the result that the rocket is shot into the air at a tremendous speed.

If we suppose the gas to escape from the nozzle at a speed of 4000 feet per second, there will be a certain propelling force exerted, and this force will remain the same, no matter how fast the rocket travels. The efficiency, on the other hand, will be very low while the rocket is traveling slowly, as the high-speed gases will carry away most of the energy, and comparatively little will be given to the rocket. It is much the same as in firing a rifle, when most of the energy of the powder charge is given to the bullet and comparatively little to the gun. The speed of the rocket where maximum efficiency is reached will be something like 3000 miles per hour. At this speed we can say that the gases leave the nozzle at negligible speed with respect to the ground, and a very high proportion of the kinetic energy generated is utilized in propelling the machine.

Although the writer's tests have shown that the shock of direct rocket action is not more severe than that to which an airplane is often subjected, even when speeds of several hundred miles per hour are produced by the rocket, we nevertheless cannot hope to use such rocket propulsion effectively at low plane speeds, because almost all the energy is lost and but a fractional proportion is used to drive the plane.

WE have to make a compromise. We want a rocket that will not only go effectively at ordinary speeds but one that can also increase its speed in ratio to the altitude until a time comes when we stop controlling the rocket action and let direct action have full sway. That is, we could leave the ground at 200 to 300 miles an hour, increase the speed gradually until, say, 1000 miles an hour were reached at 30,000 feet (at which altitude we should not notice the speed), and much greater speeds at a height of, say, 100 miles. At this great altitude the air resistance would be negligible, even at these high speeds.

My rocket plane has two propellers at the rear, each being surrounded by a stream-lined housing containing turbine blades. When the plane is in the dense part of the atmosphere the rocket blast from the rear of the plane impinges on the turbine blades and the energy of the blast is transmitted to the propellers in such a way as to make them revolve. But when the plane is flying at a very high altitude the propellers and housings are moved to one side out of the way of the gas stream. In this case the rocket blast alone furnishes propulsion and the propellers are idle.

But the rocket turbine may also be operated partly by the turbine blades and partly by the rocket blast, so that partial rocket action can be used where the air is not too thin to be reacted against by the propellers, and rocket action alone can be used where the air is too rare to permit of any propeller reaction. On returning into denser air the propellers would, of course, again be used.

The possibility of utilizing direct rocket action at high elevations is of importance, for, as is well understood by engineers, the rocket is the most efficient type of propulsion engine at very high speeds. The objection at low speeds, namely, that the rapidly moving gases carry away nearly all the energy, no longer holds at very high speeds, as we have seen, for the reason that the plane is moving rapidly and the ejected gases have little velocity with respect to the ground. Maurice Roy, writing in *La Technique Aéronautique*, estimates that rocket propulsion will be more effective than ordinary propeller propulsion for speeds in excess of 600 miles per hour.

The weight of fuel for a given flight will depend upon whether air is used to support combustion, or oxygen is contained in the plane, in liquid form. It seems probable, however, that performance will be the prime consideration, and that the weight of fuel will be a matter of secondary importance in any means that makes possible very high speed travel in the stratosphere, above the reach of storms and fogs.

As to when a plane will be equipped with the new rocket turbine, ready for a flight, it is impossible to say. The fund under which the writer is working in New Mexico, provided by the late Daniel Guggenheim, was given for the development of high-altitude rockets, and carrying out investigations with instruments raised by these rockets.

It may be of interest, however, to mention that some tests were conducted at Camp Devens in 1930 with turbine propellers driven by gases from stationary liquid-propellant rockets. In one test, in which the turbine blades of thin steel were not securely enough fastened to the rim, the blades were thrown more than 50 feet by the high speed of rotation that was produced. In a second test, in which the blades were more rigidly fastened, the operation was satisfactory, and the blades were undamaged.

THE present rocket tests are of interest in having demonstrated rocket operation, given a jet of over 200 horsepower per pound of combustion chamber. It may be said in favor of the method that it not only rests on sound theory but that all the various elements have, in themselves, been found to be practical.

The average person may well ask, "How far do you expect the plane to fly in space hitherto beyond human reach?" The distance is largely a matter of size of plane and weight of fuel. The question can, perhaps, be best answered by calling attention to my paper in the "Smithsonian Institution Miscellaneous Collections" for 1919, in which it was concluded that a series of relay rockets, of successively smaller size, each fired as the one below became empty of fuel, could reach an indefinitely great altitude. The present rocket turbine, used in place of the first relay rocket, would mean that the atmosphere, instead of being a resisting medium and a hindrance, would be useful as a means of furnishing reaction in the first stage of such a journey.

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"What It Is All About" is the title of an article by Hiram Percy Maxim, to be published next month. The noted inventor will discuss the whole universe from the philosopher's view-point.

*Reprinted by courtesy of *The New York Times*

WHY POWER COMPANIES PLANT TREES

By JOHN WINTERS FLEMING

IN 1912 two electric power public utility officials, C. C. Burns and J. B. Taylor, both of the Northern New York Utility Company, Watertown, New York, projected themselves dynamically into the problems presented by the pathetic picture of the dying wilderness tracts of northern New York state. They rolled down their desk tops, rolled up their sleeves, left their offices, and went out into the woods.

In two years they proved that as electric power men they were both efficient and effective foresters. From 1912 to 1914 they blazed a pioneering trail into the timberlands by heading the original electric power public utility reforestation program—and they planted 100,000 trees!

Truly, "great oaks from little acorns grow!" Since 1912, the companies and corporations serving northern New York state with electric power have planted 21,127,100 trees on more than 20,000 acres of what were formerly idle, waste lands. By the end of 1930, this amazing total reached 26,127,100 trees planted on 26,170 acres of land that had formerly been literally "going to seed."

During the past three years alone, the three companies comprising the Northern Section of the Niagara Hudson Power Corporation have been reforesting barren acres at the high rate of 5,000,000 trees a year. Present plans call for planting 5,000,000 trees yearly for an indefinite period of time. The electric companies have put these idle acres to work on a dividend-paying, wood-producing basis at a cost of but five dollars an acre. This slight expenditure represents the complete original planting cost.

Moreover, in the last five years the same three electric companies have stocked woodland streams and their own artificial power reservoirs with 500,000 fish. Here again the present replenishing program calls for a continuation of this stream and reservoir stocking at the rate of 100,000 fish a year indefinitely into the future.

Pertinently, the question arises: Why does the electric company plant trees and stock waters with fish? The answer is three-fold: for economic, esthetic, and scientific reasons. The economic answer can be given no more graphically than by typing a "before-and-after" portrait of northern New York state.

In 1850, New York state led the nation as a lumber market. In that year, more than a billion board feet of timber—more than one fifth of the nation's total harvest—was cut in New York state. In 1925, however, New York state stood twenty-seventh in the ranks of lumber producing states. In 1925, less than 200 million board feet of timber—less than 0.5 percent of the nation's total harvest—was cut in New York state. By 1925, the state's forest area had shrunk to less than half what is was in 1850.

The reasons for this disenthronement of the Empire State as the nation's leading lumber producer can be summed up in just eight words: Lack of forest conservation and lack of reforestation. The reasons aren't nearly so devastating as the results. Because New York state didn't start taking care of its forest areas in a scientific manner until 1900—the year the state nursery was first established—and because New York state didn't reforest its cut-over forest areas, it must face the following facts:

1. The lumber industry went into a decline and a close approach to death.

2. The pulp and paper industry which naturally centered itself in New

Two views of the Black River near the village of the same name in New York. Above is shown high water during a spring flood period. Damage to the state highway is clearly visible in this picture. At left is shown the low water stage at the same location. Reforestation would minimize floods and give a better flow during periods of drought

York state when the state led the nation as a lumber producer may have to move away to a site nearer the source of wood supply. This pulp and paper industry is dependent upon the lumber industry as its source of raw material supply. Today the pulp and paper industries in New York are spending 60,000,000 to 80,000,000 dollars a year for "imported" timber—timber from other states. Moreover, they are spending an additional 60,000,000 dollars a year paying the freight bill on this imported timber. Shipment of wood from other states and abroad already accounts for more than half of the annual supply of New York state paper mills!

3. Northern New York communities —towns, villages, and cities that evolved from, by, and for the lumber, pulp, and paper industries—are going the swift, sure cycle to oblivion that characterizes the mushroom growth and quick death of mining boom towns, towns that perish when the ore runs out; in this case, the timber.

4. Wood products have mounted in price to the New York state consumer; and all of us are still users of wood every day in a great many ways.

Thus the economic welfare of northern New York has been seriously impaired. Indirectly, but none the less genuinely, the economic efficiency of the state as a whole has been lowered. As John E. Keib, forester for Northern New York Utilities, Inc., writes: "This is the penalty paid by every state that does not replenish its forest resources."

Esthetically, the state has lost many beauty spots as its forests have been denuded and with this loss has gone the lure of many attractions: camping sites, fishing streams, hunting valhallas, and scenic routes and tours. Perhaps the most striking result of this lack of conservation and reforestation, however, is the scientific result—also closely knit into the state's economic pattern.

WHEN forests are cut down and not replaced, floods run rampant in the spring, and droughts rule the summer and early autumn so that the lives of animals and fish are threatened and the cost of producing electric power mounts to a high point.

Why do these fates inevitably follow forest depletions? The reason may be discovered by means of a very easy, very interesting experiment. Pour water slowly on a wool blanket draped over a chair. Note how gradually and evenly the water soaks into the wool and how long it takes to reach the blanket's edges. This is the natural reaction of a forest to a heavy rainfall. The limbs and leaves break up the raindrops into small particles that are easily absorbed by the rich, deep, sponge-like forest soil.

Forester Keib, of Northern New York Utilities, with a seedling tree

Now pour water slowly on a piece of canvas draped over a chair. What happens now? The water wets the canvas only on the spot where it was poured and over a narrow path where it rapidly rushes off the canvas. The water does not sink into the canvas; it is not absorbed by the canvas as it was by the wool. This is the natural reaction of barren acres to a typical heavy spring rainfall.

When heavy spring rains beat down upon treeless lands, the rich top soil or land covering is washed away. Whole hillsides have been thus eroded or sluiced down. The top soil is carried to nearby streams and deposited on stream beds—thus raising the level of the stream bottom and at the same time lowering the water carrying capacity of the stream. More heavy spring rains follow. More top soil is washed away and deposited on the stream bottom. The bottom is elevated more and more. Eventually floods follow because the stream, with its high bottom, can no longer carry the influx of water. Furthermore, these top soil deposits on stream bottoms also de-

Before and after. Above is shown a tree planting group on land laid waste in the construction of a dam. At right is the same land four years later after young seedling transplants have gotten a good foothold

The spring flood comes to town and leaves mud and destruction in its wake. Huntington Street, Carthage, New York, during the spring flood season of 1928

stroy the spawning grounds and the sources of food supply of the fish. In China there is a river that has been raising its level in this manner for many years. Today the river bed itself is 25 feet higher than the surrounding countryside!

Moreover, the barren acres, stripped of their rich top soil, are rendered unfit for agriculture. However, this saga of flood and famine, alike for man and fish, is only half the story.

Droughts rule the summer and early autumn. The streams with their overly high beds fall easy prey to the hot summer suns. Soon the streams are sucked dry and their beds are baked. Animal life dies for want of water. Fishes die for want of homes. The land is unfit for agriculture—and too parched for farming if it were fit. Man once more pays nature's steep, stiff bill for destroying—and not replacing—nature's tall, protecting forests. Again to quote Forester Keib:

"WE all know what happens in treeless countries after excessive rainfalls. The most horrible example in our own history was the Mississippi Valley flood a few years ago. Foresters do not claim that this disaster was due entirely to the cutting off of the timber. But we do claim that if forests had been present this flood would not have been so severe."

Forests regulate the flow of woodland streams. The spongy mulch of decaying vegetable matter to be found in forests, and the soft soil itself, quickly absorb a larger percentage of rainfall than can open ground where there is no obstruction to prevent the rapid run-off which makes quick and high floods. Much of the heavy spring rainfall is thus robbed of its potential terror by forests and the water that has sunk into the ground is given up very gradually by springs and seepages. Hence the woodland streams tend to flow more evenly, more regularly, more dependably the year 'round, rather than to overflow the countryside at flood tide during the spring and then dry up during the summer.

At this point the electric company directly enters the picture. The more dependable the stream-flow the cheaper it is to produce electric power. Let us assume a typical case, the case of a power plant located along the banks of a stream flowing through barren, treeless land. During the spring floods, this brimful stream sends its overflowing waters cascading against the turbine wheels. For a time the power plant functions at full horsepower and at full man-power.

Spring passes and summer sets in. The stream's water level sinks lower and lower, although its bed is higher than the year before. The power plant produces less and less power. Finally, in hot, humid August the plant is shut down. Men are thrown out of work. Industries and businesses throughout the section are hit hard in the pocketbook. Power comes high. It's the old law of supply and demand.

Reforesting, by conserving the water in the soil whence it eventually and gradually reaches the stream, assures a steady, dependable year-'round stream flow. This, in turn, insures electric power production on a year-'round even keel. Translated into common sense and cold cash this means more and cheaper and more reliable electric power. In this connection, let us not forget that such a dependable supply of cheap electric power tends to attract new industries—to use more power which is to the electric company's benefit—and to do more business which is to the state's benefit.

NEGLECT of conservation and reforestation has created a vicious circle. For want of a forest, an industry may be lost, a land made barren and unfit for farming, a beauty spot lost. For want of a forest, floods and droughts may come and animals and fishes may perish. For want of a forest, electric power production costs may leap and electric power rates jump. Thus the circle curves always back to its starting point—the need for a forest.

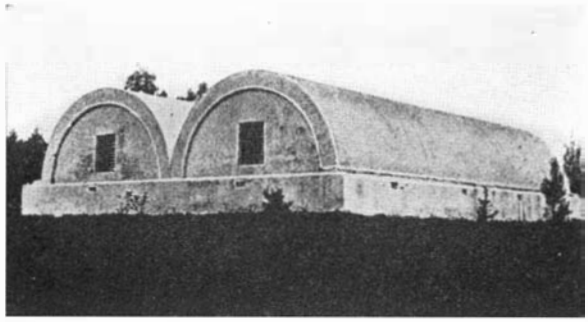
The electric company plants trees in an attempt to shatter this vicious circle at its start. The electric company plants trees to revive the dying forest industries and forest-dependent communities of New York state.

The electric company seems engaged in a well-nigh ideal business transaction—a transaction wherein all parties to it as well as all parties in general benefit and benefit tremendously. More power to the electric company!

Two-year-old red pine seedlings in a nursery. These beds contain between 10,000 and 12,000 trees which will be used to re-forest eroded or waste lands

A HORIZONTAL WELL

Supplies Fresh Water to Bermuda



Bermuda has hitherto depended for water upon the drip from roofs of houses and tanks such as this

THE first fresh water system in the history of Bermuda, regarded for centuries as impossible, was opened for public use on December 30, 1931, according to Professor W. D. Turner, of the Department of Chemical Engineering at Columbia University, who planned and directed the construction. Rain water, caught on the house tops and frequently polluted to a high degree, has served the residents of the island for generations.

"No one thought we could get water without drawing salt," Dr. Turner said in describing the difficulties which surrounded the undertaking. "Many efforts had been carried on in the past. I recall having heard stories of how wells were drilled down 400 feet through volcanic rock in a vain search for fresh water."

In Bermuda most of the rock is of porous coral, filled with small cavities and fissures. After a survey of the island, a small hill was selected near Hamilton, capital of the colony, in the belief that the fresh water filtering through the rock crevices might be collected. At this point a special adaptation of the horizontal well system was constructed. This consists of a line of pipe in a trench well above the salt water level, with joints left open to catch rain water filtering from the hill above, and sloped so that the collected water drains to a concrete pump well. From the collecting basin the water is pumped into a new reservoir at Pymwood, near Hamilton. From that point the supply is piped to the capital city and perhaps will later be piped to St. George's, the old capital, 12 miles from Hamilton.

The area to be drained by the new system was computed from a known history of rainfall—about 60 inches per year—variable but without any regular or seasonal fluctuations. To intercept a large drainage area with a short well, a site was chosen which might be called the foot, or lower end, of a valley, such that hills on each side sloped into the rather restricted area; and if a surface stream had been produced, the well would cross and intercept this stream.

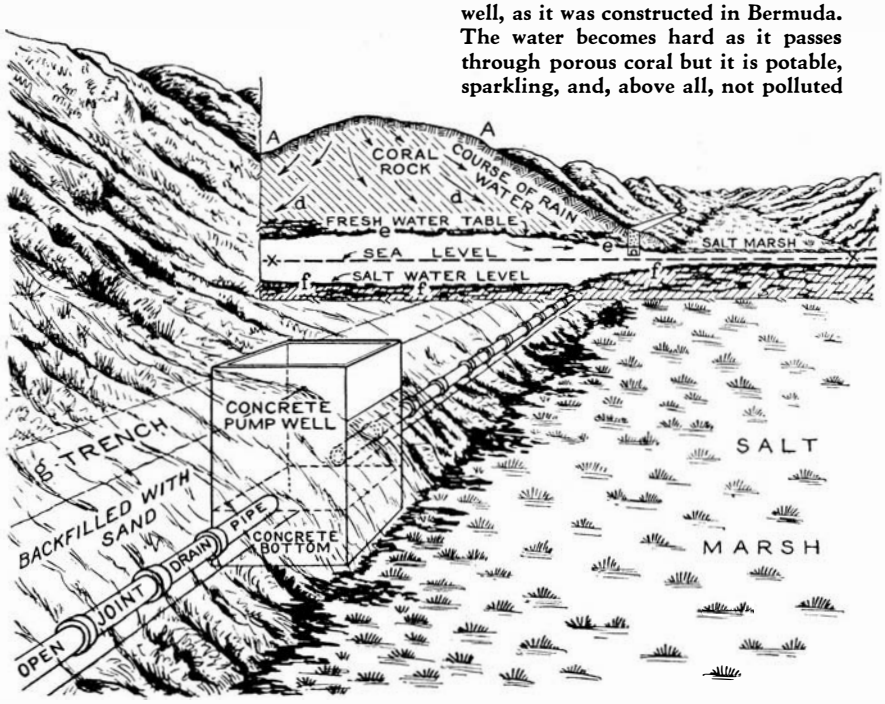
The contour chosen lay along a lowland in the center of the island toward which the hills sloped in the required valley-like formation. This is illustrated in a general way in the accompanying sketch showing the range of hills and the lowland.

A cross-section is cut through in the middle distance, showing a face of the hill sloping to the lowland at right. Arrows, d, on the face of the cut suggest the course of rain water as it percolates through the porous coral rock.

A line, ee, shows the level of saturation or water-table which rises toward the center of the hill in a form sometimes called a water lens. This form is due to the frictional resistance to flow and the same resistance causes the fresh water to assume a bulge, ff, downward also, below normal sea level, xx.

A trench, shown solid in the distance and phantom in the foreground, was dug along the foot of the hill to intercept the flowing water which appears in the form of very small springs in the side of the trench. This flow fills the trench with fresh water to the level e. The bottom of this trench is about six inches above mean high tide, and about 18 inches below fresh water level.

The horizontal well system for collecting rain water in a concrete pump well, as it was constructed in Bermuda. The water becomes hard as it passes through porous coral but it is potable, sparkling, and, above all, not polluted



A TILE drain line was laid in the bottom of the trench to convey the water from each end on a gradual slope to a central concrete pump well. The joints of this line are not sealed, but are left open so that the water may run into the tile. After the line was made ready and the joints properly wedged in true alignment, the trench was filled and packed with coral sand, so that any surface water would tend to run across it, or could reach the tile only by filtration through the sand mass. By this arrangement there can never be any suction on the tile line.

Only fresh water flowing under its own head can reach the pump well and the pumps cannot, therefore, draw salt as so often happens in vertical wells. Furthermore, all the water is thoroughly filtered and sparkling clear and pure. Flowing as it does through coral rock, it acquires a hardness such as is found in ground waters of any limestone region. This hardness is not objectionable as far as potability and taste are concerned, but for economic purposes—saving of soap, boilers, and the like—it is removed by a treatment in a complete softening plant before distribution to the service mains.

The capacity of the island system is 300,000 gallons. The population of Hamilton is 6000, but because of the conservative use of water, the new system will more than meet the demand.

GEORGE WASHINGTON.... The Father of the American Navy and Exponent of Sea Power*

By W. D. PULESTON
Captain, United States Navy

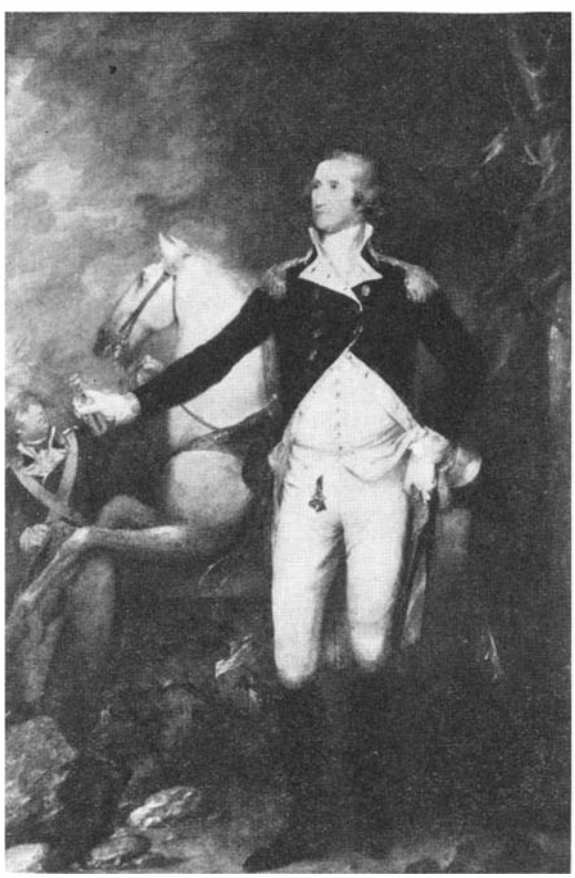
THE achievements of Washington as the first Commander-in-Chief of our Army, the large part he bore in forming the Constitution, and his services as President during the first years of our union, have caused many of us to forget that Washington also founded the American Navy. Yet it is true that George Washington was the actual founder of our Navy as much as a single individual, however great, can be considered the creator of an institution that had so many sources, that drew so widely upon the resources of a young and vigorous people, and was formed by so many able leaders.

In truth, even George Washington could not have summoned a navy into being if the essential elements had not existed in abundance, only awaiting the call. Before 1700, shipbuilding in Massachusetts had attained such proportions that the assembly had ordered that all vessels over 30 tons built in the colony should be inspected by colonial officials. By 1770 the colonies annually launched about 400 vessels aggregating 10,000 tons; almost half of this tonnage was built in Massachusetts; next came Connecticut, South Carolina, and Pennsylvania with about 1400 tons each.

THE forests that extended in an almost unbroken line along our seaboard from Maine to Georgia furnished an abundant supply of masts, spars, and timbers conveniently placed for the builders. Sail-cloth, made from homegrown flax was available in small quantities and could be imported from England or Europe. Every seaport of any size boasted at least one rope-walk, so there was no lack of cordage. So cheaply could the colonials build ships that they could undersell European shipbuilders in European ports.

The colonists were sea-carriers as well as shipbuilders and in the spring of 1775 they possessed roundly 15,000 merchant seamen and 198,000 tons of shipping. When Washington took command at Boston, vessels suitable for conversion into small men-of-war crowded our harbors, building-ways were the commonplace sights of every seacoast village, ship-wrights were among our leading artisans, and the adze and the pit-saw our most useful tools.

The colonists from their earliest days were accustomed to sea warfare and joint army-navy expeditions. Many of the colonies maintained small navies.



By John Trumbull, courtesy Gallery of Fine Arts, Yale University
General Washington at the Battle of Trenton

Because of the extensive merchant marine of Massachusetts, its navy was the largest, and by 1710 it included a 56-gun ship and a 22-gun galley. During peace the Bay State Navy was employed to escort its fishing fleet to and from the Grand Banks and to protect its coastwise trade from privateers and pirates; during the colonial wars it readily turned from fishing and carrying to privateering and, in addition, was able to form a mosquito fleet to reinforce the regular British fleet operating on the American coast. New York, Rhode Island, and Connecticut also maintained small provincial navies at an early date; and South Carolina was equal to the task of fitting out an overseas expedition to attack the Spaniards at St. Augustine. Even Virginia, primarily concerned with her tobacco plantations, could maintain a small navy to protect her Chesapeake commerce.

The main naval contribution to the mother country by the colonists was in the fleets of privateers they regularly unloosed on French and Spanish commerce during the periodic wars with those countries. Our colonial merchant sailors were ideally suited by temperament and training for privateering. They were bold seamen, skilful navigators and although averse to regular naval discipline, they submitted with fairly good grace to the regime enforced on privateers which was very similar to that obtaining in the merchant marine.

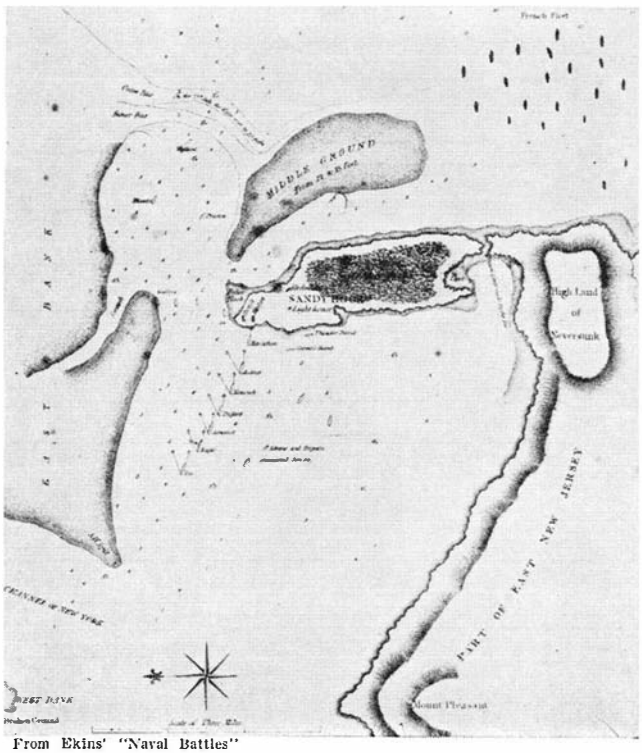
THE crews that manned these colonial vessels were extraordinarily self-reliant. They were bred by the water, could pull an oar almost as soon as they could walk, and from a small boat progressed rapidly to a sloop, schooner, or ship. Few accurate charts existed; nevertheless the officers were daring and skilful pilots. For example, the British to this day proudly tell of the British masters who piloted Wolfe's army up the St. Lawrence to Quebec in 1759; yet a generation before, William Phips took a colonial fleet up the St. Lawrence and the colonists did not consider the navigation a feat worth boasting. Their vessels were frequently wrecked, but if their carpenter's kit was not lost, they could rebuild from the wreckage a smaller vessel, step new masts, bend the sails and return to their home port, for they were mariners capable of building as well as sailing vessels.

A small stock of naval guns was kept by the merchant princes of New England, and in spite of the restrictions placed by England on colonial factories, iron mines and foundries sufficient to furnish replacements existed in the colonies in 1775. Gunpowder was more difficult to manufacture in the colonies, and

*See Editor's note, page 140

a reserve supply was usually kept by the colonial governors in magazines available for instant use against the French, Spaniards, or Indians. These government magazines on our mainland almost without exception were successfully raided by the revolutionists in the first phase of the war. In addition, these sea-minded ancestors of ours at the outbreak of the Revolution dispatched expeditions to Bermuda and the Bahamas, which succeeded in seizing the munition reserves they knew were kept at those places.

These captures did not furnish a sufficient supply, so the colonials turned to their foreign trade to supplement the munitions of war obtained at home; they purchased from agents, mainly in the Dutch and French West Indies, to make up their deficiencies. This commerce was carried on in armed merchant-men that were usually capable of beating off the attacks of small British privateers. This was the commercial and maritime situation in the colonies as Washington hurried from Philadelphia towards Boston to take command of the Continental Army.



From Ekins' "Naval Battles"

Washington's plan to destroy Howe's fleet and attack Clinton's army by land was frustrated when the French fleet, under d'Estaing, would not enter the shallow water of the Narrows (*above*) but another plan of combined land and water attack was successful at Yorktown (*below*)

From Marshall's "Life of Washington," 1807

ON his way to Boston, Washington eagerly inquired all the details of the battle of Bunker Hill. Informed of the stout resistance offered by the New England militiamen to the British regulars, he expressed himself as well satisfied. Washington was thoroughly acquainted with the British Army through his previous service with it in the French and Indian wars; and knew the steadfastness of its regiments under fire, its splendid discipline and the almost unbelievable courage of some of its smart regiments.

Washington was pleased with Bunker Hill because the New England militia, many of whom were veterans of the French wars, had withstood for an appreciable time the British regulars and he hoped that he could induce the British Generals to indulge themselves in a few more costly attacks on American sharpshooters posted behind breastworks.

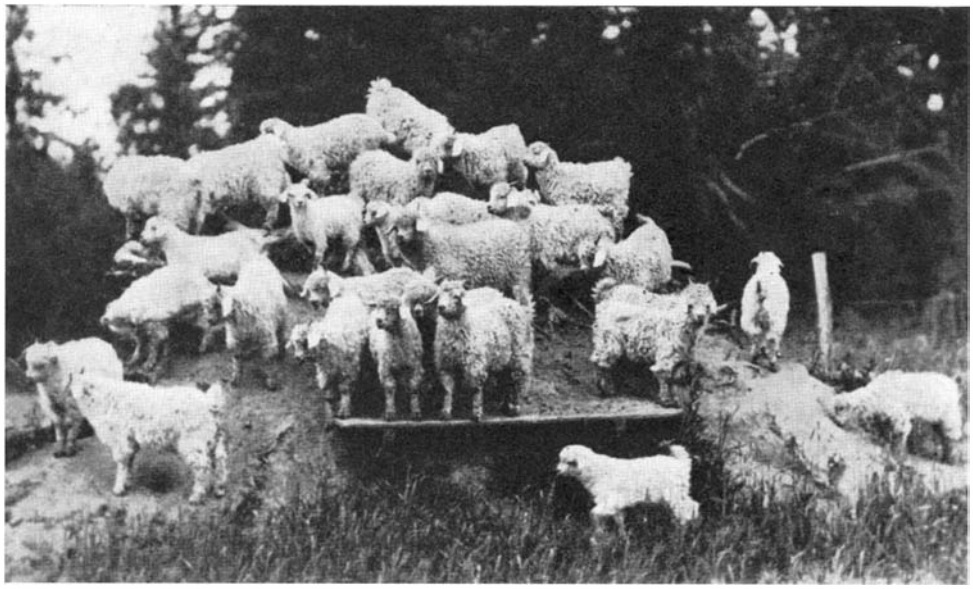
After Bunker Hill, Washington planned a counter-offensive against the British lines around Boston. His natural ardor and the encouragement a victory would give the revolutionists and those wavering between their loyalty to the crown and to the colonies, urged him to attack, but a council of war decided against the attempt, probably with reason, because the militiamen who stood so bravely in their own lines at that time lacked the disciplined cohesion essential to a successful attack.

An additional reason for the failure to attack was the scant supply of powder available to the colonials; to increase this supply and to put pressure on the British to force them to undertake another Bunker Hill, Washington created the first Continental Navy. He had been empowered by the Continental Congress to raise armies, and this authority enabled him to requisition ships and to man them with soldiers, mainly men from Marblehead who were almost entirely mariners. He gave commissions to the commanders so they could not be treated as pirates, and dispatched them to operate against the enemy's sea communications. Nicholas Boughton, a captain in Washington's army, was the first commander of a continental man-of-war, the *Hannah*, an armed schooner; early in September, 1775, he had the additional honor of taking our first national prize, the British ship *Unity*, loaded with naval stores and lumber.

WASHINGTON fitted out the *Hannah* primarily to operate against the British vessels that were supplying Gage's army in Boston. He added two other schooners procured by Colonel Glover of Marblehead to intercept vessels reported to be headed for the St. Lawrence. At the same time, Washington established local admiralty courts to pass upon the legality of all captures made.

John Adams in the Continental Congress at Philadelphia was simultaneously urging the establishment of a Continental Navy, and when Washington reported his action to the Congress for its approval, Congress went further and directed him to fit out additional vessels to seize British transports reported to be proceeding towards Quebec. Spurred on by Adams, Congress in October authorized the construction of five 32-gun, five 28-gun, and three 24-gun ships; one for each colony. The guns were mainly light 9- and 12-pounders, with some 4- and 6-pounders. Obviously these vessels could not fight frigates of 600 to 1000 tons armed with 30 to 50 18-pounders, but they would be able to engage small

(*Please turn to page* 185)



Valuable herd of Angora kids at an Oregon ranch. There are over 3,500,000 Angoras in the U. S.

FROM ANGORA GOAT TO MOHAIR FABRIC

MOHAIR as a textile has been used from the time of Solomon; there is nothing strange about a nomadic people using the hair of their animals for weaving or felting. Mohair is made from the fleece of the Angora goat, a prolific animal whose long hair serves as a great raw material for an exceedingly useful variety of textiles. The industry in this country dates from 1867 when Thomas Goodall, an Englishman, landed on our shores after an exacting apprenticeship in his mother country. Mohair plush at that time was woven on hand looms and was costly. One of Goodall's sons went to Germany hoping to secure a power loom but the quest was futile. The sons then collaborated with a Worcester, Massachusetts, loom maker and at last a power loom for weaving mohair was invented. That was 50 years ago. Now the great mills at Sanford, Maine, turn out every conceivable type of mohair including velvets, "Palm Beach" cloth and a "man-made" fur.

THE Angora goat was once regarded as a curiosity because of its "aristocratic" appearance—for a goat—and its long fleece. Now it is estimated that the number of Angora goats in the United States exceeds 3,500,000 and the annual clip of fleece is about 17,000,000 pounds. Although there are Angora goats in nearly every state in the Union, Texas, California, and Oregon contain the largest number of goat ranches. The United States now raises all the fleece necessary for domestic consumption. The World War depleted the herds in Turkey and our methods of breeding have produced a goat having a superior fleece.

The world's champion Angora goat. The fleece is 45 inches long

The fleece is shipped from the growing districts in 300-pound bags or 500-pound bales. At the mill the containers are opened and the fleece sorted. The sorters, highly skilled men who must serve an apprenticeship of three years before they can qualify as full-fledged craftsmen, work at long tables called "boards," swiftly pulling the fleece apart and separating it into sorts or "matchings" as they are called. The sorting is done over a grating below which there is a suction duct. Through this the loose dust and dirt are drawn. To the uninitiated, a pile of unsorted fleece looks pretty much alike, just a mass of curly hair, but a skilled sorter can easily pick out as many as 15 different sorts from an average batch of hair.

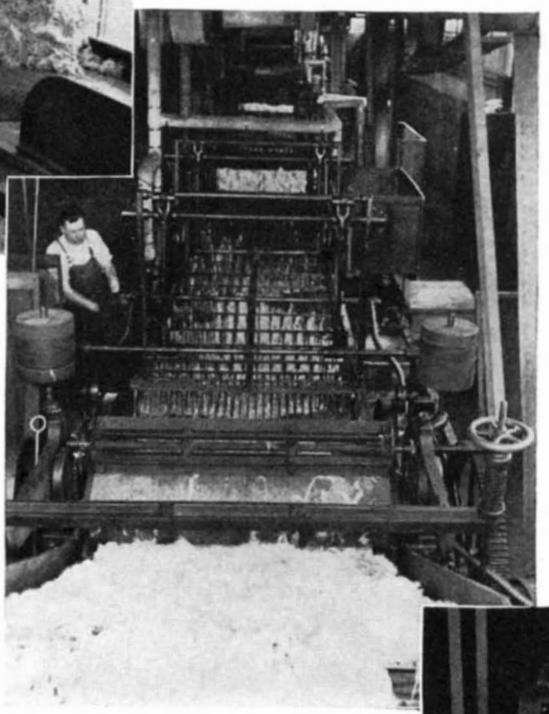
The matchings are selected on the basis of length of fiber, color, and fineness, the last being the most important. A few ten-thousandths of an inch difference in diameter of the fiber separates the various sorts, but these "split-hair" gradations are quickly and accurately detected by the sorters who seem to have developed micrometers in their fingertips and microscopes in their eyes. Twice a year, a representative of the Department of Agriculture visits the mills, takes samples of the various matchings back to Washington, and measures the fibers under a micrometer. Year after year, this check proves the accuracy of the sorters' "micrometer fingers," for the actual measurements show that the matchings have been picked correctly on the basis of fineness.

SORTERS make thousands of swift decisions daily. They must coordinate accuracy and speed and must maintain a high standard of conscientious care. A careless sorter might throw away hundreds of dollars worth of choice fleece in a day, or might jeopardize the quality of the finished product by allowing inferior fleece to go into the yarn. Good sorters can handle about 1500 pounds of fleece weekly. It is interesting to note that the sorting process is still, and probably will be for many years to come, exclusively a manual task. Here is one job for which the machine does not seem practical.

Sorting is the preliminary step toward converting the fleece into yarn which is to be woven together with a cotton back to form mohair velvet. If all discolored hair, "dead" hair, and foreign matter are not removed the dye will not "take" properly. After the fleece is sorted it is "blended"; that is, laid in huge piles and mixed so that the proper

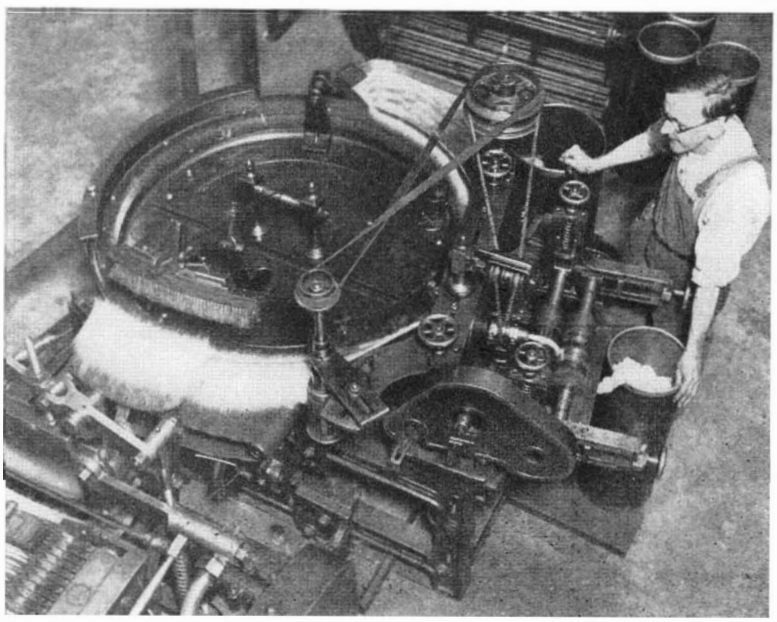
The head sorter at the Sanford, Maine, mill inspecting one of the blending piles. These piles consist of mohair fleece of different sorts so blended as to form a correct mixture for the manufacture of yarn of required fineness. As needed, the fleece is pulled from the piles and thrown into a chute leading to the washing machine

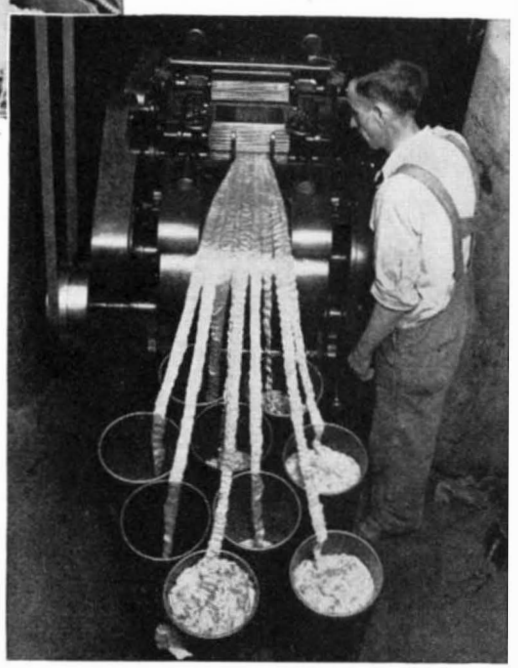
The quality of mohair velvet depends on the care with which fleece is sorted. Skilled sorters can pick out 15 different sorts from a single batch of fleece. It takes three years to become a sorter. A good craftsman can handle 1500 pounds a week with the aid of fingers alone



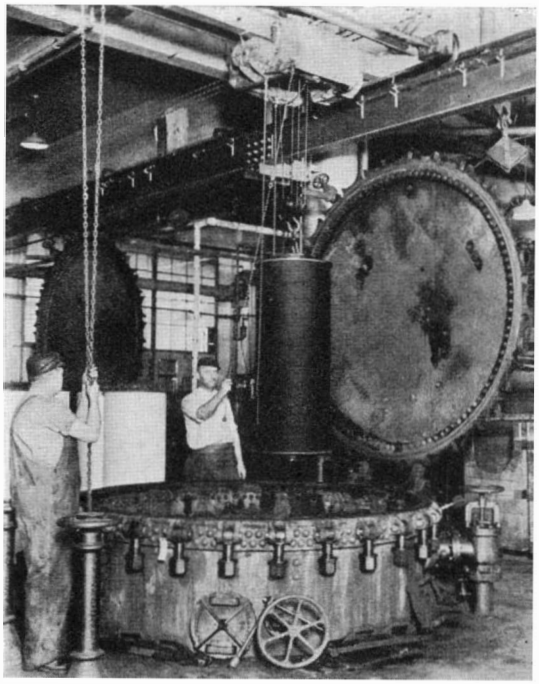
Left: The mohair fleece being soaked and raked through warm soapy water until every particle of dirt has been removed. As the fleece leaves the washer it passes through a drier where the moisture is removed by hot air; the fleece is then sprayed with olive oil

Below: A Lister "comb" which prepares the carded fleece for spinning into yarn. It removes the short fibers or "noils." Only the longer fibers are spun into yarn used in making mohair velvet. The "noils" are used for other fabrics

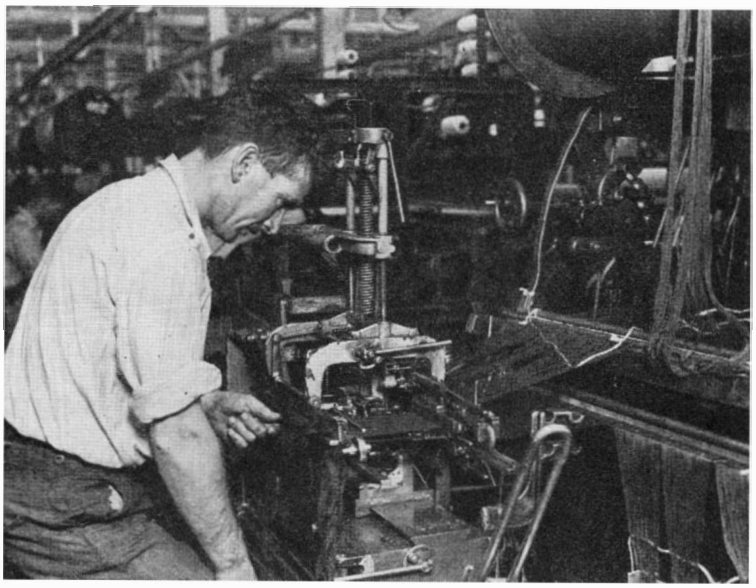




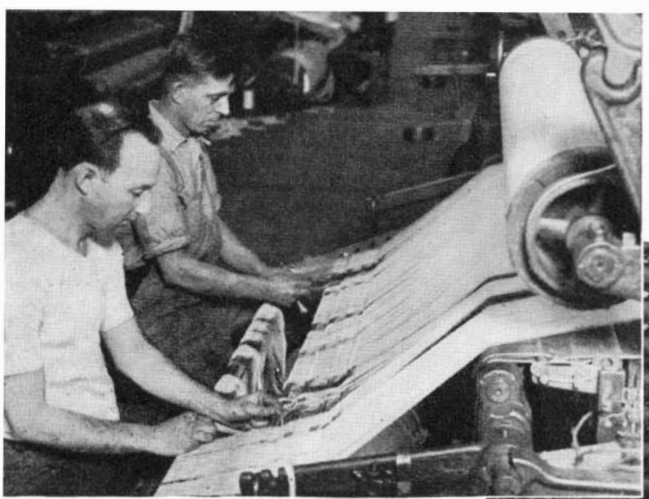
"Gilling" is the operation by which the fibers are arranged as nearly parallel as possible, smoothed out and freed from snarls, and converted into ribbon-like slivers. There are many gilling operations during the various processes



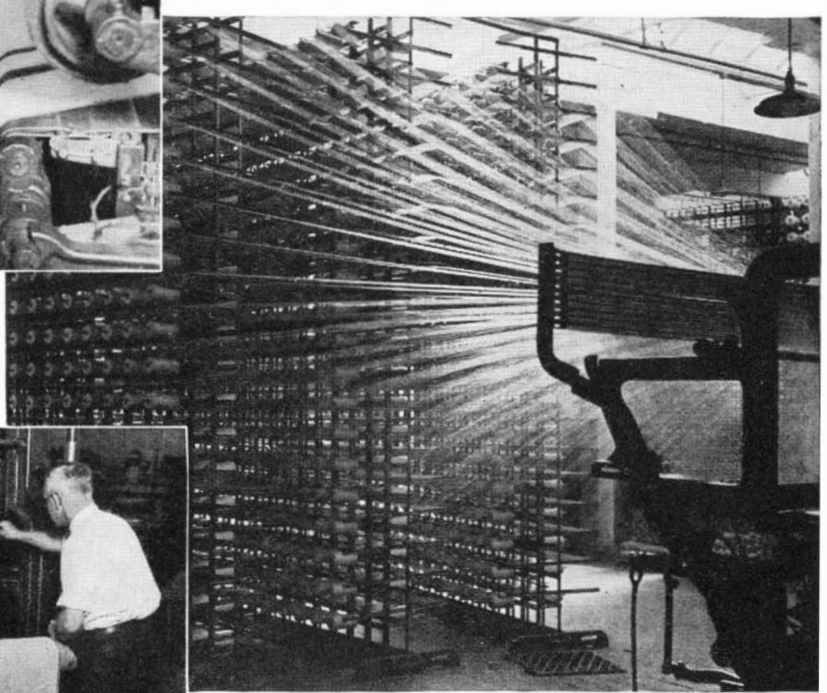
Left: Removing one of the big cotton warp "beams," as the great spools are called, from the dye vat. Thousands of yards of cotton are thoroughly impregnated with dye which is under great pressure



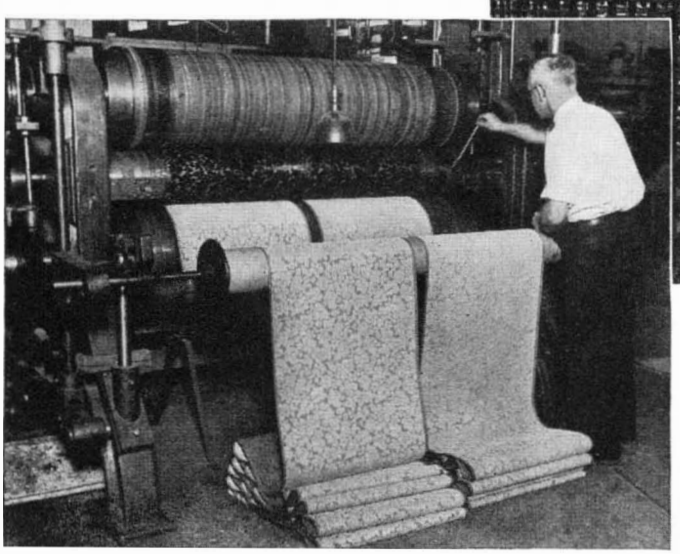
Left: Tying the ends of warp threads together to weave mohair velvet. These skilled workmen can tie as many as 1000 knots an hour. *Above:* A knot-tying machine which can tie 10,000 knots an hour. This machine supplants hand labor, tying the threads of a warp already in the loom to those in the succeeding warp



All photographs courtesy Mohair Institute



Some of the finest mohair fabrics are woven on a Jacquard loom. Hundreds of spools are required to feed the loom. By means of perforated guides or patterns, threads are dropped or lifted according to the prearranged design



Left: An embossing machine has an engraved cylinder and heated rolls which impress and cut a design on starch-loaded fabric. Mohair has extreme resiliency and the uncut loops spring back when the starch is removed

raw material is available for spinning the desired quality of yarn. The conversion of the raw fleece into the finished mohair velvet which we shall specifically describe involves more than 50 processes, each one vitally important to the success of the finished product.

The fleece is pulled from the blended piles as required and is thrown into a chute which leads to a washing machine where warm soapy water cleans the fibers. Then it passes through a drier and is sprayed with a mist of olive oil, in order to replace those oils which have been lost in the washing process and to keep the fibers in a suitable condition for handling without snarling or breaking. The fleece, up to this point, is still a jumble of curly hair. Now the locks must be opened up and the fibers laid as nearly parallel as possible so that they can be efficiently spun into yarn. The processes of carding and combing convert the tangled fleece into long smooth ribbons with the fibers free from snarls and with the short hairs removed. Only the longer hairs are suitable for the pile materials. By drawing and spinning, the ribbon-like slivers of mohair called "tops" are gradually converted into the finished yarns so that the looms can handle them. Before the actual weaving begins the cotton which is to form the back or web of the finished fabric and the mohair yarn which is to form the pile surface are wound on huge spools called "beams," and dyed. Owing to the peculiar cellular structure of mohair, the dyes penetrate the fibers easily, and a wide range of colors is available.

IN weaving, the mohair yarn is interlaced or interlocked with cotton threads. The characteristic erect pile surface of plush or mohair velvet is obtained in two ways. One process is carried out on a single loom in which the mohair is formed in loop fashion over a wire with a knife attached to the end. In this loom the loops are cut by drawing the wire, so that the individual fibers stand up erect and close together. In the second process a double loom is employed. This interesting machine actually weaves two pieces of velvet at the same time; that is, it makes two sets of warps or backs with mohair woven between them. They are cut apart during the weaving by means of a swift, sharp knife that darts back and forth, severing the mohair fibers and leaving a cut pile surface on both of the finished pieces of fabric.

In the embossing pattern-forming process the fabric, before the loops are cut, is first coated with a starch of a paste-like consistency. The coated fabric is then squeezed between heated rollers, one of which bears the design cut in copper. The design is thus imprinted, part of the fibers being pressed down and part of them left erect. The latter are sheared off, leaving short, free ends. The paste is then removed from the fabric and the uncut loops rise, thus leaving a design in cut and uncut fibers, "branded," as it were, into the surface of the velvet. The embossing process depends upon the resiliency of mohair; the extreme heat and pressure used would crush other fibers.

Some patterned fabrics are produced by the Jacquard loom with the aid of perforated patterns like a piano player roll.

Hand-printed mohair produced from wooden blocks is by no means a product of a lost art, although mechanical methods have largely supplanted hand processes. Styles have a way of changing suddenly and the art may be called for again, since machines have not been able to duplicate the peculiar beauty achieved by the age-old wooden block process. In this, men worked at long tables swinging heavy lead mauls to stamp the intricate designs into the fabrics from wooden blocks dipped in special dyes by boy attendants. Thousands of blocks are stored away today waiting for a renaissance of the art.

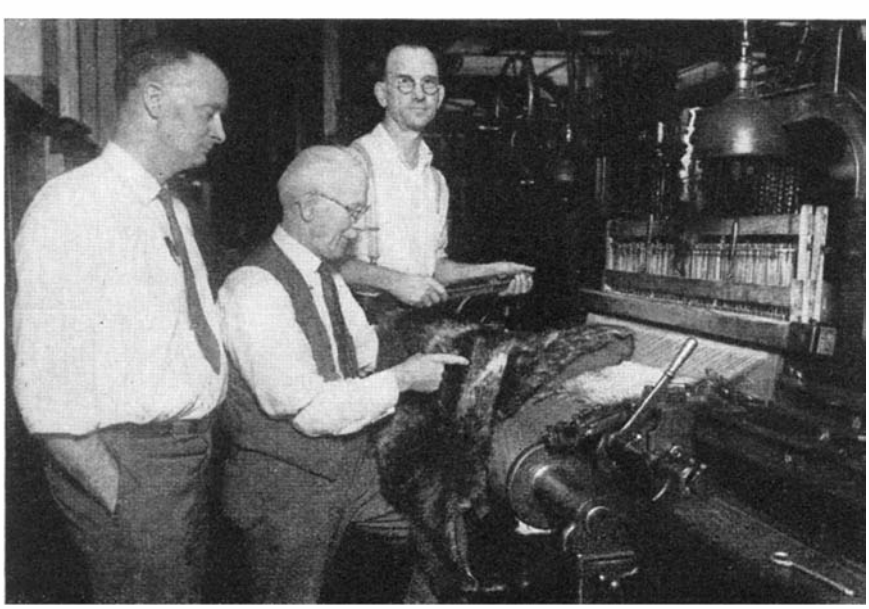
"Koongara," a new mohair product, is a "man-made" fur woven on the special loom shown below

Interesting stories could be written about the weaving of mohair for "Palm Beach" and other fabrics, but the basic material is the same, the hair of the Angora goat. Most people erroneously believe that "Palm Beach" suits are made of cotton. The late President William Howard Taft had a special inauguration suit made of mohair and President Harding not only had mohair summer suits but a special pattern was named for him. Among the largest consumers of mohair are the railroads and the automobile manufacturers.

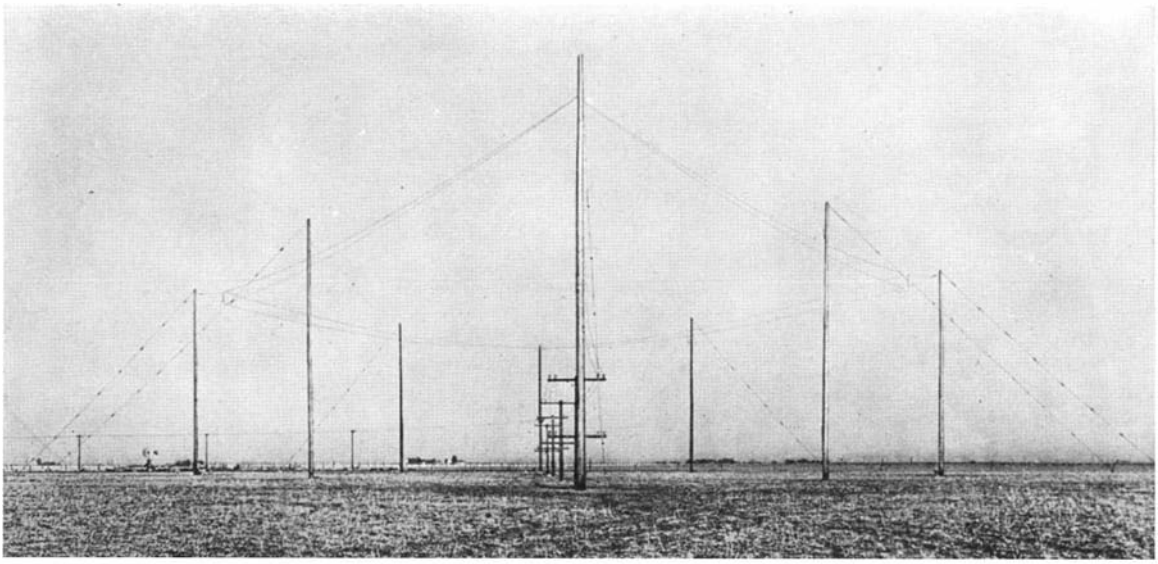
LIKE fur, wool, and other animal fibers, mohair is vulnerable to the attacks of moths. A chemical process applied after dyeing makes the fabric impalatable; the chemical causes paralysis of the moth's eating organs so that it starves to death in the midst of plenty.

One of the more recent uses of mohair proves that its pile surface absorbs a certain amount of noise; theater seats covered with it improve the reproduction of talking pictures.

A "man-made" fur is a recent development made possible by a loom that will weave mohair fibers to produce a fabric with the characteristic shaggy appearance of genuine fur. Suitable dyeing and finishing processes were developed and this season the material is being made up into winter coats. Thus the Angora goat disguises himself successfully and American textile progress scores another success.



***Below:* The inventor of the new loom which weaves both long and short fibers at one and the same time is demonstrating his "man-made" fur which is shown above**



A view of the double-V antenna used at the California transmitter of the transpacific radio-telephone circuit, looking from the end which points toward Hawaii. The iron-wire wave-suppressor shows in center

THE TELEPHONE SPANS THE PACIFIC

By R. C. SMITH

HAWAII has joined the world's telephone circle. With the opening of regular commercial transpacific radio-telephone service, on December 23, the last vestige of isolation was removed from the islands, over 2000 miles west of our Pacific Coast. This date will be recorded as an event of importance not only to Hawaii but to the world, as it marks another direct link in the telephone chain around the globe.

Fourteen calls by government, business, and telephone leaders on the Pacific and Atlantic Coasts and in Hawaii celebrated the opening of the service. The calls, each from over 2000 to 5000 miles long, covered over 100,000 miles in about 30 minutes.

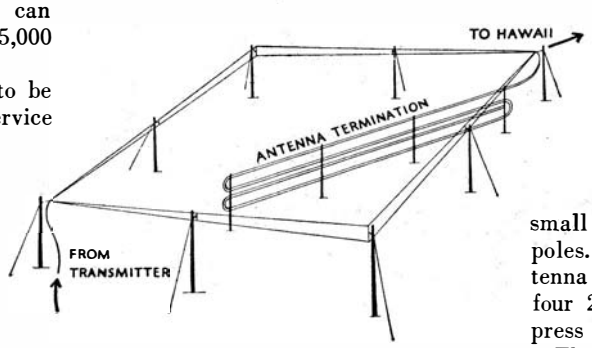
The Hawaiian circuit is made up of a 2000-mile radio-telephone channel across the ocean, hooked up with Bell System land lines in North America and Mutual Telephone Company land lines in Hawaii. Any one of the 22,000,000 North American telephones can now be connected with any of 25,000 Hawaiian telephones.

The Pacific is the third ocean to be conquered by regular telephone service since 1927, when the Atlantic was first spanned by the New York-London circuit.

The principal world channels are now the New York-London, New York-Buenos Aires, and the London, Paris, and Berlin links to the Far East, Australia, and South America. Service was recently opened to Rio de Janeiro and to Bermuda from New York. Circuits are proposed from San Francisco to Tokyo, Manila, and Sydney. Should the Australian city be connected with the Pacific Coast, the first direct telephone circuit around the world, over 21,000 miles long, would be completed.

Contrary to the old saying, there is always "something new under the sun" in the field of radio-telephony. Many new methods and equipment innovations have, in this case, achieved gratifying results.

Scientist and layman alike will find interest in the transpacific radio-telephone sending and receiving stations. Foremost, perhaps, is the simple and compact horizontal diamond type or double-V antenna, which was used for the first time in December, 1931, for commercial telephone service on this Hawaiian circuit and on the new channel to Rio de Janeiro from New York.



A diagram of the double-V transmitting antenna. Compare this with photograph above

The double-V antenna, developed by the Bell Telephone Laboratories, has been installed by the Transpacific Communication Company, Ltd., at its Dixon sending station, and at its Point Reyes receiving station, both of which are located in California.

Although the double-V antenna is not impressive in appearance, when compared to the 185-foot steel towers at Lawrenceville, New Jersey, used for transatlantic service, remarkable results are obtained through its use.

THE development of this relatively inexpensive antenna, which operates with great power economy, is of particular significance at this time. It will undoubtedly play an important part in various future extensions of radio-telephone service to remote points where the amount of telephone traffic would not justify the large cost of more pretentious antennas.

The double-V antenna at Dixon may be taken as representative of the new type. It is diamond shaped, outlined by eight wooden poles 70 feet high. The diamond is 538 feet long and 256 feet wide. It is formed of two equilateral triangles with sides 291 feet in length.

The antenna consists of two small copper wires at the tops of the poles. At the western end of the antenna is a system of iron wires on four 20-foot wooden poles, which suppress eastbound waves.

The double-V antenna is "aimed" at Hawaii. If a line were drawn from

Dixon westward through the two end poles of the diamond, it would pass through the Hawaiian receiving station at Koko Head. In this way, the 20,000-watt output of the Dixon station is concentrated in a beam for power economy.

The shape of the antenna is such that waves do not radiate north and south. The eastward waves are directed into the two iron wires, 1200 feet long. The resistance of the iron causes the electric impulses to die out.

The "sky-waves" leave the antenna at an angle of 10 to 30 degrees above the horizontal. This aims them at the undersurface of the "Kennelly-Heaviside layer" of ionized gases, which is estimated to be about 200 miles above the earth. From this point as a reflecting surface, the voice waves are deflected to Koko Head, the Hawaiian receiving station, about 12 miles from Honolulu.

"SKY-WAVES" from the sending station near Kahuku Point, 30 miles from Honolulu, are aimed directly toward the mainland receiving station on Point Reyes, just north of San Francisco. The frequencies used are between approximately 7000 and 21,000 kilocycles, corresponding to a range of about 14 to 40 meters. Should a wavelength lower than 12 meters be used, the "sky-waves" would not be deflected by the Heaviside layer, but would pass through it, thus losing the directional value of the antennas.

The double-V antenna requires flat land immediately underneath and for at least two miles in the direction of wave transmission. The sending station must have good rail and road facilities, and convenient access to telephone connections. It should be not less than 25 nor more than 100 miles from the receiving station, and must not, of course, be pointed toward the receiver.

A survey of the Pacific Coast proved the location of the present Dixon sending station to be the most suited for the immediate purpose, and for transmission to other transpacific points that may be selected later.

The surface at Point Reyes proved adaptable for the double-V receiving antenna, which is connected to the receiving unit by concentric copper tube transmission lines. The latter are straight and have been placed underground. Heretofore the transmission lines for this purpose have been supported above the ground on short stakes, and have followed a sinuous curve to allow for expansion.

The technique of connecting antennas and receivers by such transmission lines has advanced considerably. Low-loss lines 1⅜ inches in diameter have been developed for the long runs from antennas to receiving buildings, and ⅜-inch lines of the same impedance as the 1⅜-inch lines are used inside the buildings.

These ⅜-inch lines are made of copper tubing sufficiently flexible to be installed like gasoline pipes on an automobile. They can be terminated at switching panels, where they may be interconnected as required. Special one-way repeaters, designed for operation at frequencies of 10,000 to 20,000 kilocycles, have been developed for use with these switching panels, so that an entire receiving station can be given great flexibility.

The Dixon and Point Reyes stations are connected by lines of the Pacific Telephone and Telegraph Company with the latter's long distance building in San Francisco. To this central point are brought the outgoing radio-telephone circuits to Dixon and the incoming radio-telephone circuits from Point Reyes; all three points are connected by telephone and telegraph order wires required for inter-station communication.

The equipment at the San Francisco control room consists of a monitoring and testing position with volume-control, "vodas," delay, and privacy equipments with their associated power-supply panels.

Engineers coin new words. "Vodas," one of the newest, was coined by Bell Laboratories engineers from the first letters of the full descriptive name, "voice operated device anti-sing." The vodas equipment consists of relays which are operated by the voices of the persons talking by radio-telephone. When the distant speaker is talking, the transmitting line to the local radio transmitter is automatically short circuited. While the local speaker is talking, the equipment short circuits the receiving line from the local radio receiver. A conflict of voices at either end is, therefore, prevented.

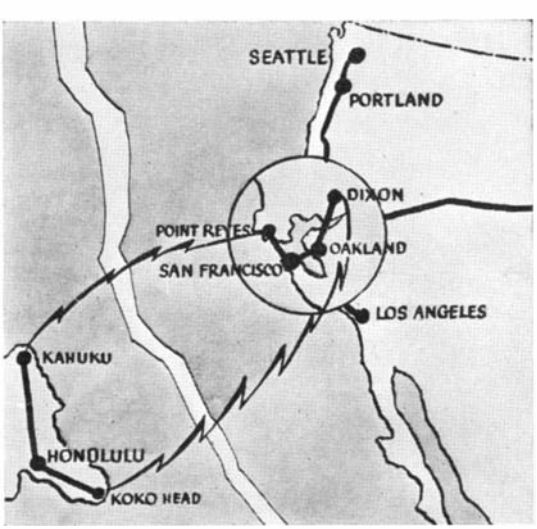
Like a modern Merlin, the "delay" machine "boxes up" the voice by compelling it to wind a tortuous way through the equivalent of about 2600 miles of wire. The machine resembles a pile of 26 shoe boxes, each containing many coils of wire tightly wound on an iron core. The voice cannot be heard until it travels through them all.

THE privacy equipment is really a "voice inverting" machine which assures absolute privacy to all radio-telephone conversations. The device is based on the fact that every spoken word sets up air vibrations numbering hundreds per second. A low-spoken word might create 250 vibrations or cycles a second. A high-pitched word sets up 1000 cycles or vibrations a second. Middle C on the piano causes 256 vibrations.

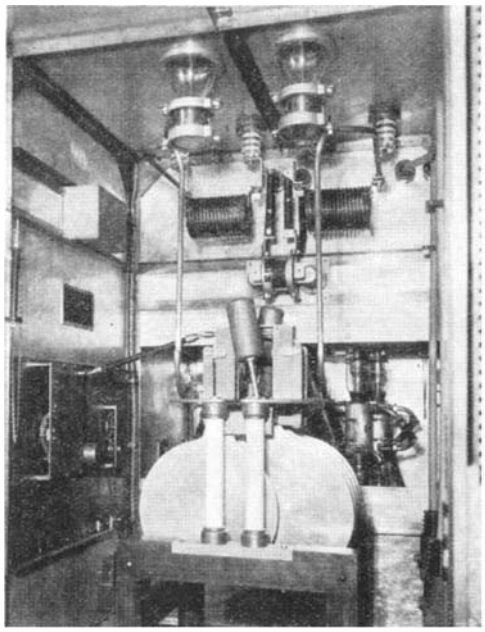
The "inverter" simply "inverts" these vibrations by speeding them up or slowing them down. The rich, low voice at 250 cycles becomes a squeak at 2750 cycles, with an occasional low grunt, due to overtones. The high voice becomes low. A school girl's giggle turns into a stevedore's roar, and a deep-chested roar turns falsetto. The whole process resembles an inverting lens which apparently stands a person on his head.

People upside down are no funnier than words in the same fix. If you eavesdropped on the transpacific radio-tele-

Receiving set at Point Reyes, California. Note telegraph instruments for intercommunication



Map showing radio-telephone channel, and some main telephone lines in the United States



In the foreground are the transmitter condenser plates, 14 inches in diameter

phone when some one said "Pacific Telephone Company," it would sound in this outlandish fashion: "Tathith-uk-play-a-feen crink-a-nope." "Mountain" would become "jay-cut." At the receiver, the speech is re-inverted or restored to normal.

From the control room, the Hawaiian circuit wires run to the regular San Francisco long-distance switchboard, to an operator handling Hawaiian service. This operator has on the switchboard section before which she sits connections with all long-distance lines running into San Francisco from all parts of North America.

At the Hawaiian stations, which are operated by the Radio Corporation of America, the radio equipment has a general layout not essentially different from that at the United States end.

Four of the Hawaiian Islands are interconnected by short-wave radio-telephone circuits of the Mutual Telephone Company of Hawaii, which serves all the 25,000 telephones in Hawaii. Transpacific radio-telephone service is, therefore, available to all Hawaii.

A LARGE book would be required to describe in detail the transpacific radio-telephone equipment. A few additional details should, however, suffice to show the size and variety of apparatus necessary to operate this new system. While the transpacific equipment is similar in general to that used at the transatlantic stations of the American Telephone and Telegraph Company on the Atlantic Coast, a number of improvements have been made.

Let us go back to Dixon, in the broad, fertile Sacramento Valley. The two-foot vacuum tubes in the transmitter serve to amplify the voice current millions of times. An elaborate water-cooling system is required merely to keep at a working temperature of 120 degrees eight of these tubes, together with the six large tubes in the rectifier. Without cooling, the tubes would immediately overheat and be useless.

Each large transmitter tube is double-ended; a grid lead enclosed in glass is at one end, filament leads in glass at the other end; the plate is a copper cylinder in the center surrounded by a water-jacket. Water is circulated through the jacket, entering at one end and leaving at the other, through a three quarter inch rubber hose.

The rubber hose is connected with the pipes of the cooling system. The latter consists of a two-inch brass pipe to feed the 14 transmitter and rectifier tubes. The pipe system runs through three floors of the building, is connected with electric pumps on the ground floor, and leads to the water-cooling unit in a penthouse.

The water-cooling unit, which operates much as an automobile water-cooling system, is made up of three radiators each five by five feet, through which the water circulates. Cooling air is driven through the radiators by three blowers, each about three feet in diameter. One hundred and fifty gallons of double-distilled water are used.

The rectifier supplies direct current to the transmitter for the final two stages of amplification of the voice current. The rectifier delivers this power at 10,000 volts through its six large water-cooled tubes. The last stage of amplification has a power output peak of 20,000 watts.

A striking feature of the transmitting station is the "copper room," a copper-shielded, line terminal compartment adjoining the transmitting room on the second floor of the Dixon building. Into this "copper room" come the wires connecting the station with the nearby long-distance telephone cable, which leads to the San Francisco control room. This room's floor, ceiling, and walls are completely covered with sheet copper, and the windows are permanently screened with the same metal.

This shielding is necessary because of the great power used in amplification. It insures that the telephone lines terminating in this room, and the terminal equipment, shall be free from electrical disturbances from outside.

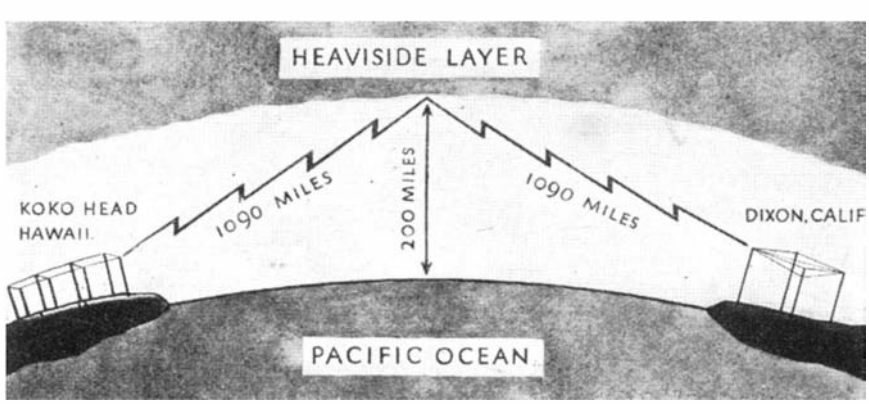
THE Point Reyes building houses one radio-telephone receiver, but is designed to accommodate additional apparatus. The receiving set has eight stages of amplification. Two of these are radio-frequency amplification, six are intermediate-frequency amplification, and one is audio-frequency amplification. "Fading," a term well understood by radio fans, is minimized by an automatic volume control. The actual volume going into the telephone wire to the long-distance room in San Francisco is adjusted by vacuum-tube repeaters.

Two sets of storage batteries furnish power for the receiver. When one is in use, the other is on charge.

The receiving set at Point Reyes will interest radio enthusiasts by reason of its size as compared with the home set. Of course, to be accurate, the entire Point Reyes station is required for receiving, and therefore is the receiving set, but speaking in a restricted meaning of the receiver, corresponding to the transmitter, the one receiving cabinet is eight by seven feet.

The Point Reyes station has duplicate receiving antennas. One is located about 500 feet northeast of the building, and the other south. While of the "V" type, the receiving antennas are simpler even than the Dixon transmitting antennas. They are made up of four poles, placed in the shape of a diamond, with a single copper wire at the top of the poles. The antennas are "aimed" to receive only from Hawaii.

So clear is the transmission over the transpacific circuit, that were someone to switch your local telephone call, without your knowing it, to Honolulu, you would not be aware of any change, although you might not know the person at the other end.



Theoretical course of the short-wave radio signals in the transpacific service. They shoot off into space, strike the Heaviside layer, and are there reflected

FROM THE ARCHEOLOGIST'S NOTE BOOK

Sumerian Diorite Head

HERE we have a head of Gudea who ruled over Lagash, a walled city of ancient Babylonia, on the Euphrates about 40 miles from Ur. This diorite head dates from about 2500 B.C., about 500 or 600 years before Abraham left Ur. The head is in the Boston Museum of Fine Arts. Gudea was by name and speech a Sumerian, while Abraham was a Semite. The naturalism and freedom from priestly restraint in this particular specimen will be noted. The carving of so hard and veined a stone as diorite must have been fraught with great risk of fracture, and was probably done in the main by a slow process of grinding and rubbing down. The material was brought either from Sinai or from the Egyptian desert east of the Nile. The stone was in the form of great natural boulders, so the sculptor was limited by his materials. No finer example of this, the greatest age of Sumerian sculpture, exists than this head and its companion in the Louvre.

Diorite head of Gudea—Sumerian ruler

Stand from Grave

THE stand with a flat top and a conical foot recently acquired by The Metropolitan Museum of Art was probably a base to set off a vase or cup like the teakwood stands for Chinese pottery. On the top is a mask of Medusa. The Athenian stand dates from about 560 B.C. and is signed by both the potter and the painter. It is only 2½ inches high. On one side of the base is a hole for hanging up when not in use.

Flat-top stand for vase—about 560 B.C.

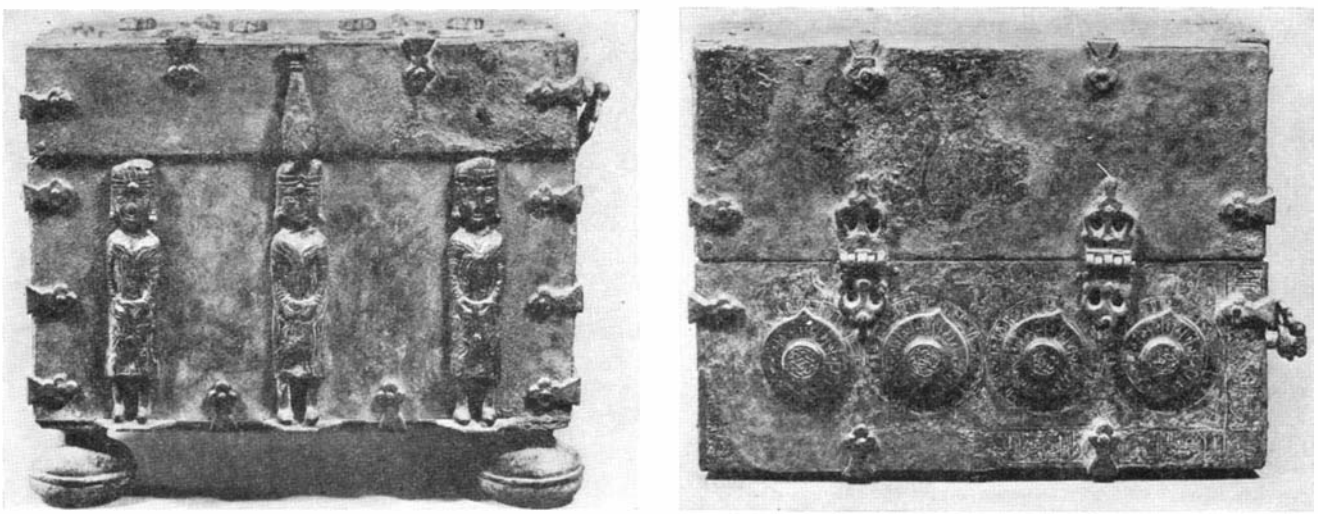
Athenian Jug

ON the body of this Athenian oil jug, which dates from 560 B.C., is a wonderful portrayal of women working wool. Two are weighing balls of wool, others are spinning with distaff and spindle, two are weaving on an upright loom, while two others are folding the finished products and putting them on a stool in a neat pile. On the shoulder is a goddess and groups of dancing girls. This little vase, which is 6¾ inches high, is in The Metropolitan Museum of Art.

Athenian jug—560 B.C.

Persian Strong-Box

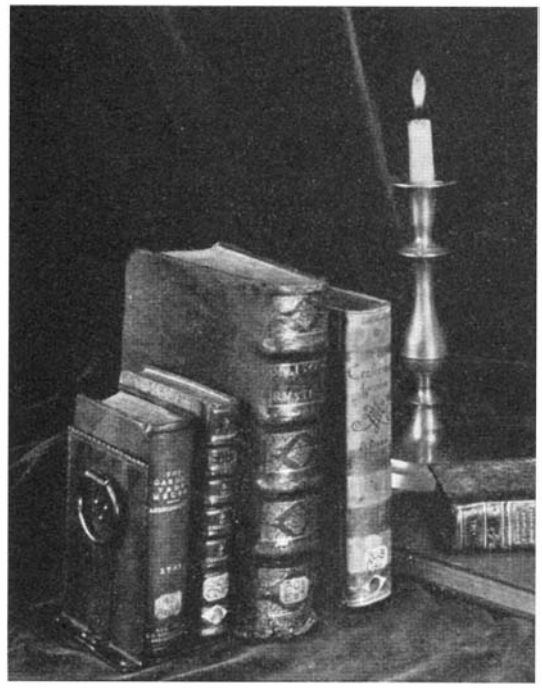
THROUGH the courtesy of the Stora Galleries, New York City, we show a 12th Century Persian bronze strong-box having a set of engraved dials. These were not locks in the sense of a combination lock as there are no tumblers but the bolt was "dogged" until the dials were set to secret symbols. Our left hand illustration shows the front, the right hand illustration the top of the chest.



Side and top of a bronze strong-box with a set of engraved dials controlling the lock mechanism

PRESERVATION OF LEATHER BOOKBINDINGS*

By R. W. FREY† and F. P. VEITCH‡



MILLIONS of leather bindings in public and private libraries of this country are in various stages of decay. Some may show little, if any, sign of decay; others can be scratched easily and have worn corners and slight cracks. Many are badly scuffed, powdery, and dusty, and are broken through along the hinges. They must be rebound to be serviceable. Frequent rebinding because of rapid deterioration is an item of great cost to libraries and to owners of books.

The timely application of dressings containing suitable oils and greases will add many years to the service of a leather binding. Such dressings lubricate the fibers, thus imparting flexibility and strength to the leather. They also protect the fibers by rendering them less absorptive and more impervious to the harmful gases that usually are in the air.

It is not possible with dressings or other treatments to restore, in the strict sense of the word, the original good properties, life, or fiber of a piece of rotted leather. Treatment should be started when the bindings are new and should be repeated periodically, once every year or two. When treatment is postponed until the leather shows signs of decay, it is too late to preserve the binding in prime condition. Even at this stage, however, treatment will retard further rotting.

Quick, direct, and positive tests of the efficiency of different dressings and materials in preserving leather are not possible because of the relatively long time that is required for the natural aging and deterioration of the leather. The Bureau of Chemistry and Soils, over a period of many years, has devoted much study to the causes of and means for preventing deterioration of leather, including the examination of many naturally deteriorated leather bindings and other leather articles; experiments on the effect of oils and greases on leather; and the critical analysis of conditions that promote deterioration. On the basis of this experience and of existing knowledge about the effect of various oils and greases on leather, many dressings for the preservation of leather have been compounded from time to time. Among those that have appeared good are the preparations tabulated.

Preparation 6 was developed by the New York Public Library and has been used systematically by that institution for several years. It is easily prepared and applied and gives good results.

Preparation 7, or purified Vaseline, has been used during the past 20 years by the Worcester County Law Library, Worcester, Massachusetts, on its law books.

It is important that the materials used to make the preparations be of the best quality and practically pure; consequently, materials of United States Pharmacopœia grade, or of the same quality, should be used. These can be obtained at or through local drug stores, chemical supply houses, or wholesale drug supply establishments. Makers of the various ingredients are listed in commercial registers under the particular product desired.

These dressings are not difficult to make, but if so desired, arrangements probably can be made with a local pharmacist or commercial chemist to prepare them. All the formulas are expressed in percent by weight.

PREPARATION 1

Neat's-foot oil, pure, 20° C. cold test	25.0
Lanolin, anhydrous	17.5
Japan wax, pure	10.0
Sodium stearate, powdered	2.5
Water, distilled	45.0

PREPARATION 2

Lanolin, anhydrous	30.0
Castor oil	12.0
Japan wax, pure	5.0
Sodium stearate, powdered	3.0
Water, distilled	50.0

PREPARATION 3

Lanolin, anhydrous	50.0
Neat's-foot oil, pure, 20° C. cold test	35.0
Japan wax, pure	10.0
Sodium stearate, powdered	5.0

PREPARATION 4

Lanolin, anhydrous	55.0
Sperm oil, winter strained	25.0
Japan wax, pure	15.0
Sodium stearate, powdered	5.0

PREPARATION 5

Neat's-foot oil, pure, 20° C. cold test	50.0
Castor oil	50.0

PREPARATION 6

Lanolin, anhydrous	40.0
Neat's-foot oil, pure, 20° C. cold test	60.0

PREPARATION 7

Petrolatum or petroleum jelly, purified	100.0

Dressings for bindings have been developed that are easily prepared and will give very definite results

WHEN making the preparations the ingredients should be melted or dissolved by heating them on a steam bath or in a double boiler. Scorching or burning is likely to result from heating directly over a flame.

Preparations 1 and 2 are emulsions with water and can be made in the same way. Melt together in one container all the ingredients except the sodium stearate and distilled water. Mix the sodium stearate and the water in another container. Cover this container, and heat slowly and gently until the stearate is dissolved. Then pour the sodium stearate solution in a thin stream into the melted grease while stirring it vigorously. A thin milk-like mixture will result. Let this cool. When the mixture is about cold it will be noticeably stiffer and from this stage on it should be constantly and thoroughly stirred until uniform in appearance. If properly made, these dressings will be very smooth, ointment-like, nearly white to pale-cream preparations without any separation of water. If the emulsion separates into two layers, it can be restored by vigorously stirring or whipping the mixture when it is cold.

*Courtesy of the U. S. Department of Agriculture.

†Chemist, and ‡Principal Chemist in Charge, Industrial Farm Products Division, Chemical and Technological Research, Bureau of Chemistry and Soils.

These preparations should always be kept in a container with a tight-fitting cover to prevent evaporation of water and consequent drying and hardening.

Preparations 3 and 4 are made by heating the specified ingredients together in one vessel until all but the sodium stearate powder have melted. The mixture is then poured on a smooth, non-absorbing surface, such as a piece of plate glass or a marble, stone, or glass topped table, and worked with a spatula as it cools. The small white particles of sodium stearate are "rubbed in" with the spatula and thoroughly worked into the other ingredients until a salve-like mixture, perfectly uniform in appearance, and without any lumps or white specks, is obtained. It is essential to work in the sodium stearate as described.

PREPARATION 5 is simply a mixture of equal quantities of neat's-foot oil and castor oil.

Preparation 6 is a soft salve. To make it, warm the lanolin slowly until it is melted, then add the neat's-foot oil, stir thoroughly until the mixture is uniform, and let it cool.

Preparation 7 is simply purified petroleum jelly or Vaseline of a high grade, equal in quality to that prepared for medicinal use. It should be nearly white or but faintly yellowish and practically without odor or taste.

At the outset it should be realized that any oil or grease will darken to some extent law, tan, and other light-colored leathers and may slightly dull the finish even though the color be black.

Good judgment should be used in applying oils, greases, or dressings to leather bindings. Care should be taken not to put on so much that the leather will remain greasy to the touch, yet enough should be applied to oil the leather well. Only a thin film of the dressing should be applied at a time. Repeated applications of small quantities should be made until the leather is well oiled. Intervals of several hours should elapse between applications to enable the leather to absorb the oil or grease. The back and hinges of a binding usually rot more rapidly than the sides, and consequently more oil and grease should be applied to these parts. This should be done especially when treating bindings that are already beginning to show decay. In order to increase the rapidity with which leather absorbs oils and greases, as well as the actual quantity it can absorb without remaining greasy, bindings should be put in a warm, but never a hot, place for an hour or two after oiling. The temperature should be about 100 to 115 degrees, Fahrenheit.

Cellulose nitrate for lacquers, ready mixed, with 30 per cent by weight of alcohol	1
Monoethyl ether of ethylene glycol	2
Ethyl acetate	3
N-butyl alcohol	1
Toluene	5
Xylene	2
Castor oil, U. S. P.	½

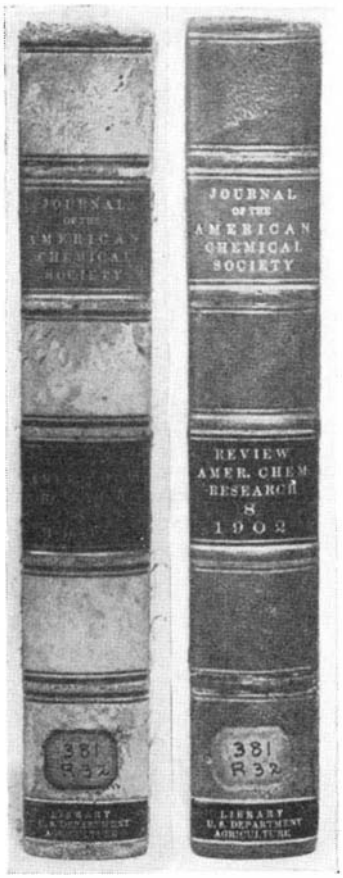
This formula for cellulose-nitrate lacquer gives excellent results; guard against fire and explosion

Dressings are best applied with the fingers and palm of the hand. Use a firm, rapid stroke and spread the dressing over as much of the leather at one time as is feasible, in order to distribute the oil and grease uniformly. The dressing should be rubbed well into the leather and not merely smeared on it. It is the oil that gets into the leather, and not simply on it, that counts.

Dry, porous bindings that show a tendency to peel or to be powdery are almost impossible to oil uniformly. Leather in this condition is very absorbent and literally grabs the oil as soon as contact is made with it. After such bindings are oiled, areas of the leather having unequal depth of color are almost inevitable, and the middle part of the back between the hinges will be darker than the leather on each side unless the binding was originally very dark or black.

Many bindings in the advanced stages of decay or rot become powdery and are disagreeable to handle, soiling the hands and clothes with leather dust. Old law sheep bindings in this condition probably are the most familiar examples, but many bindings made from other kinds of leather peel and get powdery. Such bindings are on their "last legs," but they can be improved materially by treatment with a dressing followed 24 to 48 hours later by lacquering.

Scuffed, powdery, cracked leather bindings starving for nourishment are familiar sights



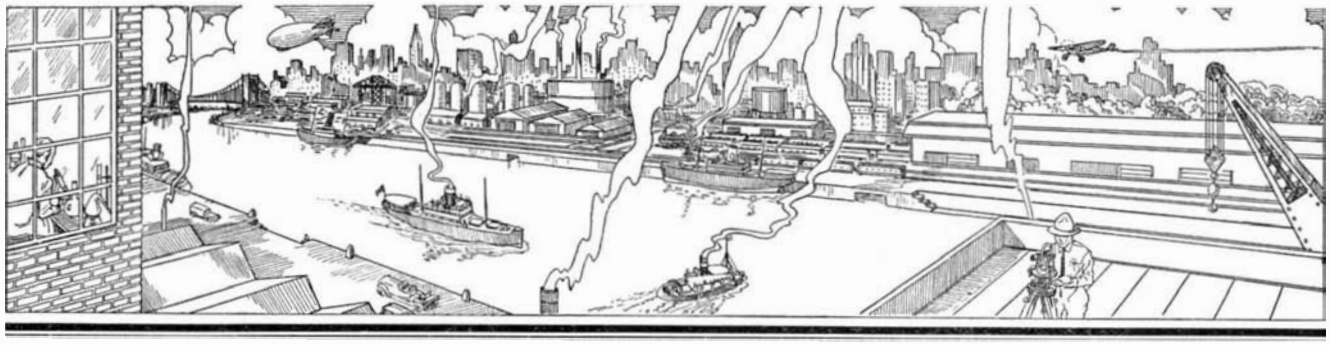
Old bindings before and after oiling and lacquering; note marked improvement after treatment

A thin cellulose-nitrate or soluble-cotton lacquer should be used. If the lacquer is too thick, a highly varnished appearance results and the lacquer is more likely to come off. There are on the market certain types of ready-made cellulose-nitrate lacquers, which may be used if sufficiently thinned with their respective thinners. Lacquers made for leather, cloth, and similar flexible materials should be used, and not those intended for metal and wooden surfaces.

A lacquer for this treatment may be made from the formula shown on this page, the weights being given in ounces avoirdupois.

The first four ingredients are put in a glass fruit jar, or other suitable container, which is then tightly closed and allowed to stand with occasional shaking or stirring until a clear, thick sirup is obtained. The last three ingredients, mixed together, are then added in a thin stream with constant stirring until a uniform mixture results.

The lacquers should be applied preferably in the open or at least in a free circulation of fresh air. They must not be used near a fire or open flame, or while smoking.



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN

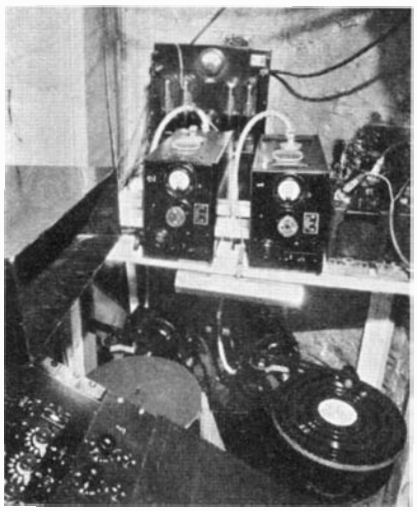
In charge, Daniel Guggenheim School of Aeronautics, New York University

A. E. BUCHANAN, Jr.

Lehigh University

Recorded Music and Sound Effects in "Hamlet"

AN innovation for legitimate stage productions was made recently by Electrical Research Products, Inc., with a



The horn and record control desk, part of the equipment used in the production of realistic sound effects in the staging of "Hamlet"

presentation by Norman Bel Geddes of "Hamlet" in New York City. Shakespeare's lines were enhanced by the use of special disk recordings of music and sound effects. Twin turn-tables, operating at 33⅓ revolutions per minute, were so arranged that there was no pause in switching from one record to the next, and also provided for superimposing one sound effect upon another. This superimposing facility was used to marked advantage in the ghost scene, during which the weird sound of the wind at midnight continues through a brief musical selection which heralds the appearance of the ghost.

The sound from the "phonograph records" was reproduced through five loudspeakers located at various positions back-stage and controlled by a switching system which permitted selective or simultaneous operation. Thus, in the mob scene, by switching from one speaker to another in sequence the sound gave the illusion of a crowd surrounding and approaching the citadel, and the weak, far off murmurs and cries developed to a great climax and loud cheers when the gate was finally broken down.

The prelude, overture, and entire musical accompaniment to the show were reproduced over the system—there being no orchestra or other conventional music used in connection with the play.

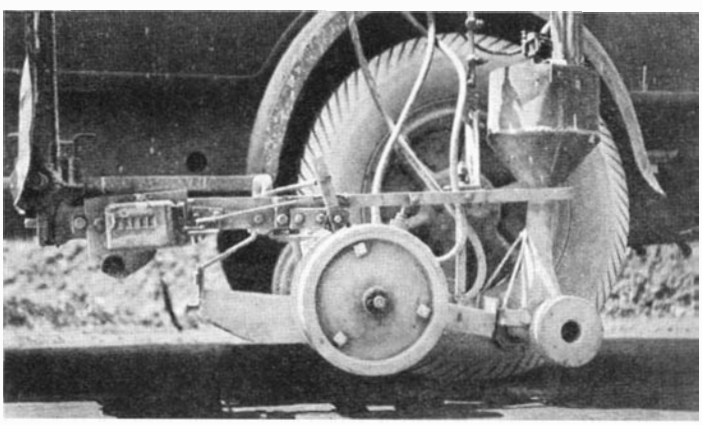
Tomato Test for Poison Gases

CANARIES were once an indispensable part of every submarine's equipment, and they are still as necessary in some "gassy" mines where they succumb to whiffs of poisonous gases too slight to affect a man.

Some experiments made by Professor Carl G. Deuber of Yale University show that the tomato plant is just as sensitive to asphyxiating gases. A mere trace of illuminating gas, for example, is enough to cause the younger leaf petioles of the tomato plant to grow downward. The reason is to be found in a more rapid development of the cells on the upper portion of the petiole. According to Professor Deuber, no more delicate test can be found for quantities of gas which may at first be imperceptible to human beings, but which may rapidly accumulate in fatal amounts.—*A. E. B.*

Blotting Traffic Lane Stripe With Sawdust

WHEN traffic lanes of highways are striped with paint, it is usually necessary to block off a part of the highway until the wet paint has dried. To obviate this troublesome operation and speed up such work, a novel method of highway striping was developed in District Four of the West Virginia State Road Commission during the early summer months of 1931. This new method involves the use of an automatic striper mounted beside the left rear wheel of an automobile, in conjunction with which there is used an automatic device for covering the fresh paint with a layer of sawdust. The sawdust effectively protects the paint from smearing by cars that might cross it before it is dried.



Close-up of the equipment mounted on a fast light truck for painting and blotting a traffic stripe with sawdust while running

The manner in which the paint spray gun and the tank of blotting sawdust were mounted on the car

Mr. A. K. Erb, Senior Assistant Engineer of the District explains that the striping equipment is that furnished by the Devilbiss Company, consisting of a special paint spray gun mounted between adjustable vanes which are, in turn, mounted upon wheels in such a manner that they may be attached to the running board of an auto truck. The paint supply tank and a compressor are mounted in the truck body.

The equipment used in blotting the stripe with sawdust was developed after some experimental work with various types of nozzles. It was found that the best results were obtained by using a large container feeding into a small funnel, the distributing end of which was fitted with two screws turning in opposite directions. These screws were driven by a pair of small gears keyed to the axle shaft of the blotting device. The small funnel and sawdust distributor are mounted independently of the large sawdust container in order that when the machine is in transit between stripes, the entire assembly may be lifted off the road by means of a hand lever.

It is interesting to note that late in the summer, the district mounted an extra paint gun on this assembly and were able practically to double the striping speed. When using two guns the speed at which stripes may be made successfully is only limited by the roughness of the road surface.

During the season just past, 5800 gallons of traffic paint were used in this machine and 2,250,000 linear feet of line were painted in 1230 hours.

Miniature Auto Plant "Builds" Cars

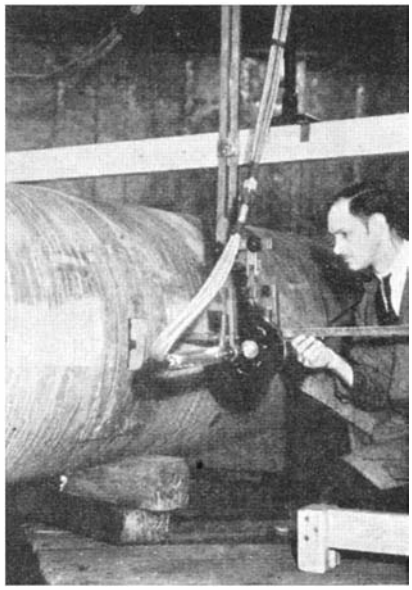
WHAT is perhaps the world's most expensive toy—a 25,000-dollar reproduction, in miniature, of the DeSoto plant in Detroit—was on view at the recent Automobile Show in New York. The fascinating cameo factory duplicates the assembly procedure of the plant it represents and "builds" tiny automobiles at the rate of 140 every hour. The tiny automobiles run out, seemingly under their own power, and onto a shipping platform ready to be packed into waiting freight cars.

The model is 20 feet long and four feet wide. It is a perfect reproduction of the DeSoto plant, scaled down about 125 times. The actual plant is 2500 feet long and 550 feet wide.

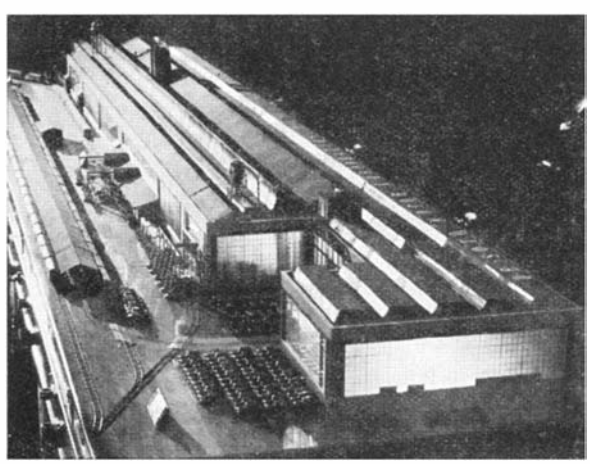
In the DeSoto plant there are no stock rooms. The incoming material and the work in process are so carefully gaged that the finished material is fed to the assembly lines at the point where it is needed in exactly the right quantities to take care of the day's production. Thus in the miniature model, the assembly operation starts with the frames where they are unloaded from the cars. These frames are placed on an endless conveyor and carried to one of the assembly lines. Traveling down these lines the frames have assembled on them, the front and rear axles, the gas tanks, the springs—here the type of car is determined for each body type uses springs designed to carry the weight and give the proper riding qualities—and then the engine is installed on Floating Power, the Chrysler development described in our September, 1931, issue.

The chassis then enters the spray booth where it is lacquered and then dried. Wheels, tires, radiator, the body, fenders, tail lamps, horns, and accessories—all are then added in turn, just as in the Detroit plant, and the finished toy car is driven away seemingly under its own power to the freight loading dock.

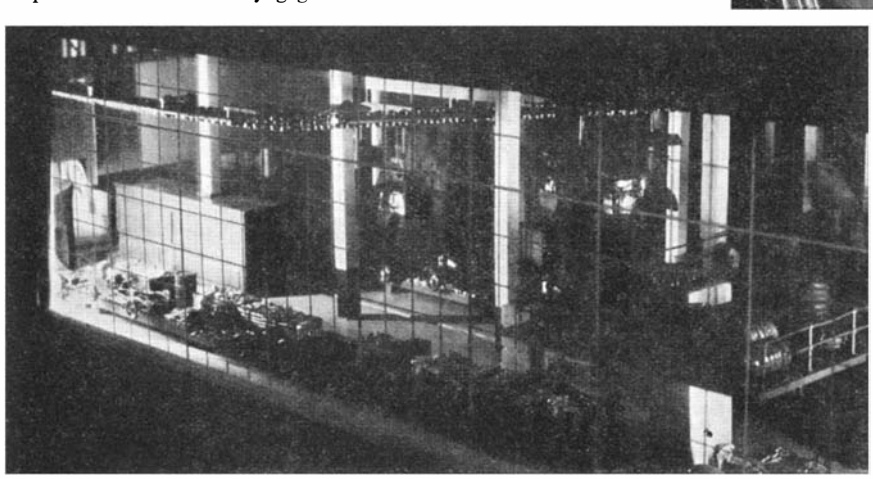
Both Mr. Chrysler and Mr. Byron Foy, President of the DeSoto company, are to be congratulated on the construction of this fascinating toy plant which will be seen at other automobile shows over the country this year.



The new X-ray laboratory at the General Electric plant at Schenectady is now at work probing into the metal parts for the new mercury turbine power station that is soon to be built there. Here an X-ray tube is being set up for a photograph through four-inch metal



At the right is to be seen the automobile plant model which goes through all the motions of producing cars. The tiny cars, when "completed," leave the building "under their own power" and proceed up the ramp for loading in the freight cars shown. Below is shown part of the assembly line with conveyors and all necessary machinery



Perfume from Liquor

IN the United States, the illicit liquor traffic has developed all sorts of schemes of making denatured alcohol drinkable. In South Africa, on the contrary, a new industry has been launched in an effort to use up excess stocks of palatable alcohol by converting it into perfume.

The Paarl Co-operative Wine Growers' Association has begun the manufacture of two perfumes, the better of which is to be known as "Eau de Cologne." The other will be named "Eau de l'Afrique." Large use will be made of orange distillate from South African orchards. The Eau de Cologne is to be colorless, but the other product will readily be recognized by its pale lemon hue.

As these products are to be in every respect equal to the imported, a large sale in South Africa is anticipated, and it is also expected that as the industry develops a determined attack will be made on overseas markets.—*A. E. B.*

Chemical Binder for Wood Veneering

A RECENT development in synthetic plastics which seems likely to extend their field of usefulness and to revolutionize present methods of laminating plywood is announced in the production of a phenol-formaldehyde resinoid binder

for wood-veneering. The resin is sprinkled on in powder form and a hot-plate press is used, since the new veneering resins are thermo-setting, requiring heat and pressure before they flux and complete the bond. Using these resins the bond is completed in less than three minutes, compared with 10 to 20 hours required by former clamping processes. The new bond gives a panel which is strong, water-resistant, and requires no re-drying. Warping is eliminated, and there is no danger of staining the face veneer—a constant hazard with former methods of gluing—and no limit to the thinness of the plies.—*A. E. B.*

Sprayed Spuds

FLOUR made from potatoes is not a new product, but flour made by spraying potato "soup" into a huge drying chamber wherein the "soup" is converted to flour before it falls to the floor is the unique process used by the Otato Corporation at Burley, Idaho. William Spencer Bowen, president of the company, describes this novel plant in a recent issue of *Food Industries*. He states that the spray-dried potato flour has proved to be superior to that made by the old method of grinding the raw potato, washing out the impurities, and drying the resulting starch. The new process yields flour that holds moisture better, has better flavor and color, and a higher content of mineral salts.

Potatoes delivered by farmers are stored in an artificially ventilated, model cellar until needed, when they are delivered to the mill by an elevator conveyor. First, they are carefully washed by being tumbled under high-pressure water sprays in a rotating cylinder. The washer delivers the clean potatoes to the cooker, 70 feet long and 4 feet wide. It will cook continuously at the rate of 100 pounds per minute. It consists of a long insulated box through which an endless belt carries the potatoes while they are being cooked by steam supplied from a 100 horsepower boiler.

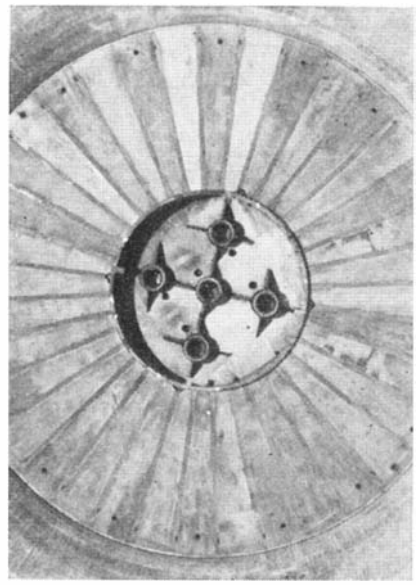
From the cooker the potatoes drop, steaming hot, into the pulper, which also removes the skins with minimum wastage. The mash then falls into the first mixing tank. Here sufficient water is added to make a free flowing liquid, or "soup." This "soup" is pumped through the finisher into the final storage tank, which is kept hot with live steam.

The thick liquid is pumped to the five spray machines at the top of the spray-drying chamber. The drying chamber of reinforced concrete is one of the largest ever constructed for the purpose of spray-drying. Its internal dimensions are 40 feet in diameter by 60 feet high. The spray machines drive aluminum spray disks at 8000 to 10,000 revolutions per minute and the "soup" is atomized by them into an exceedingly fine mist. Upon emerging from the disks, this spray of potato "soup" is met by a blast of hot air, which instantaneously dries out the water from each droplet, leaving all the solids behind. This instantaneous evaporation gives the product the physical qualities that cannot be achieved by any other means. The tiny round particles, appearing under the microscope much like puffed grains of wheat, fall to the bottom of the chamber and are swept out by a blast of warm air into the outgoing air stream.

The flour thus made does not require grinding; it is merely sifted and bagged ready for shipment to the bakeries where its unique properties are valued in both rye and white bread.—*A. E. B.*

What is a Cloudburst?

RAIN falls during rainfall, but clouds do not burst when there is a "cloudburst." United States Weather Bureau experts say that sometimes strong upward currents of air hold raindrops up from underneath and prevent them from promptly reaching the ground. Then the drops gather in much larger quantities than they usually do. When the upward air currents lessen, or so much water accumulates that the air can not support it, there occurs the deluge of rain that we call a cloudburst.



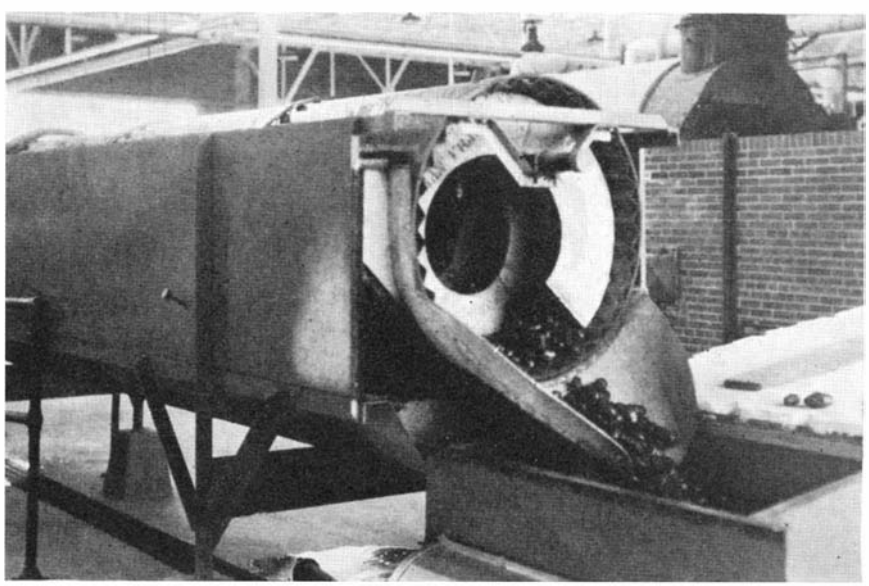
Ceiling of the spray drying chamber showing holes through which potato "soup" is sprayed to meet an ascending current of warm air

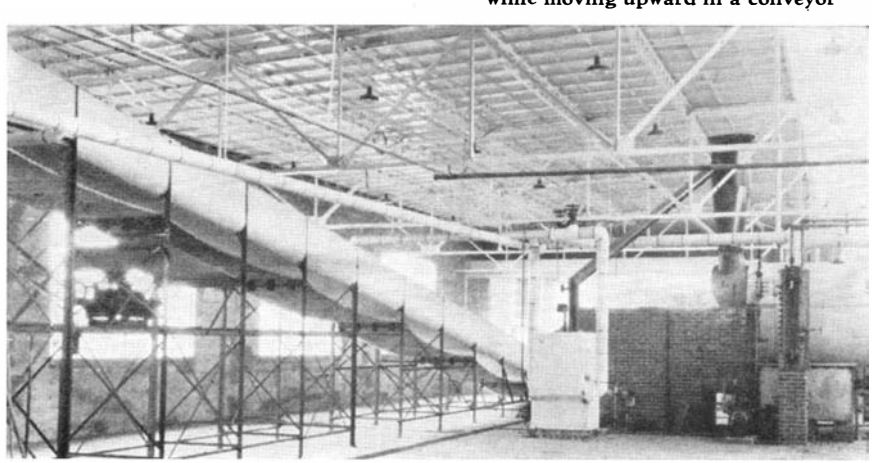
Cancer

IN 1900 when the registration area for deaths was first formed, the crude death rate from cancer in the United States was 63 per 100,000 population. In 1920, it was 83.4; in 1929 (the latest available figures) it was 96.1, an increase over the crude death rate of 1900 of nearly 52.5 percent.

In 1929 the total number of deaths from cancer was 111,569. This makes cancer the second most important cause of death. Heart disease alone with 245,000 deaths claimed a greater number of victims.

One of the most striking increases in the death rate has been in the so-called ex-





At left: **The potato washer used in the process of making sprayed potato flour.** ***Below:*** **The long, continuous cooker. Potatoes are fed at the lower end and cooked by steam while moving upward in a conveyor**

New interior of the Curtiss Condor transport. The deeply upholstered chairs are arranged in groups of six in three separate compartments

ternal forms of cancer, such as cancer of the breast and cancer of the mouth, in which, because of the superficial position, errors in diagnosis are low as compared with the possibility for error in deep-seated cancer such as those of the stomach or other internal organs.

The conclusion has been reached after careful study of statistics that in the 21-year period from 1900 to 1920, about two thirds of the increase observed in cancer death rate of persons 40 years old and over was due to an actual increase in the mortality of the disease.

Cancer may occur anywhere on the outside or the inside of the body. It is always small in the beginning. When it occurs on the outside it is much easier to discover in its early stages. It is at this time that effective action against the growth is most likely to result in a cure. After particles of the cancer have found their way to other parts of the body and given rise to new cancers, the situation is much more serious. To cure such patients, it is necessary to find out where these new centers are and then they must all be removed.

Cancer is much more likely to make an attack after the age of 35 than before that time, and consequently the death rate is higher in certain age groups than in others. Among all deaths in men between the ages of 45 and 70, one in eight is due to cancer, and among all the deaths which occur among women between 45 and 65, one in five is caused by cancer.

The most prevalent site of fatal cancer is the stomach, with 38 percent of the total deaths. Cancer of the breast caused 9 percent of all fatal cases. Cancer of the skin causes 3 percent of the cancer deaths. There is evidence to show that cancer itself is not hereditary, although a certain susceptibility toward the disease seems to exist among the members of some families. This particular phase of the problem is now being thoroughly studied by a number of investigators.

Improvements in Transport Planes

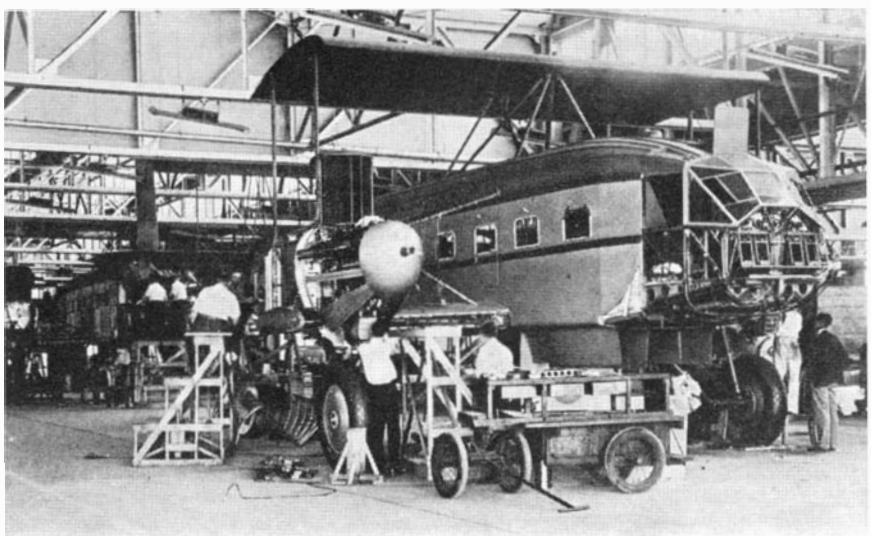
OUR photographs show the Curtiss Condor transport planes recently put into service on Eastern Air Transport lines. This excellent airplane illustrates the tendencies of the best modern design.

Our airline operators now insist on far greater comfort for the passengers. First of all they are endeavoring to reduce noise. This reduction of noise is achieved partly by careful insulation of the cabin with special plywood panels containing balsa wood as a core. The balsa wood, a very light and highly cellular material, retards the conduction of both heat and noise through the walls.

Another method of attacking noise is to use geared-down three-bladed propellers. The main source of noise of the propeller is at the tips. The speed of sound at sea-level is 1092 feet per second. When the tips of the propeller blades whirl 'round at something like seven tenths of the speed of sound—700 feet per second or thereabouts—they act as sound creating sources. The blades no longer have the air flowing smoothly past them but create waves of compression and rarification. By gearing down the motor, the tip speed and the noise of the propeller are appreciably reduced. Of course, with the propeller working more slowly, it is necessary either to increase the diameter or the number of blades, or both. The Curtiss engineers have met this difficulty by using a three-bladed propeller of medium diameter.

There is a great temptation for the airplane designer to crowd the passengers, since any increase in the size of the fuselage means a corresponding increase in the drag or air resistance. The traveling public does not like crowding, however, and we find that the Condor provides approximately 50 cubic feet of space per passenger and over eight square feet of floor area. Americans traveling in Europe often compare our Pullman system with the European compartment system to the disadvantage of the latter. Nevertheless, practice in transport planes seems to be swinging to compartments. Perhaps the reason is that air-sick passengers ought to have a compartment to themselves! At any rate, the Condor's comfortable, deeply upholstered chairs are arranged in groups of six in three separate compartments, each partition containing a sliding door and two large non-shatterable glass windows.

Despite the Condor's great size, its fuselage has delicate lines, as shown at the right. The photograph below shows the huge transport plane being re-vamped and equipped with two Curtiss Conqueror engines



Each chair is equipped with fixtures for individual luncheon trays and, in addition, large tables are provided for card playing or writing. The cabin ventilation and heating have been very carefully studied and the ventilation is perfectly adequate with all windows shut. It is considered by the best authorities that decrease of noise and vibration and the provision of perfect heating and ventilating are the best possible safeguards against air-sickness.

The photograph at the left shows the Condor in process of assembly. The pilot's cockpit is at the very nose of the fuselage with vision unimpeded by any nose engine. While it is somewhat harder to achieve flight with one engine out of commission, when only two engines are used, nevertheless the elimination of the nose engine is well worth considering from the point of view of vision and cabin vibration.

The side view shows what delicate lines the fuselage has in spite of its enormous

Courtesy *Flight*

Autogiro in which droop and interblade cables have been eliminated

size. It also indicates how carefully the engine nacelles are faired into the wing.

It is claimed for the Condor that with full load, it has a speed of 145 miles an hour and a ceiling on one engine of 3500 feet. In addition to the 18 passengers and the crew of two, it can carry 500 pounds of mail in the combined baggage and mail compartment, placed aft of the cabin.—*A. K.*

U. S. Veteran Pilots Outfly Others

AMERICA can more than match the veteran pilots of commercial air lines in Europe. A comparison made following publication of a European report that nine veteran pilots of Imperial Airways, Britain's premier air line, during the past 12 years, have attained an average flying time of 6655 hours, contrasts with an average of 8600 hours of ranking nine pilots of United Air Lines New York-San Francisco route. The greater flying experience of United Air Lines pilots is enhanced by their larger percentage of night flying, as approximately half of the mileage flown by the American group has been at night, whereas night flying in Europe until two years ago was practically unknown. Included in the United Air Lines personnel are two pilots who have each flown 1,000,000 miles.

Pros and Cons of the Autogiro

THE autogiro continues to add to its list of wonderful achievements. For example, it has recently been successfully used in connection with the aircraft carrier *Langley*. It has landed on top of a New York City pier, on the White House lawn, and in other restricted areas. Its demonstration in the hands of Jim Ray, skilled test pilot, in the matter of almost vertical descent, never fails to arouse the admiration of the public. Its exponents maintain that it is the ideal machine for private flying and will add greatly to the safety and popularity of aircraft. We have had frequent occasion to enumerate its virtues and possibilities. At the same time, it seems only fair to give another side of the picture which comes to us from a number of reliable sources.

These critics concede that the chances of personal injury in a well-maintained autogiro are less than in the conventional airplane. On the other hand, it is claimed that the chances of having an accident are as great and perhaps even greater judging from past experience, than in the ordinary plane. It is alleged that about 30 autogiros have been sold in the United States and that of these 15 have been completely "washed out" of service and that many of the others have had some accident or other. Landing gears have been "swiped off," vanes broken off, blades have deflected and struck the tail surfaces, and so on. Again, it is held that the low landing speed of the autogiro is a mixed blessing. By virtue of low landing speed, injury to personnel in a crash may not be so great but cross-wind landings are far more likely to result in damage to the autogiro. It would appear that autogiros have a strong tendency to nose over and to the left, and it does not take much tipping to damage the rotors.

The school of critics also points out that no invitation has been issued to the public to step into an autogiro for an hour or two of instruction and then fly it safely away, in analogy with automobiles and even motorboats. The truth seems to be that it requires as much skill to operate the autogiro successfully as it does to pilot a conventional airplane. For the autogiro, there are special rules to be observed such as starting the blades in rotation with the autogiro placed cross-wind and then subsequently taking off into the wind. The autogiro must not be nosed down too rapidly or the blades may cease rotating and droop. They must be safeguarded also against excessive upward coning. The servicing of the rotor system and starter requires great care and is something else for the operator to think of in addition to the difficulties of the conventional airplane. It is said that, to obtain the fullest benefit from the autogiro, more skill than is possessed by the average airplane pilot of today is actually required.

On the question of speed and payload, the autogiro certainly shows up poorly. If the best a two-seater autogiro with 300 horsepower can do, with two occupants and gas for a few hours, is something over 100 miles an hour while an airplane of equal power with similar gasoline capacity might attain 180 or even 200 miles an hour, certainly the comparison is not in favor of the autogiro; the plea is that, while the autogiro may give greater freedom from fatal accidents, speed is, after all, the justification of flying. As one of our correspondents concludes his argument, "the autogiro will undoubtedly find a place for itself in aviation but its operation will be confined to very skilful pilots unless other improvements are made."

In all fairness, however, we must point out that the autogiro is still in an evolutionary stage and that many improvements are being introduced both by the parent British company and by the Autogiro Corporation of America.

Our two photographs show two new machines recently built by the British company which embody many marked improvements and meet at least some of the criticisms of the autogiro opponents. The rotor system has now been considerably modified. Three blades are used instead of four, which makes for simplicity. The up and down bracing in the form of shock cords has been a frequent source of trouble (and of course a source of aerodynamic resistance). This shock cord bracing has now been entirely eliminated and the blades, of completely cantilever construction, are prevented from going too far up or too far down by definite stops on the rotor system.

In order to equalize the rotational movement of the blades and to prevent vibration, there have been in use hitherto other shock cords connecting each blade, one ahead of it or behind it. Now, as can be seen from the pictures, these inter-blade cords have also been eliminated. This has been done by making the horizontal hinges very long and perfectly capable of equalizing the speed of all the blades. On the two-seater it is possible to fold the blades back. This is a decided advantage for housing or taxying purposes. By careful design the vertical fin surfaces have been brought down much lower so that the danger of blades striking such vertical fins has been eliminated, and at the same time, the over-all height of the autogiro can be reduced. In the cabin plane illustrated in one of our photographs the entire supporting structure of the rotor has been streamlined into the cabin which, of course, adds greatly to efficiency.

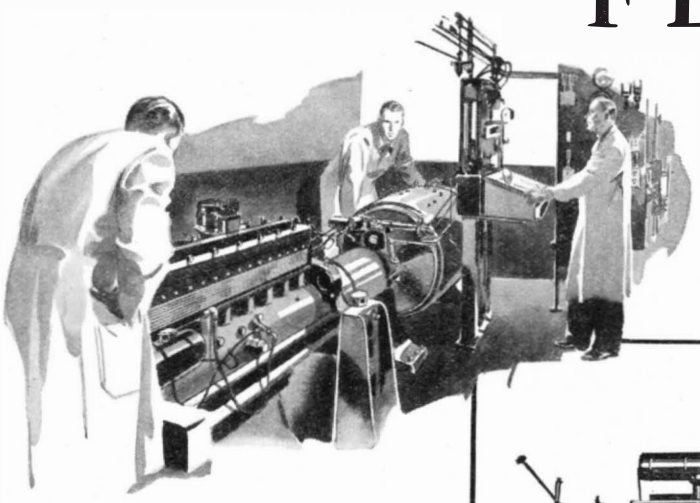
Another argument against the autogiro is its comparatively high gliding angle. It

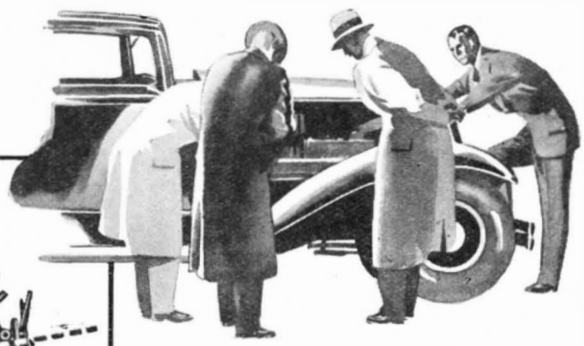
Copyright Photopress

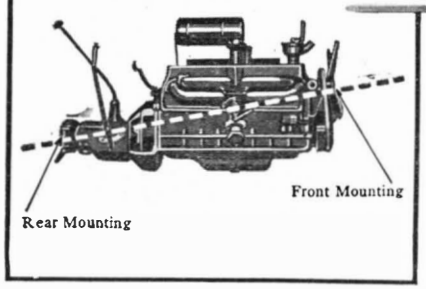
Cabin autogiro made by a British concern

What is this FLOATING POWER?

PATENTED AND FULLY PROTECTED



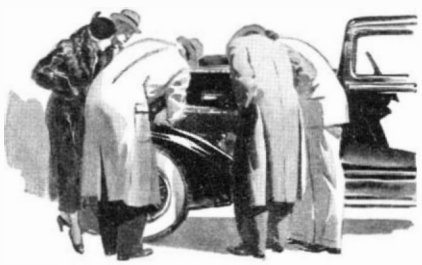




FLOATING POWER is the most talked-about new thing in the motor car world.

Everybody is interested—asking questions—asking what it is and what it does.

Floating Power is not just another name for a certain quality of power—it is engineering's final triumph in the long, hard fight against vibration.



Automotive engineers have grappled with vibration for years. Flywheels and crankshafts have been balanced almost to a hair. Pistons and connecting rods have been perfectly matched. Vibration dampeners have been employed. Every known means of securing mechanical precision has been used in efforts to reduce and minimize vibration. Years ago Chrysler Motors engineers developed rubber engine mountings. Those mountings did much to control and subdue vibration—and they are still being used by many manufacturers.

But Chrysler Motors engineers are never satisfied. They kept on working. They kept on endeavoring to wipe out vibration *entirely*. Finally, their efforts led to the discovery of Floating Power. Floating Power is an entirely new *kind* of engine suspension.

The power plant is supported at two points—front and rear—on mountings of bonded rubber and steel. These mountings are so located as to support the engine in perfect balance.

Power impulses from the engine never reach either the frame or the body—because the impulses are absorbed at their source by the slight movement of the engine in its Floating Power mountings.

The result is an entirely *new kind of performance.*

Floating Power creates a fascinating new "feeling" in motoring—a new smoothness impossible to describe, but noticeable the moment you take the wheel.

Floating Power is patented and used exclusively on the cars of Chrysler Motors—Plymouth, Dodge, De Soto and Chrysler.

Previously there had been nothing like Floating Power—in principle or in results. Drive one of these cars and learn for yourself the wonderful experience of driving at all speeds without feeling *any* vibration.

is perfectly true that the pilot of an autogiro needs to exercise less care in selecting a landing spot than the pilot of an airplane. A modern airplane has a much better gliding angle than the autogiro, and if an airplane pilot is at a good height above the ground when his engine fails him he has a very large radius of flight before touching the ground and this enables him to seek a landing place in suitable territory. It is doubtful whether the gliding range of the autogiro will be much more than 60 percent of that of a good plane. On the other hand, the autogiro is capable of making a steeper descent at a moderate sinking speed.

We believe that both the proponents and the opponents of the autogiro have much truth in their remarks but that the question is not definitely settled as yet, and that further progress in this new type of aircraft is to be confidently expected.—*A. K.*

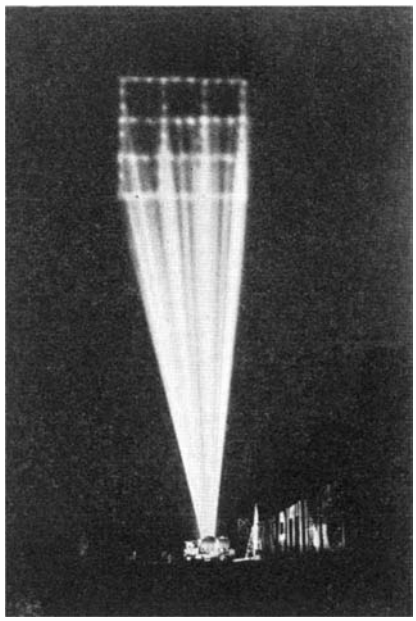
Shock Absorbers in the Airship

IN a rigid airship such as the U. S. S. *Akron*, the entire ship is divided into a number of compartments housing huge gas cells. These compartments are formed by systems of diagonal net diaphragms strung in a spiral to the center. There is always some surging and shifting of the bags under pressure while the airship is in flight and this surging of the gas cells is naturally a source of some difficulty and danger, considering that each of the gas bags contains between 200,000 and 900,000 cubic feet of gas.

The Cleveland Pneumatic Tool Company has perfected a device incorporated in the *Akron* which makes the wire netting resilient and thus removes the dangers of surging. This device consists of a cylinder and

piston operating with helium sealed in a special compound to prevent its escape. The pull of the diaphragm mesh is balanced at all times by a telescoping and shock-absorbing movement of the piston in the pressure cylinder. These shock-absorber struts have been tested in every possible way and have given complete satisfaction. There are 120 of these struts in the *Akron*, 12 being attached to each of the 10 main frames.

Incidentally, the Matériel Division at Dayton, Ohio, has developed a device also directed toward meeting the defects of air pressure variation, but for use in non-rigid airships. In a non-rigid airship there is one main gas compartment and one or more air balloonets. In rough air, the gas pressure is subject to more or less rapid fluctuations, and letting in or out the proper amount of air in the balloonet to maintain the proper shape of the hull has been up to the present, a manual operation. Now an automatic air pressure device has been introduced. When the pressure in the gas cell goes down, a valve leading to the balloonet opens, the balloonet takes in air, fills up and maintains the outer form of the ship.—*A. K.*



The beam of the new aircraft searchlight, showing grid pattern

A Novel Aircraft Searchlight

A NEW searchlight, invented by Major J. C. Savage, and recently described in the London *Times*, can throw patterns so that a raiding airplane will be plotted in the air much as artillery targets are plotted on map squares. It has been tested by the British War Office and is likely, sooner or later, to take the place of the old type of searchlight in the defenses of London. It is perhaps the most powerful searchlight in the world and the method of projection secures intensity of illumination at a great range. Its main advantage, however, is that it allows the speed, height, and direction of the airplane to be calculated within a minute from the time it is found by the beacon.

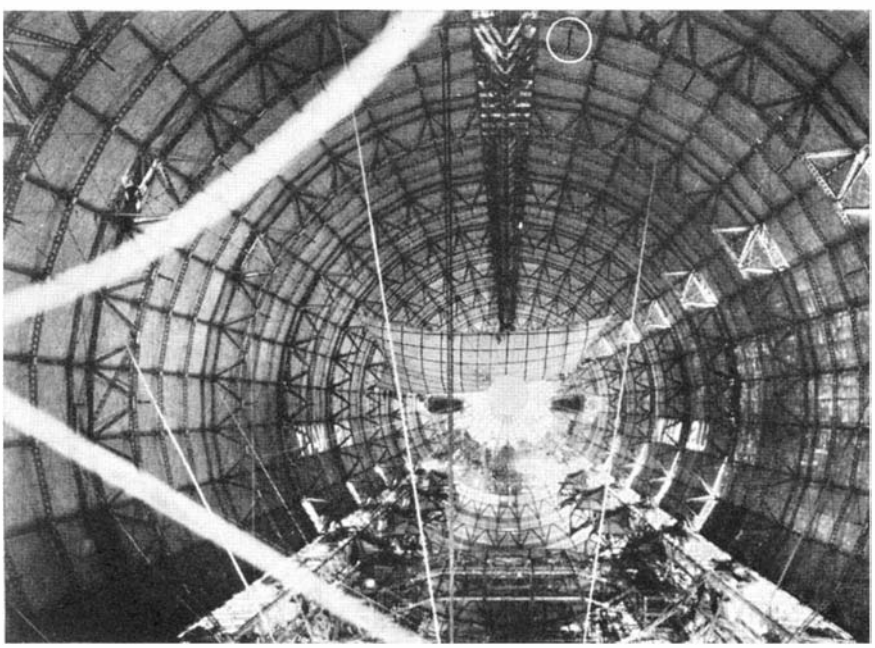
The pattern used in a test of this searchlight was a square divided by cross lines into 9 smaller squares. This grid had the double effect of making the airplane strikingly visible as it passes from the blackness into the light of the lines and of making it possible to obtain all the necessary particulars for anti-aircraft fire as soon as the plane has crossed any two of the lines. The airplane is moreover unable to take a fresh course in order to avoid the light as it might with a plain beam, for the pilot can see no beam until he enters it and then does not know which way to turn in order to get out of the grid.

The secret of this invention lies in the fact that the beam, whatever its pattern, consists of 300 beams of parallel form, each deflected by a mirror along the particular path which its share in the general pattern demands. The generation of the light and its transmission are two separate processes. In the course of transmission, the form of the beam is determined and the component parts of the beam are such that even if the familiar cone-shaped beam is desired it will not suffer from the usual diminution of intensity because it really consists of a number of parallel or non-diffusive rays.

The light available is 3,000,000,000 candle-power and the loss of power in transmission is very slight. It amounts only to about 5 percent because of reflection and 2½ percent because of the tiny dividing lines between the 300 mirrors. The apparatus is mounted on a gasoline-electric truck which generates the current and serves as a transport medium. The light itself is set in a big drum which has two compartments, one for generating the light, the other for breaking it up into 300 rays and transmitting them. The whole drum can be transversed also by electricity over a complete circle and the transmitting section of it can be elevated and depressed by electricity. Both processes may take place at the same time and at any desired rate.

For airplane spotting, the sky-grid has a variety of advantages. Worked in con-

Left: **One of the shock-absorber units used on the *Akron* to take up surging of netting between gas cells. *Below:* Position of the shock-absorbers, one shown in white circle**



junction with sound locators it should be possible to turn the beam on a raider immediately and without any sweeping. The sound locator fixes the position of the machine to within 5 degrees. The diagonal of the grid covers an angle of 28 degrees. With this wide tolerance it was found possible to place the grid at once astride the airplane. The light may also be used to light airdromes for night landings and has obvious and great possibilities for battleships defending themselves against an air fleet.—*A. K.*

Air Passengers Increase

THE total number of passengers carried on American-operated air lines during the first 10 months of 1931 was greater than the number carried during the entire year of 1930. The total for 1930 was 417,505. By the end of October, 1931, reports to the Aeronautics Branch showed that 428,465 passengers had been carried, and this did not include traffic on American-operated foreign lines since July 1, as these figures have not yet become available.

The number of passengers carried by scheduled air lines operating in continental United States in October, according to reports from 35 out of 40 companies, was 47,665. Miles flown by the scheduled air lines reporting for the month were 4,183,793; express carried was 66,672 pounds and passenger-miles flown were 10,587,389.—*A. K.*

Non-inflammable Gasoline Sought for Aircraft

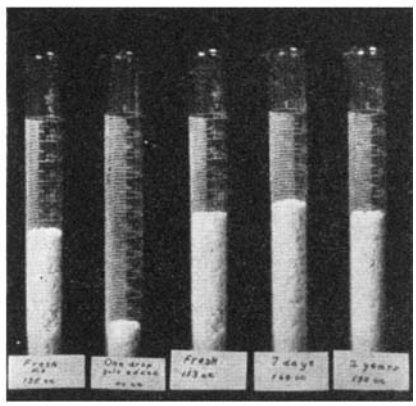
INVESTIGATIONS looking toward the development of a fuel which would minimize the fire hazard in aircraft operation are being conducted by the Standard Oil Company of New Jersey. It is reported that the new fuel, as developed at present, has been tested in the laboratories of the National Advisory Committee for Aeronautics at Langley Field, Virginia. The tests are said to have been very favorable, not only in demonstrating the safety value of the product but also in proving that it develops greater power than does the ordinary aviation gasoline. This new product is the latest development of the hydrogenation process by which chemists are converting coal into oil and oil into gasoline.

New Source of Sugar Supply

IT has been discovered by recent experiments that the Jerusalem artichoke is a source of a sweeter sugar than is yielded by either sugar beet or cane. It is considered likely that farmers in Ireland will take up the growing of these artichokes after further experiments have been carried out, as they will grow in almost any soil, while the leaves make good feed for horses.—*A. E. B.*

How to Beat Eggs

A BIT of chemistry that should interest the ladies is reported by J. L. St. John and I. H. Flor of the Agricultural Experiment Station at Pullman, Washington. They have found out how to make the most out of the whites of eggs and their investigations have exploded several popular fallacies. For example, chilled eggs do not beat up as well as warm eggs; storage eggs beat up just as well as fresh; and watery whites give a larger volume, when beaten, than thick whites. The accompanying photographs tell the story better than words.—*A. E. B.*



Graduates at left show effect of egg yolk added to white before beating. Left was white; next had one drop of yolk added. Next three: Storage does not affect beating quality. Same volumes obtained from fresh, seven-day, and two-year eggs out of storage

Still More Hard Luck for the Ether

IN our number for October, 1931, an article was entitled "More Hard Luck for the Ether." It told how another experiment to detect the ether had failed to find evidence that such a medium actually exists. This provoked numerous rejoinders from readers who apparently regarded it as a scientific heresy. However, the old ether concept is now practically down and out. Science has whittled it away to nothing. The word ether is still employed, but it does not mean what it used to mean. It is only a convenient expression.

The following is a comment on the ether, written by one of the world's leading physicists, Dr. W. F. G. Swann, Director of the Bartol Research Foundation of the Franklin Institute, and published by the Engineering Foundation. Dr. Swann entitles it "What Has Become of the Ether?"

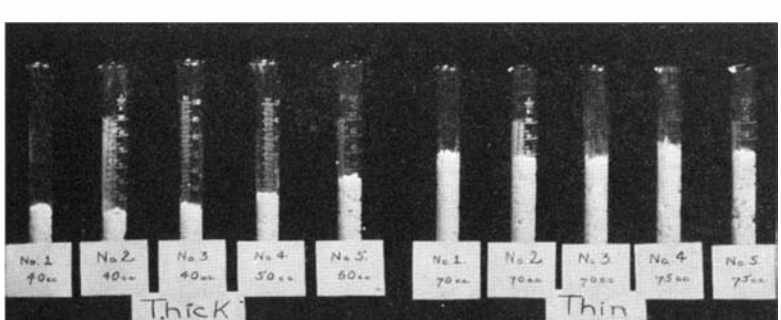
"The scientific thought of the latter half of the last century was concerned greatly with the properties of a hypothetical medium, the ether, whose function it was to transmit light and heat through space, and which later had added to it the duty of carrying wireless waves—a medium in whose subtle properties it was hoped some day to find the secret of gravitation and of every other unsolved phenomenon in the universe.

"One would have liked to think of the ether as like water; but that would not do, because the kind of waves which water would transmit were quite different from those required for light. A solid would have been better for the purposes of light, but how would it be possible for the earth and all the other planets to glide so smoothly through a solid? How could a medium act like the most limpid of fluids and the most rigid of solids?

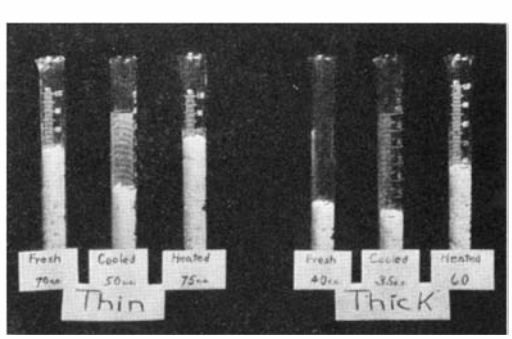
"Now, it was perfectly possible to express mathematically the laws according to which light and allied phenomena behaved in all the experiments in which they played a part; but the equations looked cold and lifeless. It was indeed possible to define the properties of a medium which in the form of waves would transmit effects which were the counterpart of the observed effects; but the properties necessary to attribute to the medium were such that there was nothing else anything like it.

"When the layman contemplates such an abstract concept as the ether, he usually adds to the properties relevant for the performance of its functions certain irrelevant ones, possibly color or freezing point. Even though he would be horrified to admit that he was thinking specifically of such things, they occupy a sort of hazy status in his mind, and these irrelevant parts frequently constitute what he calls 'reality.'

"One irrelevant concept which the materialistic physicist wished to think of in relation to the ether was its state of motion. He wanted to be able to speak of the velocity of the earth in relation to it, or of its velocity in relation to the earth. He wanted to picture the drag which it would exert on the earth as it passed through it, and so on. The irritating thing about this cantankerous ether was that, while it behaved with per-



Contrary to popular belief, eggs with thin, watery whites beat up better than those with thicker, firmer whites. The five graduates at the left contain beaten white from a thick source, while those at the right contain beaten white from a thin source. Note greater volume of the latter



Another popular belief shattered: Cooled eggs do not yield a greater volume when beaten, than warm eggs: Comparison is also made here between thick and thin whites

fect consistency in its legitimate job, it gave all sorts of inconsistencies for things which were not part of its job.

"Persons said, 'Ah! If it has a velocity relative to the earth, then such and such an experiment should give such and such an effect.' The experiment was tried, and no effect was observed. 'Very well, then, it has no velocity with regard to the earth; it is dragged along.' Then somebody else said, 'If it is stationary with regard to the earth, if it is dragged along, then such and such another experiment should work in a certain way.' It did not work in that way.

"So long as we confined ourselves to the properties of the 'medium' as specified by the equations, all was well; but whenever we added anything else, the supposed 'ether' refused to co-operate. When we had removed from it all irrelevant appendages to which nature seemed to object, there was nothing left constituting any sort of picture of 'a medium.' One who tried to picture the phenomena covered as those of a medium in the sense in which he started off to think of a medium, would be in the position of a philosopher who wished to attribute certain causes to a being whom he originally thought of as a man, but whom further investigation indicated as having no arms, legs, nose, or mouth; a being who had to be not cylindrical but spherical; not solid, but gaseous, and so on. It is difficult to believe that one philosopher would derive much real help from continuing to think of such a being as possessed of human qualities.

"The mathematician found little to talk about in the ether other than its properties as expressed by the equations. He came to dislike the very use of the word 'ether,' since he knew that anyone who talked about the ether other than in terms of its purely mathematical properties was really in his subconscious mind thinking of something like water or some other substance familiar in every-day life. Such thoughts would naturally breed all sorts of questions which had no business in the discussion—what the boiling point and the freezing point of the ether might be; whether there might not be 'icebergs' of ether floating about in the extreme cold of interstellar space. Lord Salisbury once defined the ether as a word designed to provide a nominative case for the verb 'to undulate.' I have recently given another definition: The ether is a medium invented by man for the purpose of propagating his misconceptions from one place to another. Of all subtle fluids invented for the stimulation of the imagination, it is the only one which, so far, has not been prohibited."

Warning Against New Baldness "Cures"

WARNING that a new crop of baldness "cures," though not necessarily any new crops of hair, may be expected shortly, is seen in the note recently received by the American Medical Association from the proponent of the latest method of growing hair on bald heads, Dr. Bengt Norman Bengtson of the University of Illinois School of Medicine.

Dr. Bengtson recently reported to the American Medical Association striking results in treating certain types of baldness with a pituitary gland preparation. Now it appears the baldness "cure" manufacturers are ready to cash in on the new method

(*Please turn to page* 179)

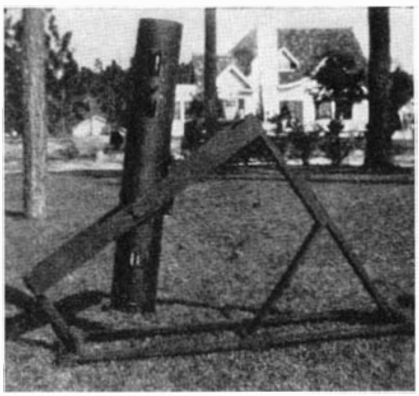
THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

YOUNGSTERS do not make out well as amateur constructors of telescopes, but in a very few cases lads between 12 and 14 have made good, generally because their minds were older than their years. One of these is Reed Knox, Jr. of University Terrace, Deland, Florida. Knox, whose age is 14, writes:

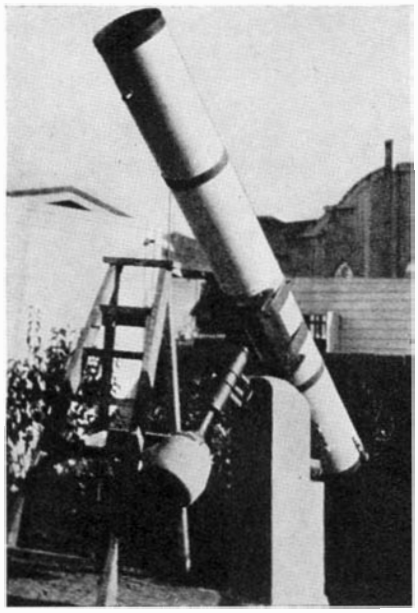
"It has been two years since the last time I wrote you about my telescope, and another mirror broke on the concrete. It has taken longer for me to make a six-inch than it took Mr. Fecker to make a 60-inch, but I finally have it done, as the photograph shows. The mounting is steady and very handy. I use a ½-inch eyepiece now with a power of 86 times. I hope to start on another telescope soon for a friend of mine. I have been to Pittsburgh several times in the last two years, where I spent most of my time in Mr. Fecker's place and at the Allegheny Observatory. Mr. Fecker let me polish some on my mirror last spring in his shops, and showed me a new kind of pitch lap on which you can regulate the evenness of the polishing by drilling holes in the lap."

HERE is another letter from a 14-year-old worker, Waino Mellin, of 2136 Byron Street, Berkeley, California: "The mirror is ten and one half inches in diameter and has a focal length of 111 inches. The pier is concrete set two feet in the ground. I used Model T Ford axles and housing, as the photograph shows. I made a flat for the diagonal, an eyepiece of moderate power, and bought one of low power. The definition of the mirror is excellent. I have separated *Lambda cygni*, whose components are six tenths of a second apart.



Knox

"I began telescope making about two years ago when I was 12 years of age, so naturally my progress was very slow. After two failures and one year of hard work I crudely mounted a three-inch. The results started me on a six-inch right away and it was mounted four months later. It had a figure so bad it could not be expressed in words, nevertheless it gave surprising results and I spent many pleasant hours of observing. Then I tackled an 11-inch. The mirror required about 40 hours of work. I struggled ten hours with turned-down edge but could only parabolize ten and one half inches of the diameter. My two worst troubles were silvering and making pitch laps. But finally I succeeded in obtaining thick, brilliant and tough coats of silver and made good pitch laps.

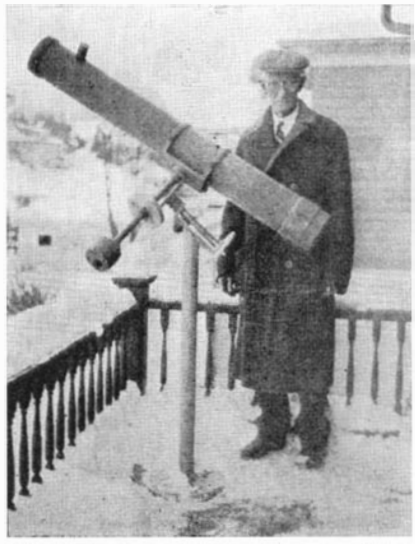


Mellin

"I am now working on a ten-inch and two seven-inch mirrors. I think telescope making is the most pleasing and interesting of any hobby, and best of all is observing the structure of the universe."

SO much for the two juniors. Now for a senior.

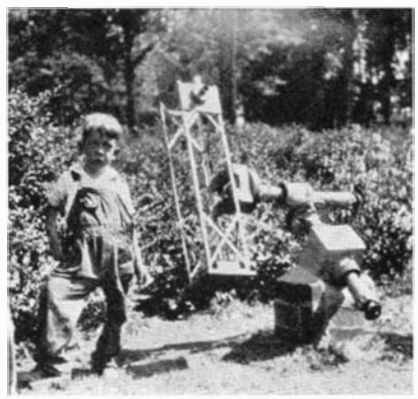
"In one of your earlier numbers you figure at what age a boy should be capable of making a telescope. Now it struck me," says Luther I. Waite, 46 Bennett Avenue, Binghamton, New York, "that there might be an age limit at the other end of the picture. A little over a year ago I bought a copy of 'Amateur Telescope Making' and last winter, after I was 76 years old, I made a telescope. I bought a ten dollar beginner's outfit from Mr. Pierce of Springfield, Vermont. In trying to mount the handle on the disk, I cracked the glass. I sent for another and when the second one was about ready to polish I dropped it and broke a big chunk out of the back and supposed of course that it was spoiled. So I sent for the third glass. I finished and mounted this glass and with a one-inch eyepiece that will magnify about 48 times I get good results.



Waite

"In Sir James Jeans book 'The Universe Around Us' it says a telescope with an eyepiece which magnifies 60 times will make Jupiter look as large as the moon. The moon looks to me to be 8 to 10 inches in diameter and Jupiter looks only about 1¼ inches. I do not understand what is the matter."

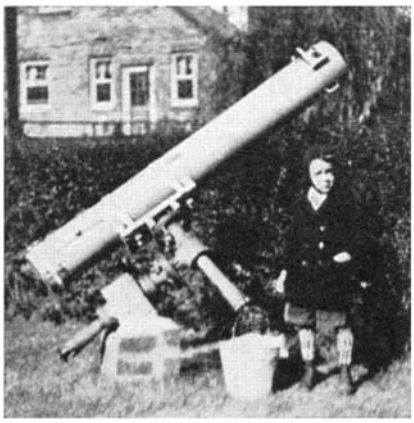
Well, well! It ought to look "as big as a dinner plate." What's wrong? Jupiter may be farther from Binghamton than the rest of the world.



MacQueen 1

PERHAPS the youngest amateur telescope maker of all is the one shown in the photographs captioned "MacQueen." However, this youngster appears to have had an assistant, Dr. J. W. MacQueen, Martin Building, Birmingham, Alabama. The senior partner of this firm of MacQueen and MacQueen, amateur telescope makers, is the secretary and he writes: "I've always had some side line, along with more serious duties, for interest and relaxation, but telescope making beats chess and bookbinding by a long shot. And to couple it with the fun of amateur astronomy makes its interest two-fold.

"The picture enclosed is my first mirror, six inches in diameter with focal length of 40 inches. It only took about 35 hours grinding over a period of two months and I must confess I was a little weary by that



MacQueen 2

time. I polished, using HCF and rouge, with the HCF on top of a layer of pitch. This worked fine and polished rapidly." [We like this better than HCF on plaster of Paris. Just cold press it in and go to work.—*Ed.*]

"The tube is an innovation, I believe. The Chief Engineer standing by the mounting in the picture was playing with an old Meccano set and I wondered if the small girders and beams would be strong enough to hold the weight of the mirror. He and I made the unorthodox square rig shown in the picture which has proved highly satisfactory. Nothing better can be found than the small strips of steel with frequent holes and brass bolts that come with these outfits to make the holder for the diagonal mirror, whether one wants to make the whole tube from them or not."

Some time later we again hear from the secretary of the MacQueen-MacQueen concern, who writes:

"I'm in again. Here's a picture of my second telescope, an 8¾ inch. I still don't believe the experts can grind, polish, and figure one in six hours. But anyway that's probably your story and you'll stick to it." [Ha ha! It was Ellison's. *He* can do it, but for ordinary mortals 10 or 20 or 30 or 40 or . . . is more like it.—*Ed.*] "The whole job has cost less than 40 dollars."

THE telescope photograph captioned "Francke" was sent in without description, by Louis Francke, 1301 West Tenth Street, North Little Rock, Arkansas.

Francke

CURRENT BULLETIN BRIEFS

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

WHEN WE SPEAK OF A TENTH, by Christopher Morley, is a delightful little brochure describing how the tiny wheels of watches travel the mysterious highway of time. It is cleverly illustrated. *Hamilton Watch Company, Lancaster, Pa.—Gratis.*

THE CARE OF YOUR WATCH is a tiny vest pocket booklet giving good advice valuable to all owners of watches. *Hamilton Watch Company, Lancaster, Pa.—Gratis.*

CODE OF LIGHTING: FACTORIES, MILLS AND OTHER WORK PLACES (Bureau of Labor Statistics No. 556 Safety Code Series) is the revision of 1930. The sponsor is the Illuminating Engineering Society, New York. *Superintendent of Documents, Washington, D. C.—15 cents (coin).*

ROENTGENOLIC STUDIES OF EGYPTIAN AND PERUVIAN MUMMIES (Anthropology Memoirs, Vol. III. Field Museum of Natural History), by Roy L. Moodie, Ph. D., is a large volume consisting mainly of X-ray plates of mummies showing conditions caused by diseases in ancient times. *Field Museum of Natural History, Chicago, Illinois—$5.00.*

A SURVEY OF STORAGE CONDITIONS IN LIBRARIES RELATIVE TO THE PRESERVATION OF RECORDS (Miscellaneous Publication, Bureau of Standards No. 128), by Arthur E. Kimberly and J. F. G. Hicks, Jr., deals with the conditions of storage which may be responsible for the deterioration of records and other material stored in libraries. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

HOW TO OWN YOUR OWN HOME—A HANDBOOK FOR PROSPECTIVE HOME OWNERS, (Building and Housing Publication BH17, Bureau of Standards), by John M. Gries and James S. Taylor, with a foreword by Herbert Hoover, sets down the broad outline of the problem as it confronts the home seeker, and describes the steps and precautions which should be taken in buying a home. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

ELECTRICAL EQUIPMENT ON MOVABLE BRIDGES (Technical Bulletin No. 265, U. S. Dept. of Agriculture), by Condé B. McCullough, Albin L. Gemeny, and W. R. Wickerham, deals with the modern electrified movable bridge. It is a condensed statement of fundamental principles written for the bridge engineer and is, for the most part, based on personal experience. It is splendidly illustrated and has two folding plates. *Superintendent of Documents, Washington, D. C.—35 cents (money order).*

COTTON FABRIC TENTS, TARPAULINS AND COVERS (Commercial Standards CS28-32, Bureau of Standards) gives the recorded standards of the industry. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

LATITUDE RE-DETERMINATIONS (Special Publication No. 173 Coast and Geodetic Survey, U. S. Department of Commerce) by Frederic W. Darling, describes the redetermination of the value of latitude at three old latitude stations. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

PROJECTS IN SCIENCE AND NATURE STUDY shown at the American Institute Children's Fair is an attractive booklet, fully illustrated, showing the work of children. *American Institute, 60 East 42nd Street, New York City.—Gratis.*

THE UNITED STATES HALF DIMES (Numismatic Notes and Monographs No. 48) by D. W. Valentine, is a monograph on a U. S. coin interesting to collectors. The collotype plates show the coins enlarged to twice normal size. *The American Numismatic Society, Broadway at 156th Street, New York City.—$5.00.*

THE EVOLUTION OF THE ELEPHANTS AND MASTODONS (Special Guide No. 2 Peabody Museum of Natural History) by Dr. Richard Swann Lull, is an excellent museum handbook to be used in connection with the remarkable collection. *Peabody Museum, New Haven, Conn.—15 cents.*

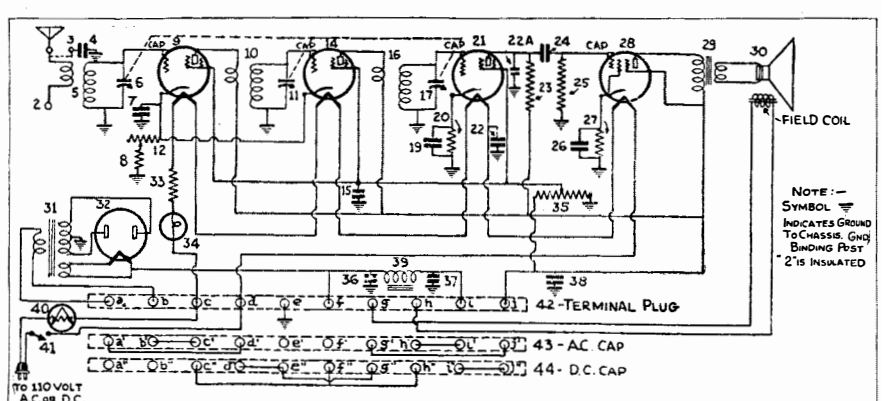
TONCAN IRON PIPE FOR PERMANENCE describes a ferrous pipe which presents extreme resistance to rust and corrosion. The data is complete. *Republic Steel Corporation, Youngstown, Ohio.—Gratis.*

HOUSE INSULATION, ITS ECONOMICS AND APPLICATION is the 19th report of the National Committee on wood utilization. The pamphlet is not limited to wood-fiber products alone as materials other than wood can be used. It is fully illustrated. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

TABLES AND CHARTS OF SPECIFIC GRAVITY AND HARDNESS FOR USE IN THE DETERMINATION OF MINERALS (Engineering and Science Series No. 34), by Joseph L. Rosenholtz and Dudley T. Smith, is an invaluable contribution to the literature of minerology. *Rensselaer Polytechnic Institute, Troy, N. Y.—Gratis.*

HUMIDIFICATION OF RESIDENCES (Bulletin No. 230), by Alonzo P. Kratz, consolidates useful information from various sources, as well as the results of laboratory experiments. *Engineering Experiment Station, University of Illinois, Urbana, Illinois. —Gratis.*

SMOKE AND ITS PREVENTION (Engineering Series No. 24), by H. M. Faust, is a valuable pamphlet giving a general survey of the problem. It is estimated that the cost of the smoke nuisance in Chicago is 65 dollars per year for each person. *Ohio State University, Columbus, Ohio—Gratis.*



A.C.—D.C. PORTABLE RADIO RECEIVER. This compact little portable for the radio constructor works on either A.C. or D.C. It is a splendid "companion" for the traveler; ideal for camps and bungalows, for emergency use, or as an extra set in the home. The new Arcturus 136-A tubes are used in the radio-frequency and detector stages, while the highly efficient 138-A pentode is used as a power tube. Because of ingenious design, it is unnecessary to change the tubes or wiring, when changing from an A.C. to a D.C. source or vice versa. All changes necessary are made merely by slipping off a plug at the rear of the receiver and replacing it with a second plug, marked for the kind of current to be used. The set operates a dynamic speaker with plenty of volume and good quality. Diagrams and additional information on this receiver may be obtained from *Allied Engineering Institute, Suite 541, 98 Park Place, New York, N. Y.—5 cents.*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 175)

without waiting for further scientific confirmation of its value. The situation is not without danger, since pituitary gland extracts are extremely potent substances that cannot be safely used without medical advice.

Since his preliminary report, Dr. Bengtson has been besieged with thousands of letters. Commenting on these, he said: "The experiments, while gratifying in certain types of baldness, do not indicate that a complete solution to this age-old problem has been realized.

"Several non-medical organizations presumably interested only from a commercial point of view have already attempted to obtain material for promulgation to the public, and several charlatans have stated that they were personally associated with me and therefore absolutely competent to administer the method.

"I have had no associates and no one is authorized to speak for the experimental clinic which is being conducted by the research department of the University of Illinois School of Medicine.

"While interesting, the results have not yet been such as to warrant extreme optimism. Only after extensive and exhaustive research will it be possible to say to what extent the method is specific."—*Science Service.*

Tooth Decay Prevented

FOR the first time in history, dental caries, or tooth decay, has actually been prevented. This means that the end of toothaches and of decayed and infected teeth, with their attendant ills, is now in sight. The method found effective to prevent tooth decay in animals need only be applied to human beings.

This achievement, the result of 10 years of work with hundreds of animals and representing an immeasurable boon to mankind, has been accomplished by Dr. E. V. McCollum, professor of biochemistry at the Johns Hopkins School of Hygiene and Public Health, and his associates, Dr. Henry Klein and Dr. H. G. Kruse.

"The quality of the saliva is the important thing in determining whether teeth will decay and this is determined by the chemical composition of the blood," said Dr. McCollum. The saliva, he has found, acts normally as a buffer solution so that acid cannot accumulate and break down the enamel of the teeth. When this enamel is damaged, germs that are always present in the mouth get a chance at the teeth and decay follows. The saliva, however, cannot act as a buffer solution, keeping the mouth at just the right state between acid and alkaline, unless it contains a certain proportion of phosphorus. There must be, in addition to a proper buffer quality for neutralizing acid formed by the fermentation of food residues, a proper calcium and phosphate ion concentration in the saliva in contact with the enamel to prevent disintegration of the surface molecules of that substance.

Phosphorus gets into the saliva from the blood. Blood gets its phosphorus from the foods eaten, specifically from such foods as

milk, eggs, lean beef, beans, and peas, which are rich in phosphorus.

Phosphorus is not quite all that is needed, however. Dr. McCollum and his associates found that no matter how much phosphorus is eaten in food, not enough of it will get into the blood and then into the saliva unless a certain amount of both calcium and vitamin D are also taken into the body.

It is not possible to say, "Eat so many pounds of this or that food every day," Dr. McCollum pointed out. But plenty of the foods that contain these three substances and plenty of sunshine to insure an abundance of vitamin D will keep the phosphorus in the saliva up to the right level and thus prevent tooth decay or dental caries.

People with a "sweet tooth" will be delighted to know that they can eat sugars and starches in abundance, according to the Baltimore investigators, and still prevent their teeth from decaying, if they keep the calcium-phosphorus level of their blood right and get plenty of vitamin D from sunshine or cod-liver oil or any of the foods that now contain it. Eating excessive amounts of starch, candy and sugar, tends to crowd out of the diet foods which are better constituted for the prevention of tooth decay and makes necessary greater caution to have the remainder of the diet of just the right composition.

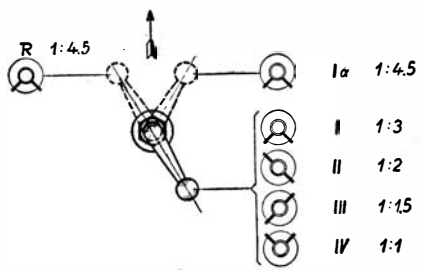
Calcium-rich foods are milk; eggs; watery vegetables, especially spinach, lettuce, and cabbage; and, to a lesser extent, fruits. Vitamin D is the sunshine vitamin, occurring wherever the ultra-violet rays from the sun or from artificial light strike the fat, ergosterol. Vitamin D occurs naturally in fish oils, egg yolk, butter fat, and whole milk. It has been put into certain other foods artificially, since science has shown that this may be done by exposing foods containing ergosterol to ultra-violet light.—*Science Service.*

An Airship Engine in An Automobile

A MOTOR CAR powered with the same engine, in smaller size, that drives the *Los Angeles*, the *Akron*, and the *Graf Zeppelin* and that drove the ill-fated *Shenandoah*, recently made its appearance in America. This is the Maybach "Zeppelin," the United States representative of which is A. J. Miranda Jr., Inc., of New York. It is built by the Maybach works in Friedrichshafen, Germany, where both the *Los Angeles* and the *Graf Zeppelin* were built.

The new car's engine has 12 cylinders in two banks arranged in a V of 60 degrees. Actual brake horsepower is 200 at 3200 revolutions per minute, and the road speed of the car is 105 miles an hour at 3600 revolutions per minute engine speed. Bore and stroke are $3\frac{5}{8}$ inches by $3\frac{15}{16}$ inches, the cylinder being, therefore, almost "square."

Besides being unique in having an engine that has proved highly satisfactory as a power plant for airships, the car has other noteworthy features. The most important of these is, perhaps, the new Maybach transmission with its four speeds conveniently



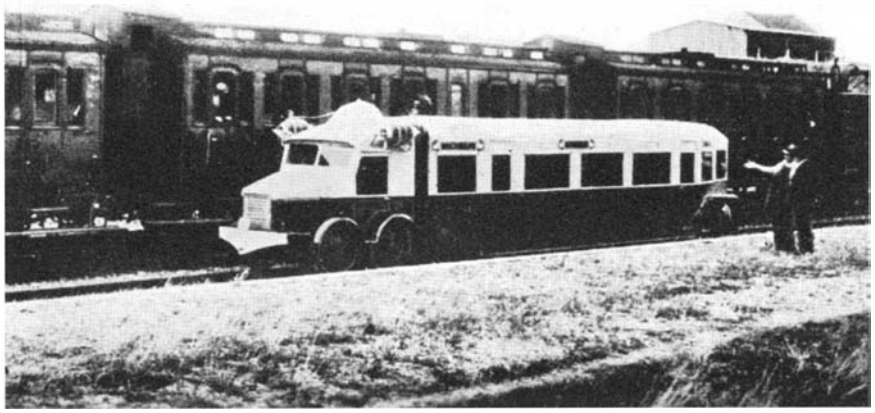
Positions of the transmission control on the new car described, together with gear ratios obtained

selected at the steering wheel without the use of the clutch pedal, giving the advantages of electrical gear-shift control without its drawbacks.

For many years, attempts have been made to develop so-called automatic speed selecting gears designed to adapt transmission automatically to any gradient and running speed. Of these automatic gears there are two main types. One of them seeks to obtain adaptation to grades and speeds by the stepless variation of the reduction ratio, an aim which has, however, been frustrated by the great complexity and resultant unreliability of the mechanism. The other type employs the usual four or more speeds, and aims to bring about their selection with little thought on the part of the driver.

The guiding thought in the new Maybach transmission is to do away with any kind of shifting effort, and to simplify control to the point where going from one speed into another is reduced to a simple though distinctly conscious utterance of the driver's will. This solution is based upon the principle of the well-known Maybach overspeed gear. This principle has now been extended to provide, not two speeds as hitherto, but four speeds, any of which may be selected

The Maybach "Zeppelin" car which recently made its appearance in this country



The French rail bus that runs on pneumatic tires

at the steering wheel by a light pressure of the finger.

To shift, the driver merely moves a small lever on the steering wheel to the desired position, raises his foot from the throttle lever for a moment, and immediately gives gas again. During this brief instant, the gears have been automatically shifted without the clutch having been operated by the driver. Apart from its convenience and simplicity, a particularly valuable point about this method of speed selection is that it enables the driver to keep both hands on the steering wheel. In shifting speeds in critical situations, whether in the crowded traffic of large cities, on mountain roads, or elsewhere, this is a most important advantage. Furthermore, the shift is entirely noiseless.

The shifting is accomplished with the help of the engine vacuum, a method proved thoroughly successful in practice with the

A close-up of one of the wheels of the rail car, showing the flange, pneumatic rubber tire, and rail

Maybach overspeed gear. That this method of control is highly dependable, is indicated by the fact that in many vehicles the vital braking function is controlled in the same way. Until recently, however, all attempts to employ such a vacuum control for operating the gear shift have always failed because it was impossible to engage the gears by purely mechanical means and without "feel." This difficulty has now been overcome by the introduction of the Maybach "overrun" clutch, which renders it possible to change from one gear to another entirely without feel, at any speed, and no matter at what different velocities the gears may be running.

The position of the gear shift levers (on the steering wheel) and the gear ratios at different speeds are shown in one of the illustrations reproduced herewith. The four silent gears form a particularly favorable combination of ratios without unduly large steps. The indispensable reverse speed incidentally provides a fifth reduced forward speed, brought into play by means of the reverse speed hand lever. Altogether, five forward speeds are therefore at the disposal of the driver.

A New Rail Car With Pneumatic Tires

A PNEUMATIC tired, self-powered, stainless-steel railway car is nearing completion in the Philadelphia plant of the Edward G. Budd Manufacturing Company, it was revealed recently when that company announced the signing of a contract with Michelin et Cie, of France, giving it the right to develop and sell in this country the Michelin car which recently aroused world-wide interest after successful test runs abroad. The French product will take on various refinements and improvements as a result of developments in the use of light gage stainless steel.

"This new type railway car, which can be powered by Diesel-electric, gasoline-electric, or gasoline-mechanical drive, represents an engineering conquest of superfluous weight," officials of the Budd Company pointed out. "The average Pullman parlor car weighs 5000 pounds per passenger, whereas the new car weighs only 325 pounds per passenger. Moreover, this new development solves for the first time the problem of running a pneumatic-tired car on rails."

The new car is the last word in comfort —it seats 40 people—and is noiseless. The rubber tires make it possible for the car to travel at a speed of 60 miles an hour and more without danger of derailment, in spite of its light weight. In addition, the new tire is so constructed that it cannot flatten out even when punctured. This

equipment makes possible the reduction in the horsepower needed, less time consumed in starting and stopping, higher speeds with more safety, and a tremendous reduction in the dead load which has been such a factor in the high cost of present-day transportation.

The short branch lines are largely responsible for our railway deficits. The new auto-rail bus, operating at little expense, is capable of assisting to a great extent the revival of the railways and increasing their receipts. Obviously the development of such a vehicle holds much promise for the railroads. This rail car has been developed in collaboration with competent railway authorities and some of the country's leading rail officials are greatly interested in its development and perfection.

The Pennsylvania and Reading roads have offered the Budd Company several miles of tracks on which to conduct test runs.

Listen and Learn

IN the early days of radio, predictions were freely and optimistically made that this new service would render invaluable aid to the cause of education because of the large numbers of people it would reach. Since those days and until the National Advisory Council on Radio in Education began its series of Saturday night programs, attempts to achieve fulfilment of this prediction have been sporadic and half-hearted. Having recently completed its first series of 10 broadcasts of educational subjects of an intensely interesting nature, the Council began a second series on January 2 and will continue them up to and including May 21.

The new series is being broadcast over a nation-wide network of 52 radio stations. Each Saturday night until the series is finished, there will be presented at 8:30 P.M., eastern standard time, a 15-minute talk on present-day economics, followed at 8:45 P.M. by a talk on psychology of today. It is obviously impossible for us to give here a complete list of subjects yet to be broadcast; suffice it to say that each has been prepared by an authority and that most of them have the particular quality that will make them appeal especially to our readers.

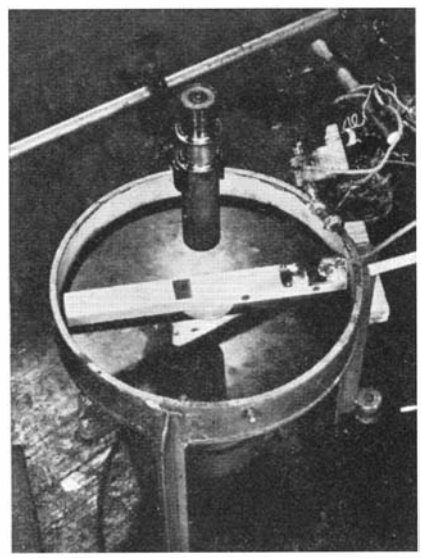
Arsenic as Wood Preservative

ACCORDING to recent experiments arsenic can be used advantageously in wood preservation processes. Arsenic, in the form of arsenates, combined with chromates or bichromates, seems to become fixed on application. It is said that wood permeated with a 2 percent solution of arsenic acid and bichromate, can be shaken in water several thousand times without apparently relinquishing any arsenic or chromium to the wash water. This impregnation also serves as a fire protection.—*A. E. B.*

A Biological Stroboscope

AN advance in biological knowledge is expected to result from the use, by scientists, of a new type of microscope which has been evolved by Dr. E. Newton Harvey of Princeton University and Alfred L. Loomis of Tuxedo Park, New York. By means of this instrument, biologists are now able to observe for the first time the changes taking place within cells as they are subjected to centrifugal force. Preliminary calculations already made with the help of the new microscope indicate that existing ideas of some of the properties of matter within the cells will have to be revised.

Hitherto scientists have been handicapped in their study of cells by their inability to witness and measure the various steps in



The biological stroboscope: eyepiece in center, light source at right

the deformation of cells and in the movement of particles within them when the cells are whirled rapidly about. Knowledge of what transpires when cells are subjected to centrifugal force has been based on deductions formed by examination of the cells before and after they have been in motion.

Although the cell is being whirled about at a rate of 8000 revolutions a minute, the new microscope presents the observer with a clear, steady picture of it throughout the process.

In the new centrifuge-microscope a disk or turn-table similar in size and operation to that in a phonograph is rotated at high speed by an electric motor. Mounted on the disk and extending along its diameter is a hollow aluminum bar. In this narrow bar has been built the lower lens system of a microscope. This is contained beneath an aperture at one end of the bar and consequently is near the outer edge of the disk. Above this aperture is placed the slide holding the cell which is to be observed. By an arrangement of mirrors similar to that employed in periscopes, the image is carried to the center of the bar and is reflected upward through a second aperture to the microscope which is stationary.

This arrangement provides a means of constantly observing the cell when it is in motion, but the image given by the apparatus as described thus far would be nothing but a blur. The solution consisted in catching a glimpse of the cell for a fraction of a second during its whirl and in making possible the repetition of that glimpse at frequent and regular intervals. Thus through the projection of a series of images, a continuous picture results so that the scientist may watch any changes taking place.

This series of images is produced by flashing a light at regular intervals above the

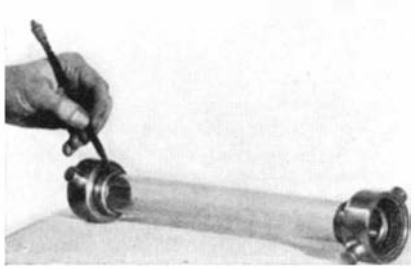
whirling disk. The light is so regulated that its flashes coincide with the passage of the cell beneath it. The flash lasts for about one millionth of a second. Standing away from the whirling disk and looking upon it, the observer is subject to an optical illusion. The disk does not appear to be moving at all and the bar seems to be stationary beneath the light. The flash is produced by a small mercury light, the duration and intermittency of which is controlled by the discharge of electricity through the mercury vapor. The whole principle is that of the stroboscope.

Hard New Concrete Aggregate

A NEW material with which concrete floors that are oil- and water-proof, and highly acid-resistant can be constructed has been placed on the market by The American Fluresit Company of Cincinnati. This material, Duromit, consists of a mixture of very hard granules, the largest of which passes through a one twelfth inch mesh screen. These granules are mixed with cement in the place of aggregates and sand.

Since Duromit is of a hardness between corundum and diamond, floors built with this material are 400 percent harder and more wear resistant than regular cement floors. It is said that Duromit floors will not dust or check nor will they pit and become rutty, although they will remain slip-proof. These qualities are particularly valuable in and around industrial plants where much trucking is done. The surface of a floor made with this material can be ground down and polished to resemble a Terrazzo finish.

Duromit concrete has a compressive strength in one day of 7000 pounds per square inch, and 15,000 pounds per square inch in 28 days. The tensile strength in 28 days is over 1000 pounds per square inch.



A new method of soldering metal to glass, for use in making sanitary tubing, has been developed by Westinghouse. Solder is joined in molecular bond with a metallic glaze on the outside of the glass tube and the metal of a pipe fitting

Guard Your Table—Read the Label

HOUSEWIVES will find new words, printed in bold-face type, upon the labels of some canned peaches, peas, pears, tomatoes, cherries, and apricots packed this season and going on the market now. These words are, "Below U. S. Standard; Low Quality But Not Illegal."

What do the words mean, and what should the housewife do when she finds them on a particular can?

The words mean that the national pure food law has been amended to authorize the Secretary of Agriculture to prescribe and formulate quality standards for all canned foods save meat and meat products, and canned milk. The Secretary has already announced official standards for peas, peaches, pears, tomatoes, cherries, and apricots, and these standards are now in effect. The amendment, popularly known as the canners' bill, further authorizes the Secretary to prescribe a designation to be printed upon the labels of canned foods that fall below the standards that have been set.

The canners' bill also gives the Secretary authority to define a standard fill for canned foods. Canned foods shall be considered as of standard fill if the entire contents occupy 90 percent or more of the volume of the closed container. If a buyer finds the words, "Slack filled," on a can, she will know that the food in that container does not occupy 90 percent of the volume.

"A housewife with a limited amount of money to spend will be greatly aided in making her purchases of canned foods within the coming months if she will carefully read the labels on the containers," says Dr. P. B. Dunbar. "Nor need she fear, if she buys a can of food labeled with the substandard designation, that she is getting an unwholesome product.

"If the food actually were unwholesome, it would of course be illegal under the food and drugs act and subject to action under that measure. She need not hesitate to purchase a food branded, 'Below U. S. Standard; Low Quality But Not Illegal,' because that food will carry the nutritive, if not the esthetic, value of standard canned goods."

The housewife need not look for the wording indicating a substandard product on any canned goods, save the six mentioned, for some time to come. The standards for canned peas, peaches, pears, apricots, cherries, and tomatoes are all that have been formulated and officially announced to date. The Food and Drug Administration will work out standards for other canned foods as rapidly as possible, however.

Pickle Manufacture Aided by Ultra-Violet Rays

PETER Piper, who picked a peck of pickled peppers, has become a back-number since science invaded the pickle packing industry. Dr. Otto Rahn, of Cornell, addressed a recent meeting of the Pickle Packers' Association and announced his discovery that ultra-violet light could be used to prevent fermentation in the brine used for pickles, sauerkraut, and so forth.

Properly put up, brine pickles, like sauerkraut, produce the necessary acid for their preservation, but the quantity of acid tends to decrease, and this deficiency must be supplied. The most important factor in bringing about this decrease is the formation of a yeast, or scum, on the surface. It is a real yeast, although different from common bakers' yeast, he continued. It oxidizes the lactic acid, and when the acidity drops below the point necessary for preservation of the pickle, trouble begins.

The method of dealing with the trouble is based on the fact that ultra-violet rays

will kill micro-organisms. Laboratory experiments, therefore, were directed to turning ultra-violet rays on a jar of pickles in brine and reproducing, as far as possible, the conditions of the ordinary packing plant. After many trials as to time and frequency of treatments, it appeared that exposure to the rays for 20 minutes each day, or for 30 minutes every second day, during the pickling period would prevent yeast formation.—*A. E. B.*

"Steam-Cooled" Railway Diners

TEN diners equipped with the latest type railway air conditioning and cooling systems will be placed in operation in the near future by the Atchison, Topeka and Santa Fe Railroad on their trans-continental trains running through the West and Southwest.

The Santa Fe will be the first railroad to use the new Carrier air conditioning system, which employs steam from the engine as the refrigerating energy and water as the sole refrigerating medium as described in our November, 1931, issue. Gaseous refrigerants are eliminated.

More than a year ago the Santa Fe inaugurated the first transcontinental air conditioned diner on their crack train, *The Chief*. It was the success of this air conditioning system in maintaining uniformly comfortable conditions during the heat waves of the past two summers, even across the burning Mojave Desert, which company officials say decided them to air-condition the 10 additional diners.

The new cooling system will maintain a temperature not to exceed 80 degrees with a relative humidity of 50 percent, when the outside temperature is 100 degrees. The temperature inside the car will thus be lowered at least 20 degrees under extreme conditions, with corresponding moderation in the relative humidity.

Calendar Reform?

THE University Association for the Study of Calendar Reform has a membership in more than 75 universities and colleges. As should be the case, all opinions on the matter of calendar reform are included. Questionnaires have been circulated among certain groups to see whether opinion on the whole favored revision, and also to obtain opinions and comments on the relative merits of the 12-month revisions and the 13-month plan. The results are summarized in the following table—

	Astronomy	Banks	Education	Transportation
Replying	134	586	400	197
	Percentage			
Favoring revision	67	47	90	61
Opposing revision	28	48	8	36
Favoring 13 months	25	19	31	17
Favoring 12 months	62	55	61	63

It will be seen that bankers are the most conservative and educators the least so of the groups canvassed, but on the whole a good majority favors some revision of the calendar. It is also apparent that the 12 months must be retained if a plan for revision is to win favor at this time.

The ablest minds are, however, not agreed. One can advocate no alteration of the calendar, a 12-month revision, or the 13-month plan, and still be in agreement with famous men. This shows that there should be further study of fundamental facts, and in this investigation colleges, universities, and research institutions can appropriately take a leading part.

Toxoid, Successor to Toxin-Antitoxin

"A DEATH from diphtheria must be considered as a result of ignorance or neglect," says Dr. W. T. Harrison of the National Institute of Health. Two methods of preventing diphtheria deaths now exist: one is early treatment of the disease with antitoxin; the other is prevention by immunization with toxoid, successor to toxin-antitoxin.

"The prevention of diphtheria by active immunization is the greatest thing in public health since Jenner's development of vaccination against smallpox," Dr. Harrison said. He predicted that diphtheria, once the dreaded scourge of childhood, will disappear in a few more years.

Credit for the development of immunization against diphtheria goes to Dr. William H. Park, director of laboratories of the New York City Health Department, although toxoid was first introduced by Prof. G. Ramon of the Pasteur Institute in Paris. "Dr. Park has done more than any living man to wipe out diphtheria," Dr. Harrison said. He developed toxin-antitoxin, and it is his influence on health departments, parents, and physicians that has enormously reduced the diphtheria death rates in many American cities.

The diphtheria bacillus produces a poison or toxin which, in massive amounts, causes illness and death. Antitoxin is an antidote to the diphtheria poison and is used to treat cases of the disease. Toxin-antitoxin, on the other hand, is toxin largely neutralized by antitoxin. When it is introduced into the body, the antitoxin gradually splits off, leaving more and more of the toxin. These very small doses of toxin have the effect of raising the body's resistance to the disease or giving it immunity.

Toxin-antitoxin has the disadvantage that when it has been frozen for a time it may become inert, or, on the other hand, may become toxic or poisonous. This uncertainty is entirely absent in toxoid. Toxoid is toxin to which a small amount of the common disinfectant formalin has been added, and which is then kept at a temperature of 100 to 102 degrees Fahrenheit for from three to six weeks. During this time it loses all its toxicity but retains its immunizing properties.

Toxoid is entirely non-poisonous and absolutely harmless, Dr. Harrison emphasized. No case of injury has been known to follow its use. Neither is there any danger of serum sickness, as it contains no horse or other serum. It is given in courses of two or three treatments. After the first course, nine tenths of the children become completely immune. Toxoid is 20 to 30 percent more efficient, even when only two doses are given, than is toxin-antitoxin, experiments have shown.

Toxoid plus alum gives the best results, Dr. Park and his associate, Dr. May C. Schroeder, report. Toxoid should be used for pre-school children. In a small percentage of older children and adults, toxoid causes a marked local reaction.—*Science Service.*

GEORGE WASHINGTON

(*Continued from page* 155)

enemy cruisers, attack straggling convoys, and capture transports and storeships. The construction of the proposed frigates required time, so Congress also purchased a few merchant vessels and rapidly converted them into Continental ships. Adams had some difficulty in persuading Congress to act, so the Congressional Navy was delayed, whereas by the end of November 1775, Washington had equipped and commissioned in addition to the *Hannah*, the cruisers *Lynch*, *Franklin*, *Lee*, *Harrison*, *Warren*, and *Washington*. In January 1776, he added the *Hancock*.

This was literally Washington's navy and he had entire control of it. The enlisted personnel of his fleet was undisciplined in a military sense, but most of them had served in the merchant marine and were amenable at sea to the crude but effective methods of their officers who employed the fist and the belaying pin, and enforced discipline in extreme cases by the pistol or musket. On arrival in port, however, the crews deserted the ships whenever they wished. The merchant officers were the same breed as the men with the same virtues and defects as their crews, plus a natural gift of leadership. One of our earliest naval historians, Cooper, praised their seamanship, navigation, and bravery, but said they "lacked the high moral qualities . . . indispensable to the accomplished officer."

WASHINGTON complained bitterly of the commissioned personnel of his fleet, and exhorted Manley, whom he appointed Commodore of his fleet, to communicate some of his own energy to the other officers. He wrote of the men that the "rascally privateersmen mutinied if they couldn't have their own way." Yet these crews were but typical of our colonial merchantmen of over 15,000 men. Washington was probably more indignant than surprised because he had encountered the same traits in the volunteer soldiers he had recruited from the frontiersmen of Virginia in the Indian wars. And Parkman says of the colonial militia of Massachusetts that they accepted the heavy losses due to their military inefficiency rather than submit to discipline. Even Manley, who was Washington's favorite captain and who captured the *Nancy* —the ordnance ship carrying the precious munitions destined for Gage—is reported to have refused to obey the summons of the Massachusetts government to join the Penobscot expedition.

Besides capturing munitions of war, this infant navy captured enough British Army officers to enable Washington to obtain proper treatment for colonials who had fallen into British hands. This was very important, for technically the colonists were rebels and were subject to execution when captured.

Upon his departure from Boston in March, 1776, Washington gave command of his navy to General Artemas Ward, and a year later the Congress ordered its disbandment to make way for the Continental Navy that, with the state navies and the privateers, constituted our naval forces until 1778 when the French Navy came to our assistance. The state navies, like the militia, were for local defense. These little navies were composed of small vessels that could not meet the heavier British ships on the high seas, but were very useful as auxiliaries in the rivers and bays where their shallow draft somewhat compensated for their lack of strength. Washington employed them to advantage in delaying Howe's movement into the North and East Rivers, and to the Delaware in 1776 and 1777.

The British Navy had not been properly maintained after the Seven Years War, and its administration suffered from excessive corruption among its civilian officials; on a peace establishment it consisted of 356 vessels, including 140 ships-of-the-line, but with only 40 of the line in commission. By 1776, 16 additional ships-of-the-line were commissioned and the personnel increased to 29,000. Between 1776 and 1778, under the vigorous administration of Admiral Howe, the British squadron in American waters captured, destroyed, or forced the Colonials to destroy most of our Continental Navy in commission or building on the stocks in the bays or rivers that lead to New York, Philadelphia, Hampton Roads, Charleston, and Savannah.

Some few of our naval vessels escaped to prey upon the enemy commerce and Paul Jones actually made a landing upon British soil, but our main sea effort after 1777 was through our privateers of which we had 136 in 1776, 73 in 1777, and then an increase up to 449 in 1781, and 323 in 1782, while the Continental Navy dwindled from 34 in 1777 to 7 in 1782.

The activity of our privateers astonished the world; they interrupted British trade between Ireland and England, marine insurance rates soared, and many English merchants used neutral ships in order to protect their goods. This destruction of British trade did much to incline the British commercial classes towards granting independence to the colonies. Still, it left Washington without any direct naval cooperation and, after Bunker Hill, almost three years passed while he was forced to contend against an enemy possessing complete control of the sea, who could direct blows at will against any of the colonies.

FORTUNATELY for the Colonials, Washington from the first realized the tremendous mobility of the enemy navy and decided that he would not attempt to defend every point of our long seacoast from the enemy incursions. Sparks describes Washington's policy as follows: "Attacks of the enemy at isolated points along our coast must be repelled by the militia in the vicinity except when the Continental Army is in condition to make detachments without jeopardizing the general cause."

Washington's acts confirm Sparks' words for, after the British occupied New York City, he took a central position in northern New Jersey, where he could watch the movements of the British in New York and maintain the communication between New England and the middle states. When the main British force went to Philadelphia, Washington followed to Brandywine and Valley Forge, but he always was prepared to interpose between it and the forts on the Hudson near West Point that secured the communications between New England and New York.

Washington had first learned the value of sea power while serving in the British Army. As Commander-in-Chief for three years he faced an enemy possessed of sea power and he had its power exerted against him in three difficult campaigns. For two brief months in 1778, after the alliance with France, the French fleet was superior to the British fleet in North American waters. Washington saw his chance to turn sea power against Clinton and eagerly prepared his army to act in concert with this new ally. His past experience enabled him to suggest a sound plan for effective joint action of the French fleet and the Continental Army.

IN April, 1778, d'Estaing sailed from Toulon for the United States with a fleet of twelve ships-of-the-line and five frigates. There awaited him in the Delaware River, thanks largely to Washington's dispositions, an opportunity rarely given to an admiral. Vice Admiral Lord Howe lay in the Delaware with only six ships-of-the-line defending the transports and the storeships that carried the heavy supplies necessary to maintain Clinton's army in America. With this fleet and convoy destroyed, Washington and d'Estaing could easily dispose of Clinton's army.

The British government and Clinton himself were alive to the dangers that would threaten the scattered land and naval forces operating in the Colonies if a superior French fleet appeared in North American waters. Therefore, all the British forces except the Newport detachment were ordered to concentrate in New York, and a reinforcement of 13 ships-of-the-line was hurriedly ordered to New York from England. So threatening was the danger considered that Clinton dared not embark his troops for the short water passage from Philadelphia to New York but marched by land over the poor New Jersey roads, harassed by Washington's army and the local militia.

But d'Estaing was a continental soldier with practically no sea experience, and his fleet took 33 days from Toulon to the Straits of Gibraltar and another 53 days to the Delaware capes. Meanwhile, his active and able naval opponent, Admiral Howe, had reached Sandy Hook with the empty army transports and the filled storeships. The fear of Washington diverted Clinton from the direct route to New York and he marched his army via Freehold to Sandy Hook from whence it was ferried to Manhattan Island by Howe's fleet.

Had d'Estaing arrived 10 days earlier he could have captured or destroyed Howe's inferior fleet, with its storeships and transports. If Howe's squadron had been defeated in the Delaware, even if Clinton succeeded in reaching New York with his army, it would have been caught there between Washington's army and d'Estaing's fleet, just as Cornwallis was finally caught at Yorktown between Washington's army and de Grasse's fleet.

The promptness of Howe denied d'Estaing his first opportunity in the Delaware Bay, but by immediately following Howe to Sandy Hook, d'Estaing obtained a second opportunity, for Howe, with his inferior fleet, must accept a fight or abandon Clinton's army. Howe anchored his fleet in a strong position in Sandy Hook Bay commanding the entrance channel to the Narrows. He retained a ship-of-the-line and a frigate as a mobile reserve. Clinton mounted some guns on Sandy Hook and manned some armed merchant ships with soldiers and together with Howe awaited the arrival of d'Estaing.

Washington took his old position near White Plains and sent Hamilton and Laurens to urge d'Estaing to enter with the first fair breeze and destroy the British fleet. Unfortunately, the pilots reported that there was insufficient water for the heavy French ships, and once again Washington saw his chance to crush Clinton between an army and a fleet vanish.

This failure led Washington to request d'Estaing to proceed to Narragansett Bay, destroy the small British frigates there, and co-operate with General Sullivan in a similar operation against a detachment of the British Army at Newport. D'Estaing agreed and within two weeks he had captured or destroyed the small naval force in Rhode Island waters and established the blockade by sea. But the indefatigable Howe, with some reinforcements from England, appeared off Pt. Judith a week later and d'Estaing stood out to engage. A violent storm arose that dispersed both fleets. The French fleet was so badly damaged that it went to Boston to refit after which it proceeded to the West Indies. For a third time within two months Washington saw a carefully considered combined attack fail of success for reasons entirely beyond his control.

HE was called upon to wait three more years for Yorktown and the vindication of his tactical conception of a joint operation. In the meantime he was forced to witness d'Estaing's hasty and fruitless frontal attacks on the British at Savannah in 1779. In 1780 the arrival of Rochambeau and Admiral de Barras greatly strengthened Washington's army but still left the British with a superior fleet in North American waters. But Washington's hour was near at hand for, in the spring of 1781, the French government finally determined to send a superior fleet to the West Indies, and authorized its commander, de Grasse, to operate in North American waters during August and September, the West Indian hurricane months. For another short two months, therefore, Washington might be favored with a temporary command of the coastal waters of the Colonies.

To seize this fleeting opportunity, Washington and Rochambeau, at the historic Wethersfield Conference, agreed that the French Army, then at Newport, should march to the Hudson River, join the American forces in the neighborhood of West Point, and operate against the British forces in New York City (which had been much weakened by providing reinforcements for Cornwallis in the Carolinas and Arnold in Virginia), or extend operations southward if a naval superiority permitted. On May 26, Washington learned from his former aide, Laurens, Minister at Paris, that 20 French ships-of-the-line were departing for the West Indies, 12 of which were destined for the United States, where they might arrive by July. On June 5, Washington communicated his plan of action to Governor Rutledge of South Carolina who had come to his headquarters personally to request relief from the British forces, and again stated that "no relief could be given

from this army until we had acquired a naval superiority."

On July 20, Washington forwarded through Rochambeau to Count de Grasse, commanding the French West Indian Fleet, the essence of the Yorktown plan as follows: first, if sufficient land and sea forces were available, to attempt to capture New York; if the joint forces were insufficient, then he would afford all relief possible to the southern states.

Late in June, Washington had suggested to de Barras that the French fleet under his command at Newport could proceed to the Chesapeake. On July 29, de Barras declined to go until he knew de Grasse was in the Chesapeake, for Graves' fleet, based at New York, was superior to his own and the French admiral knew that a British naval force was *en route* from the West Indies to the United States. Washington wisely desisted from further urging lest he jeopardize the junction of the two French fleets. De Barras gave Washington the important information that de Grasse could certainly be expected on this coast by August 10. Washington continued his plans for an attack on New York during July, but because of the preference of de Grasse for operations in the Chesapeake, began on August 1 to turn his thoughts seriously to the southern alternative.

From the first conference at Weathersfield, Washington realized the many variable factors that would affect the movements of the French fleets under de Grasse and de Barras. Therefore he kept his plan flexible and his army in hand so that he could co-operate with the French fleet wherever it chanced to arrive; in short, he held Rochambeau's army and his own in almost instant readiness to combine with de Grasse. It was well he did, for de Grasse's first responsibility was the security of the French West Indies and he could leave his station for only a short time.

Washington knew the limitation upon the French fleet from the bitter experience of 1779 when d'Estaing made his hasty and futile attack on Savannah and hurriedly returned to the West Indies; and he was statesman enough to realize that the French government must safeguard French West Indian possessions. Therefore, instead of exclaiming against the selfishness of allies, he prepared to take full advantage of whatever temporary aid he could obtain from the French fleet. To add to his troubles, during this entire summer he had been importuned to send reinforcements from his army to western and northern New York, to Pittsburgh, to Virginia, and to the Carolinas. He refused to detach any of his force for local defense.

On August 14, Washington learned from Admiral de Barras that Admiral de Grasse would sail on August 3 from Haiti for the Chesapeake with over 25 men-of-war and 3200 soldiers, and that de Grasse was extremely anxious that everything be in readiness for the joint operations as he had promised his Spanish allies to be back in the West Indies by the middle of October.

Washington, aware of the necessity of a prompt decision, immediately changed his objective from Clinton's army in New York to Cornwallis' army in Virginia. By keeping his troops in hand, he was ready to undertake either operation. Some of his real preparations for the attack on New York had become known to the enemy and he now ostentatiously prepared for an attack on that city, while he rapidly completed his preparations to attack Cornwallis. He had already directed Lafayette to prevent, if possible, Cornwallis' return to North Carolina, so little remained to be done but to keep Clinton in expectation of an attack on New York, while he and Rochambeau marched to Elkton, at the head of the Chesapeake.

In de Grasse, Washington finally found a resolute naval colleague who could bear his part in a combined operation. De Grasse detained the French West Indian merchant convoy at Cape Haitien so he would not have to weaken his fleet by providing a naval escort, added a French Haitian garrison to his army contingent and headed for the Chesapeake. Fortune now finally favored Washington. Howe, one of Britain's really great admirals, had been succeeded on the American station by the mediocre Admiral Graves. Admiral Rodney, commanding the British West Indian station, returned to England because of his health, and dispatched his Second-in-Command, Rear Admiral Hood to New York to reinforce Graves. Hood, an active and vigilant commander, reached the Chesapeake ahead of de Grasse, looked in upon an empty anchorage at Hampton Roads and proceeded to New York. Hood's fast pursuit had caused him to overrun his enemy. In consequence, de Grasse entered the Chesapeake without opposition early in September, landed his troops in the James River to join Lafayette, and took station in Lynnhaven Bay which enabled him to drive off Graves and Hood when they later came from New York to succor Cornwallis. De Barras coming from Newport reinforced de Grasse and together they closed the seagate upon the British Army and on October 19, 1781, Cornwallis surrendered.

IF ever a General had earned a victory, it was Washington at Yorktown. At Boston, in 1775, he had seen Howe escape with all his army and Tory refugees and their stores, because his improvised navy was inferior to that of the British. During the next three years he was forced to conform to the movements of an enemy possessing the mobility that complete command of the sea confers. In 1778 and 1779 at Philadelphia, New York, Newport, and Savannah, the French fleet was temporarily in control of our coastal waters but, unfortunately, d'Estaing, a gallant soldier, was unequal to his naval opportunities. De Grasse was a fit naval colleague for Washington and together they finally achieved at Yorktown what might have been done at Philadelphia or New York in 1778.

Washington, from the beginning of the Revolution, realized that sea power would be the deciding factor. He created the nucleus of our first Continental Navy that through the efforts of John Adams was given the support of Congress and when that was swept off the seas by the overwhelming navy of Great Britain, he turned to France and through Lafayette and our own Laurens obtained the support of her fleet. It seems demonstrably true that when Washington saw Howe escape him at Boston, he imagined a future day when he could block the sea-gate as well as the land-gate—that is to say, on Dorchester Heights the vision of a Yorktown appeared to George Washington.

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

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More About a Single Court of Patent Appeals

ON page 212 of our September 1931 issue we presented a short article which put forth a plan for a single court of patent appeals, and stated reasons why such a single court is desirable. In order that our readers may be informed as to all phases of the question, we reprint in part below, from the *Journal of the Patent Office Society*, arguments by Ford W. Harris, Esq., against the formation of such a court.

". . . If we take seriously all of the arguments put forth by the proponents of a single court, we must inevitably decide that our present system is operating very poorly. It may, for the sake of argument, be admitted that the system might operate very poorly, since it is *possible* for each court to act independently and thus throw us into confusion. In fact, this is probably the best argument that the proponents of the single court have; at least it seems to be the argument mainly relied on by them. Personally, it has always seemed to me that our courts are reasonably consistent. Since in my rather limited practice I have not personally observed serious conflicts between the different circuits, I thought it might be wise to investigate the matter. My analysis was made rather hurriedly for my own personal satisfaction and makes no pretensions as to absolute accuracy. It can, however, be checked if one is interested, and there is probably no very large error in it.

"The facts seem to be about as follows . . . :

"First; that there have not been more than one and one half instances of conflicting decisions per year in the last decade: Second; that there have been only three instances in the last ten years where the Court handing down the second or conflicting decision has been reversed by the Supreme Court: Third; that in seven of . . . . . ten cases the Court handing down the second or conflicting decision was sustained by the Supreme Court, which indicates to me that the second decision in each of these seven cases prevented substantial miscarriage of justice.

"An interesting side light on the matter is that *Thropp's* case, 68 L. Ed. 709, and the *Sanitary* case, 74 L. Ed. 147, were both Third Circuit cases. It is also interesting to note that the Courts for the Fourth, Fifth, Eighth, and Ninth Circuits had no conflict with other Courts, that the Court for the Third Circuit which had two reversals was in conflict in seven of the ten cases, and that the Court for the Second Circuit, which probably has by far the largest number of patent appeals, was involved in only two conflicting cases, in both of which it was sustained. In the *Eibel Process* case, 67 L. Ed. 523, its original decision was sustained, and in the *Corona Cord* case, 72 L. Ed. 610, its conflicting decision was sustained. It is also interesting to note that, all told, the Court for the Third Circuit was not only involved in seven conflicts, but that it was reversed in five of them. Three of these reversals were on original or first decisions, however.

"My final conclusions are:

"First, that considering the volume of patent litigation, there were few conflicts, since during these ten years the Circuit Courts must have decided something like 1500 patent appeals, and three reversals of conflicting decisions seems to me to be a very small number, and; second, that in most instances these conflicts were justifiable and salutary.

"This being the case, why tinker with our present system of appeals? We know what its defects are and they are not serious. We do not *know* what the defects of the single court will be." Those who "protest have in my opinion pointed out the probable defects very forcefully. . . .

"My own estimate of the single court propaganda is that we will get no such court. I think it is unwise to belittle our Circuit Courts by loud cries of inconsistency when the record shows only a few sporadic cases.

"What we need is more confidence in our courts and in our bar on the part of the general public. I think this propaganda for the single court as it is now being carried on is highly destructive to such confidence."

MR. LIDDY will be pleased to answer the inquiries of our readers who may desire information relative to the various subjects reported in his department.
—The Editor.

Advertising Agency Abandons "Home Work" Sewing Ads

THE Federal Trade Commission has ordered a complaint issued against a company advertising home work sewing. It is said the real objective of the advertiser is to sell samples and outfits and not to provide profitable work for women at home.

The advertising agency which placed such advertising for publication, signed a stipulation with the Commission agreeing to abide by whatever action the Commission takes against the advertiser and discontinue handling for publication such copy.

'Amos 'n' Andy' Mark Refused

THE Patent Office has just refused to register the notation "Amos 'n' Andy" as a trademark for use upon work shirts. The decision was based upon the opposition of "Amos and Andy," a firm consisting of Charles J. Correll and Freeman F. Gosden, according to First Assistant Commissioner William A. Kinnan in a report published in *The United States Daily*.

The partnership opposed the registration under the provision of section 5 of the Trade Mark Act of 1905 which prohibits the registration of any mark which consists merely in the name of an individual, firm, or corporation, not written in some particular or distinctive manner.

The fact that the partnership of "Amos and Andy" does not sell goods, but "delivers and performs skits, dialogues and dramatic compositions," is immaterial, it was ruled, to the application of the statutory provision.

"Radio Activity" Advertising Dropped

A CORPORATION selling and distributing a water filter signed a stipulation with the Federal Trade Commission agreeing to stop advertising in a way that would deceive buyers into the belief that water, which has been placed in this company's filter, is caused to become charged with radio-activity in such a degree as to possess special health-giving properties and therapeutic value, when such is not the fact. The company agreed also to stop use of any advertising purporting to be quotations from observations of doctors or other authorities, so as to imply that these authorities endorse the use of radio-active water of about the strength of that said to be produced in water by the company's filter, when such is not true.

Carbureter Attachment Ads Censored

THE Federal Trade Commission has ordered Whirlwind Carbureter Company, Milwaukee, manufacturer of a mechanical device called "Whirlwind Vaporizer" for attachment between carbureter and intake manifold of an automobile motor, to discontinue certain misleading advertising.

The company, as well as Elling O. Weeks, its president and treasurer and inventor of the device, and P. C. Sorensen, secretary, are to discontinue such representations as the following:

"Over the mountains from Los Angeles—559 miles on 11 gallons of gas. Think of it! Five hundred and fifty-nine miles over rough mountainous country burning only 11 gallons of gasoline. Imagine more than 50 miles to the gallon. That is what the Whirlwind carbureting device does.

"The Whirlwind saves motorists millions of dollars yearly. Car owners all over the country are saving money every day with the Whirlwind, besides having better operating motors."

The phrase, "450 miles on a gallon of gas," is prohibited unless there is printed so as to be equally conspicuous, the explanation to the effect that some person has claimed that there is enough energy in one gallon of gasoline if converted 100

percent into mechanical energy to run a four-cylinder car 450 miles.

The commission found that under certain conditions the device might appear to have some merit, but generally, when attached to an automobile motor, brings about little improvement in the performance of the engine and in no case results in an increase from 25 to 50 percent in the mileage from a given quantity of gasoline. Neither does the device completely prevent accumulation of carbon.

The advertisement headed "Over the mountain from Los Angeles on 11 gallons of gas" is based upon a letter, the truth of the contents of which the company made no effort to verify, the commission found.

The company's representations were found to be grossly exaggerated, false and misleading, and to be supported by no scientific tests or measurements.

Color Used in Plant Patents

THE monotony of the black and white of the United States Patent Office files is now to be enlivened by bright colors. The plant patents recently authorized by act of Congress will be issued in full color whenever the color is a part of the invention claimed by the horticulturist who has produced the new variety of plant.

The two colored patents issued so far are for a white carnation with a delicate touch of yellow and for a rose of deep pink.

The necessity for putting out patents in color has set a new problem for the patent office officials, for color has never previously been required for any type of patent. Despite the great additional expense for printing, the office is not allowed by law to charge any more for copies of the patents, so it is planned to limit the sale of them to those who can show that they have real need for them.

Axle Shaft Dealer Corrects Advertising

ENGAGED in the sale and distribution of automobile parts, including axle shafts, worms, gears, and brake-drums, some of which it manufactures and others of which it purchases and finishes, a corporation signed a stipulation with the Federal Trade Commission agreeing to stop advertising that the axle shaft it sells is of its own manufacture, when such is not true.

The company will no longer state that it uses the "Brinnel Test," when this is not the fact, nor that its products are made from a special alloy of nickel-chromium steel, when only a portion thereof are manufactured from such steel.

(Names of individuals or firms signing stipulation agreements are not mentioned in the commission's press releases or publications, but the facts in each proceeding are presented to show methods of competition condemned by the commission as unfair, for the guidance of industry and protection of the public.)

Apparatus and Process Claims in Patents

THE Patent Office Board of Appeals, in *ex parte* Thomas C. Sheehan, passed upon the question of the right to apparatus and process claims being contained in the same patent. On a final requirement of division, by the Primary Examiner, between apparatus claims involving a series of means coupled with functions, and method claims for a series of steps for performing the same functions, the applicant appealed to the Board of Appeals, contending that the apparatus claims and method claims were mutually dependent elements of the same invention, and to include such apparatus and method claims in separate patents would imperil the validity of the later one, on the ground of double patenting. The applicant also contended that it was impossible to reduce to practice or complete either branch of his invention without by the same act reducing to practice or completing the other branch, and therefore it followed that the apparatus claims and the method claims were mutually dependent elements of the same inventive act.

The claims selected for consideration, as representative of the several apparatus and method claims, were as follows:

1. The combination with mechanism for feeding a metal strip, of means for tempering the strip as it is fed, and devices operating on the strip fed from the tempering means to draw the temper from the mid portion thereof only.

18. The method of heat treating thin steel strips which consists in imparting feeding movement to the strip, then heating and rapidly cooling the strip to temper the same and passing the mid portion only of the cooled strip into contact with a hot surface to draw the temper of that portion of the strip.

The Board of Appeals held that where apparatus claims involve nothing more than a series of means coupled with functions, and the method claims a series of steps for performing the same function, that there is no patentable distinction between the two and that the courts would hold applicant guilty of double patenting if he accepted a patent with claim 1 as the apparatus claim, and another patent with claim 18 as a method claim.

Payment for Testimonials Must be Stated

A MANUFACTURER of toilet articles and preparations, Northam Warren Corporation, New York, was ordered by the Federal Trade Commission to cease using or authorizing the use by others in advertising of testimonials or endorsements of its toilet articles and preparations, for which testimonials the company has paid substantial sums of money, without disclosing the fact of such payment.

In advertising its manicuring preparations sold as "Cutex," the company obtained testimonials from Ethel Barrymore, Anna Pavlowa, Atlanta Arlen (Mrs. Michael Arlen), and Mrs. Howard Chandler Christy.

For her endorsement Miss Barrymore received 1000 dollars. Anna Pavlowa, who at the time of the transaction was in London, received 100 pounds. Atlanta Arlen was paid 200 pounds. Mrs. Christy was given 500 dollars, while Miss Lassie Honeyman, a personal friend of Mrs. Christy, received 150 dollars for services in helping to obtain the testimonial from Mrs. Christy.

These advertisements were published at various times from 1928 to 1930. As an illustration of the procedure there is quoted the following letter from Ethel Barrymore:

"I hereby give the Northam Warren Corporation and/or the J. Walter Thompson Co. (advertising agency) permission to use in its advertising, my photograph and/or my name and/or a statement to be submitted to me and which, when approved by me, I agree to sign.

"I agree not to endorse any other manicuring product, and to test adequately the complete Cutex outfit with which the Northam Warren Corporation will supply me. *Ethel Barrymore*"

Miss Barrymore authorized the use for advertising of a statement prepared for that purpose and submitted to her. It contained, among other, the following language: "'Everything must flatter us to our finger tips,' says Ethel Barrymore. The best loved actress on the American stage adds, 'And of all the ways of grooming the finger tips I find new Cutex Liquid Polish the most flattering.'"

Similar procedure was applied in the Pavlowa, Arlen, and Christy instances.

Tombstone Company Stops Misrepresentations

A CORPORATION engaged in quarrying, cutting, and finishing granite tombstones and monuments, will no longer circulate in interstate commerce photographic views or cuts of tombstones or monuments produced by other companies, in connection with its own trademark, or such pictures so set out as to appear to be pictures of its own products, when this is not true. Agreements to this effect were made in a stipulation between the company and the Federal Trade Commission.

Cigars Not to be Advertised as "Anti-Nicotine"

AN individual manufacturer of cigars signed a stipulation with the Federal Trade Commission agreeing to cease using in advertising the words "Anti-Nicotine" independently or in connection with other words so as to deceive buyers into believing that his products are free from nicotine, when this is not true.

The individual will also cease advertising that the cure and preparation of the tobacco from which his cigars are made requires from two to four years or more, and that almost the entire nicotine content is extracted, when such is not the fact. He will cease representing that his cigars contain only a minimum of nicotine, or an amount less than the average content of other brands for which no claim as to denicotinization is made by the manufacturers, when this is not true.

He will cease stating that his products can be used, regardless of quantity, without biting the tongue or without throat irritations so as to imply that the cigars can be used, regardless of quantity, without such danger, when this is not true.

(Names of individuals or firms signing stipulation agreements are not mentioned in the commission's press releases or publications, but the facts in each proceeding are presented to show methods of competition condemned by the commission as unfair, for the guidance of industry and protection of the public.)

Books SELECTED BY THE EDITORS

APPLIED GYRODYNAMICS

By Ervin S. Ferry, Prof. Physics, Purdue University

"THE purpose of the present book is to bring gyrodynamics out from behind the integral sign and to present it to the acquaintance of engineers and students having mathematical equipment of the ordinary graduate of engineering or physics"—so runs the preface. All gyroscopic devices of industrial importance have been surveyed and every known source of information has been tapped—the author even taking the course of the Sperry Gyrocompass School during his vacation. The deduction of the laws and principles upon which depends the action of the various devices is considered by methods that are understandable to those who are not specialists in mathematics. A much needed and most important work.—$4.20 postpaid.

TOOL AND DIE DESIGN

By Charles B. Cole and Frank W. Curtis

"MODERN production methods have created an almost unprecedented demand on the tool industry. High cost of manufacturing has made it necessary to increase the output of expensive machines. Therefore, manufacturers are giving increasing attention to the designing of high-speed and heavy duty tools. This makes the problem of tool design one of almost constant change to keep in line with the latest improvements. Sheet metal is continually being broadened to the application of many parts, to take the place of castings and forgings. Many products can be punched, stamped, or drawn from sheet metal at a lower cost than by any other method of fabrication"—from the introduction. A worthy contribution to technical literature.—$1.65 postpaid.

NEW ELECTRIC LIBRARY

IF there is any number of electrical questions to which you want clear, concise and conclusive answers you will find them in the ten volumes of this handy set. The subjects run progressively—Principles and Rules; Dynamos and D. C. Motors; Testing Instruments and Storage Batteries; A. C. Principles and Diagrams; A. C. Motors; Condensers and Meters and Power Stations; Wiring and Transmission; Railways and Automotive Ignition; Radio and Motion Pictures; Welding and Signal Service. 4⅞" by 6⅝", limp binding, gold edges, 6000 pages with 9000 illustrations. A most attractive set, or sold by separate volumes.—each $1.60 postpaid.

JANES' ALL THE WORLD'S AIRCRAFT 1931

C. G. Grey, Editor

A COMPLETE record of aeronautical progress throughout the world during the past year. It maintains all the excellence of previous issues but naturally is more comprehensive and inclusive. A formula was evolved by which the mass of detail which came from manufacturers all over the world was rendered down and presented in a set form which makes possible a comparison of one airplane with another, no matter where the airplane may have been produced. Where figures have been determined under official observation this fact is clearly stated in a footnote. For the balance, the utmost care has been taken to guarantee the greatest accuracy possible. 8¼" by 13¼", profusely illustrated.—$13.00 postpaid.

AVIATION HANDBOOK

By Warner and Johnston

THIS is the Kent or Marks of the aviation field, for surely there is no better authority on this subject than the former Professor at M. I. T., Assistant Secretary of the Navy and now editor of *Aviation*, and his able assistant. Not a textbook, but the basic facts and formulas are made available to designers and engineers in airplane manufacture. Frankly, a compilation drawn from many sources, condensed and arranged in a manner consistent with the requirements of practical men. 4½" by 7⅛", 715 pages, semi-flexible binding. A welcome addition to the Handbook family.—$7.75 postpaid.

THE AIRPLANE AND ITS ENGINES

By Chatfield and Taylor

INTENDED primarily for the reader who desires a sound knowledge of the basic principles and present development of the airplane and its power plant, without giving the intensive study which is essential for the designing engineer or the expert mechanic. An elementary knowledge of physics or mathematics only is thus necessary for its understanding. This second edition clarifies the former text and amplifies the explanation of fundamental principles together with the additions and changes necessary to record the progress of aeronautics. The section on power plants especially describes the latest types of engines which have proved successful or which promise to replace the earlier types.—$3.20 postpaid.

AIRPLANE CONSTRUCTION AND REPAIR

By J. E. Younger, Prof. Mech. Eng., Univ. of Calif.

PROFESSEDLY a text to provide training in the efficient and intelligent performance of the duties of an airplane mechanic. Fundamental material, augmented by problems and experiments for practical applications and for study of the fundamental concepts. The experiments, while bordering on the realm of real research, are so simple in character that they may be performed in the most poorly equipped shop with gratifying results. 418 pages of text profusely illustrated and ample index. A work of unusual excellence.—$3.20 postpaid.

MODEL AIRPLANES

By Joseph S. Ott

BUILDING flying models has now developed into a delightful art of considerable educational value. A boy who has built a variety of such models will have had a wonderful time, improved his manual dexterity, and learned a great deal about aviation. Mr. Ott, an authority on the subject, has kept all three objectives in view.

There is quite an art in picking the right materials—which must be light though strong—such as balsa, bamboo, cement, dope, acetone. Constructing a model propeller is a problem in technology with pitches, blanks, sections to think about. The structure of the model contains almost as many parts as a full size airplane, and model stability must be based on sound elementary aerodynamics. The book covers special modern designs such as the Sikorsky Amphibion, D. H. Intercepter, and so on, and it tells one how to build a rocket flyer that will not catch fire! A clear style, full knowledge, and good illustrations make this an entertaining and valuable book.—$2.65 postpaid.—*A. K.*

1001 CELESTIAL WONDERS

By Charles Edward Barns

OF the various amateur observer's handbooks which have been published, this is by far the most practicable. First, it fits the pocket and, secondly, the charts and information in it are prepared in such form that they can be used to best *practical* advantage, not merely by a reader seated indoors in an overstuffed chair, but by the actual out-of-door observer at the side of his telescope. Instead of the usual ten-acre atlas, with confusing charts and text matter which must be searched for in the dark and cold and wind, there are 72 separate small charts each with all the data concerning the stars in that chart placed directly on the opposite page. Each chart is good for a few minutes observation and then the observer moves to the next. Together the 72 charts cover the heavens down to 30 degrees S. latitude. This is the kind of book which will encourage the telescope owner to make a thorough, systematic canvass of the heavens and as a star-book we heartily recommend it.—$2.65 postpaid.—*A. G. I.*

THE NEW CONCEPTIONS OF MATTER

By C. G. Darwin, F.R.S., Prof. Univ. Edinburgh

FOR popular readers who do not object to thinking as they read, this book will give an unusually clear insight into important phases of the new physics. The subjects dealt with are waves and particles, and the book is an excellent introduction to the physics of the new wave atom. The treatment is not mathematical, the book being a transcript of a series of semi-popular lectures delivered in Boston. However, to the reader who is not somewhat familiar with elementary physics it cannot sincerely be recommended; it can be recommended with equal sincerity to those who are. Of course intelligent critics of such a book will realize that it is impossible to make the newer physics "easy"—except by emasculating it. For those who are not altogether lazy, this 222 page book will be a prize. Professor C. G. Darwin, the author, is a grandson of Charles Darwin.—$3.15 postpaid. —*A. G. I.*

THE INGENIOUS DR. FRANKLIN

Nathan G. Goodman, Editor

SELECTED scientific letters of Benjamin Franklin to various people throughout the world detailing many interesting experiments, deductions and conjectures which originated with this most surprisingly diligent observer. One knows, as a rule, some of the more fundamental experiments which have become history but there were many others of considerable importance that are not usually chronicled. Here they are outlined in his individual style with great clarity, just as they were penned. An informative, in fact an historical record which should be available to all who approach physics in any way. —$3.20 postpaid.

JANES' FIGHTING SHIPS 1931

Oscar Parkes, Editor

DESPITE the effect of treaties and conferences in limiting naval construction there is sufficient fresh material to justify this year's issue. Interest in new design does not depend upon the number of ships built, and limitation of construction does not lessen the necessity for keeping abreast of development. Far-reaching changes are maturing in warship design the world over, particularly in France and Japan and the present lull in other countries is mainly due to a policy of marking time, pending the completion of certain experiments, both in methods of construction and propulsion. With these points in mind this year's issue assumes considerable importance. It seems unnecessary to add that in all respects the old standard of accuracy and quality of production is fully maintained.—$13.00 postpaid.

A HISTORY OF THE MOVIES

By Benjamin B. Hampton

AN absorbing account of the rise of the motion picture industry from the earliest days right up to the present moment. The author was for years connected with the business management of movies and his book naturally reflects his experience. The technical side of the subject is touched upon only where necessary to carry the theme, and nowhere is it stressed. As a story of the development of a tremendous business which we all patronize more or less frequently, this book is unsurpassed. The collection of over a hundred fine photographs, bound together in the back of the book, are alone worth the price of admission. They date back to the forerunner of the newsreel and to the first story-telling movie, just after the turn of the century. Many half-forgotten faces arouse pleasant memories.—$5.25 postpaid.—*A. P. P.*

THE STORY OF MY LIFE

By Clarence Darrow

SCARCELY ever has this reviewer read a story so full of the "milk of human kindness" as is this simple recounting of the aims, motives, and aspirations of a modern Sir Galahad. Always on the side of the weak defending against the strong, a staunch opponent of the death penalty, the author was originally a pacifist whose reason turned him belligerent during the war. No one should miss this calm, clear, unfurbished recounting of a life devoted to humanity and the forceful championship of individual liberty. Without question one of the most interesting autobiographies ever written.—$3.65 postpaid.

WORLD ALMANAC 1932

THERE is no more useful reference to have within reach, than this frequently consulted handy-book. If you do not know about it we can only say that we could not do without it ourselves and if you do know this valuable little volume, you will want to have the new issue. It is thoroughly revised and brought up to date each year.—Cloth $1.15 postpaid.

THE MIND IN ACTION

By A. Campbell Garnett, Prof. Philosophy, Butler University

TAKING Spearman's principles of cognition as a starting point (we reviewed Prof. Spearman's "Creative Mind" in our June, 1931 issue) and keeping in mind certain important facts regarding the self, pointed out long ago by James and Ward, the author presents a new theory of volition, of habit, and of sentiment which will be of permanent importance to the psychological profession. The interpretation of the higher values of human life—esthetic, intellectual, moral, and religious—will be found immensely stimulating. Of a particularly clear and happy style, the smooth flow of the paragraphs carries one along with ungrudging conviction although it must be realized that many of the statements are individual deductions.—$2.15 postpaid.

COCKTAIL TIME IN CUBA

By Basil Woon

THIS title may seem flippant but the reader will be surprised at the amount of general information contained between the covers. Particularly interesting is the short résumé of the position and activities of the more prominent characters in everyday as well as diplomatic life and the summing up of what is interesting to see. Just the information one should have previous to visiting this growingly popular winter resort.—$2.65 postpaid.

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THEIR Confidence was Justified

WHEN 169 RAILROADS FAILED IN 1893, JOHN H. PATTERSON SAID:

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WHEN PIG IRON DROPPED 50% IN 1907, ANDREW CARNEGIE DECLARED:

"This panic will soon run its course and pass away leaving no impediment to the return, in due season, of another period of wholesome, because needed, expansion of our resources. . . .

"We have had the greatest expansion of modern times. Reaction had to come—will prove healthful. Nothing can stay the rapid progress of the Republic. She is all right."

WHEN DEEP, DARK GLOOM RULED IN 1921, THOMAS FORTUNE RYAN SAID:

"Our merchants have been buying only what they can sell quickly for cash. The consumer has had to listen to so much pessimistic talk that he buys only what is absolutely necessary. People everywhere have been scared. They are getting over that.

"Our people are the greatest consumers of food and manufactured articles in the world in normal times—and normal times are coming back. . . ."

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In 1893 stark ruin stalked through the land. 467 banks failed in a few months. Mills, furnaces and factories shut down everywhere. Bankruptcy was on every hand. America had twice as many unemployed per thousand population as she has today. But she put them all back to work.

In 1907 panic broke loose. The production of pig iron dropped 50% in less than a year. All but the strongest men lost heart—"We are ruined", they declared, "recovery cannot come in our time." Yet in two years prosperity had returned.

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Above all things, let us have faith.

America Has Beaten 19 Major Depressions
She will Beat this one

THE NATIONAL PUBLISHERS ASSOCIATION

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"The extra protection to my throat"

MIND IF I COLLYER "JUNE"? June gave Park Avenue something to boast about . . . she's one of New York's "400." When June middle-aisled it, dozens of eligible bachelors went back into circulation. Did you see her in WARNER'S "ALEXANDER HAMILTON"? For 4 years she has smoked LUCKIES. That nice statement of hers was not given for money. "Thanks, June Collyer."

"It's the extra things I get from Luckies that make me so enthusiastic. The extra protection to my throat, the extra fine flavor of Lucky Strike's choice tobaccos. And the extra convenience of the little tab which opens the Lucky Cellophane wrapper so easily." June Collyer

"It's toasted"

Your Throat Protection—against irritation—against cough

And Moisture-Proof Cellophane Keeps that "Toasted" Flavor Ever Fresh