German Sterilization

An Official Statement from Berlin

SCIENTIFIC AMERICAN

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otograph by Morris Rosenfeld

In Defense of the America's Cup (See page 117)

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THIS latest edition of a famous authority contains discussions by well-known naval men on Naval Forces of the British Empire, Foreign Navies, Comparative Naval Strength, The Disarmament Conference 1933, Physical and Recreational Training, The Building of a Cruiser, and British Warship Building Resources. In addition, there is a Marine Shipping Section which covers various phases of world shipping in eleven chapters; also numerous references, tables, and profiles and plans.

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NINETIETH YEAR • ORSON D. MUNN, Editor

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SCIENTIFIC AMERICAN DIGEST

SCIENTIFIC AMERICAN, September, 1934. Vol. No. 151, No. 3, entered at the New York, N. Y. Post Office as second class matter June 28, 1879, under the act of March 3rd, 1879; additional entry at Greenwich, Conn. Published monthly by Munn & Company, Inc., 24 West 40th Street, New York City. Subscription price $4.00 per year. Canada $4.50. Foreign $5.00. Manuscripts are submitted at the author's risk and cannot be returned unless accompanied by postage.

ACROSS THE EDITOR'S DESK

"UNCLE SAM, Ace Detective" may sound like the title of a best-seller murder mystery, but in reality it is the title of a serious article scheduled for early publication in SCIENTIFIC AMERICAN. No whit less thrilling than the product of the pen of a master fiction writer, it records the success of a criminal identification system which has been operating for the past ten years in this country. While the system of finger-print identification is far older than this, the obstacles to nation-wide adoption of it in the United States have been great. It took the genius of J. Edgar Hoover, successor to the famous William J. Burns as Chief of the Division of Investigation, to overcome these obstacles and produce a system of identification that is a rapidly growing bogey to crime. If you are one of those who look upon Scotland Yard and other foreign detective systems as being superior to anything available in the United States, you are going to be agreeably surprised when you read this article. It is one of the best we have ever published on the science of criminal identification.

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THAT there are two sides to every question is never more clearly shown than when the question of tariffs and nationalism is discussed. The two main political parties in this country have argued bitterly for generations on free trade *versus* protective tariffs. So closely is foreign trade and its ramifications linked with industrial, and hence scientific, developments that we have arranged with the Hon. James W. Gerard, Chairman of the Committee for America Self-Contained, to present the arguments for making the United States virtually independent of foreign countries for our industrial and social needs. Mr. Gerard's article will be presented next month, and will be followed at a later date by another article prepared by an equally famous economist, who will present the other side. No matter what your political leanings may be, or in what light you may regard the questions of nationalism and foreign trade, these articles will prove to be thought-stimulating and informative.

ALTHOUGH SCIENTIFIC AMERICAN has published many articles on various phases of the construction of Boulder Dam, one of the best that it has been our editorial privilege to accept is now in hand, ready for publication. Prepared by R. G. Skerrett, well-known writer on engineering subjects, the article gives a résumé of the entire project, and then goes on to discuss in complete but non-technical detail the huge steel tubes that will conduct the impounded water from the 115-mile long reservoir to the gigantic turbines in the power house, or to the course of the river below the dam.

COMING SOON

¶ "Uncle Sam, Ace Detective." An intriguing account of the criminal identification system under the direction of J. Edgar Hoover.

¶ "America Must be Self-Contained," by James W. Gerard. A plea for the protection of American industries and working men.

¶ Interesting details of progress at Boulder Dam.

¶ The views of the opponents to human sterilization, by Ignatius W. Cox, S.J., Ph.D.

¶ "Wings Over Water," by Reginald M. Cleveland. Water-going aircraft are opening new phases of transportation.

¶ Meet the widow, in an article on the poisonous black widow spider.

●

THREE articles on the subject of human eugenic sterilization have been published in these pages, giving a broad view of the subject in its economic and social aspects. There is, however, a large group for various reasons opposed to sterilization, and we have asked the Reverend Ignatius W. Cox, S.J., Ph.D., to give these opposing views. Those who are familiar with the forceful writing of Father Cox need no further hint; to those who are not, we can only say that they will miss a rare treat if they miss Father Cox's article, to be published soon.

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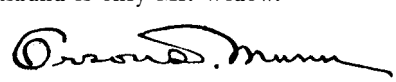
"BETWEEN a large majority of the key cities of the United States more and better landing fields are provided by natural bodies of water than by either man-made or natural airports on land. . . ." Thus, in a nut-shell, is given the gist of the reason behind the article "Wings Over Water," by Reginald M. Cleveland, scheduled for publication next month. One of the significant recent developments in water-going aircraft transportation is the commuting service between Long Island and New York City which has been made possible by the construction of suitable terminal arrangements in the East River and the use of seaplanes. That water-going planes are receiving the closest attention of technical experts is brought out in Mr. Cleveland's article to be published soon.

●

THERE are "hundreds, and probably thousands of cases of spider bite yearly in the United States. Nearly 400 cases of black widow poisoning were actually reported, 20 cases being seen in a Los Angeles hospital in the past year." This statement, made by a California physician, is quoted in an article on the black widow spider, scheduled for early publication. Although the author of this article considers the statement to be "a bit exaggerated," it serves to show that there is a definite danger from the bite of this little-known spider, one of two species in this country which may be considered as really poisonous. We invite you to "meet the widow" in an early issue, and learn something of her habits. Though she is a widow, her husband is also present, but as is so often the case in human society, her husband is only Mr. Widow.



Editor and Publisher

Courtesy *Scientific Monthly*

DR. NORBERT WIENER

DO unusually precocious children later "crack up" and become mediocrities, as is commonly said? An unprejudiced examination of the evidence provides no justification for such statements—indeed, it provides plenty of justification for the statement that most such persons retain the same outstanding ability all their lives.

In 1909 a very youthful student named Norbert Wiener, the son of a Harvard professor, graduated from Tufts College when but 15 years of age. A year later the freshmen students just entering Cornell University at the normal age of 18 found there this youth of 16, already doing *graduate* work. In his studies, he was just seven years ahead of the normal age. A great deal was written about him in the press, and it was predicted that before many years he would "peter out." Instead, he became a professor of mathematics at the Massachusetts Institute of Technology, always doing brilliant work. Now he has been elected to membership in the National Academy of Sciences.

But the National Academy of Sciences is not the place to look for anyone who has "cracked up." Instead, it is a select body of America's very ablest men of science, chosen solely on a basis of proved ability and actual accomplishment. Election to its membership is the highest earned honor in American science, which fewer than 500 living scientists have won.

Courtesy *The Grace Log*

THE GREAT CHIMU FORTRESS OF PARAMONGA, IN PERU

PREVIOUS to the discovery of America by the Europeans, there was a large and powerful nation of Indians on the Peruvian coast, named the Chimu. Inland, in the mountains, were the Incas, always warlike. About the year 1400 the Incas defeated the Chimu at the great Chimu fortress of Paramonga, shown above, pursued them to their capital of Chan Chan and starved them into submission, later exterminating them. The Chimu are thought to have been an offshoot of the Mayas. The fortress of Paramonga was constructed of adobe bricks, plastered over. As the climate is dry, it remains in an excellent state of preservation today.

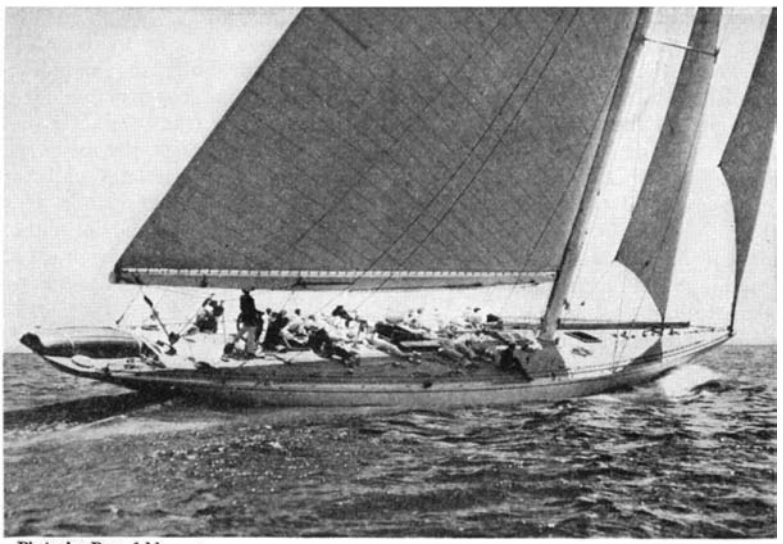


Photo by Rosenfeld

Rainbow under sail in one of the Cup defender trials. All labor-saving devices are on deck, as required by new rules of the America's Cup Race

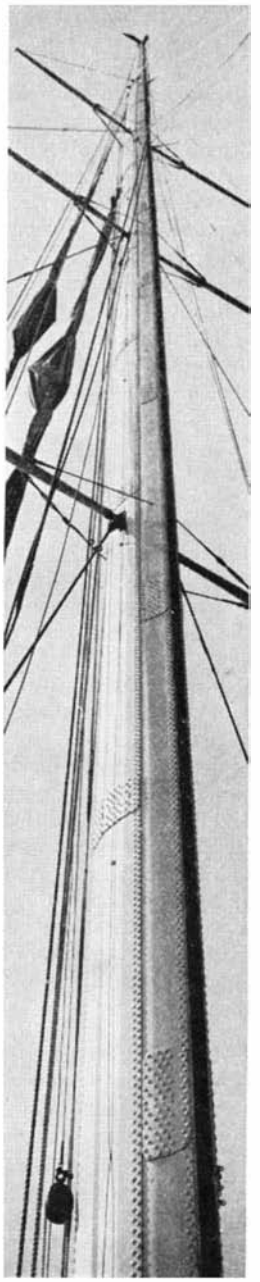


Photo by Rosenfeld

Looking up the duralumin mast of *Rainbow* to the new masthead fitting described in the text. Steel rods are used instead of the usual wire shrouds

In Defense of the

AMERICA'S CUP

By HERBERT L. STONE

Editor of *Yachting*

THE America's Cup, in the 83 years it has been an object of international competition, has become the symbol of supremacy under sail. It is, perhaps, the most important sporting trophy in the world open to international competition. On its successful defense, in 14 attempts to capture it since 1870, untold millions have been spent, and into the challenging and defending yachts have gone the best brains and engineering skill of the countries involved. In the desire to attain the ultimate in speed in sailing yachts it is not to be wondered, therefore, that in a mechanical age the boats built to challenge or defend should have become mechanized to an extent that would have caused sailors of the old school of beef and brawn to blush with shame and wonder what ships and men were coming to!

Certainly the yachts of today are a far cry from the gallant little schooner *America* that sailed across the Atlantic in 1851 and met and defeated a fleet of 14 British yachts in a race of 53 nautical miles. Quite different, also, they are in hull form and rig from the sturdy, able yachts of the seventies and eighties of the last century, to which a race for the America's Cup was but an incident in a long yachting career. Yet the present Cup yachts merely follow the trend of yacht design of the period, as did the older yachts just referred to, with, perhaps, somewhat greater attention paid to details of rig and construction to make them the "last word" in yacht designing. And when once afloat, and in the hands of those who have to sail them, the same skill, seamanship, and nerve are required to get the speed out of the fabric of hull, spars, and sails, as in the days of wooden ships and iron men, to which we like to hark back. In fact, the modern sailing yacht is a much more sensitive and delicate thing to handle than the older, heavier, and perhaps clumsier, yachts of half a century ago, and a higher degree of skill in helmsmanship, sail trimming, and conditioning—or tuning up, as it is called—is required to get the most out of it.

The theory of aerodynamics is better understood today than it was in the past, and is more and more being applied to yacht design (especially in the rig) and handling. Science is supplanting tradition, which has always been strong in seafaring men to whom the tried was always the best and who looked askance at anything new. This application of scientific principles has resulted in greater speeds for a given sail area and size of hull, so that we see 80-foot waterline yachts with 7500 square feet of sail, equaling the speed over a given course made 30 years ago by 90-foot waterline yachts with over double the sail area. In the trial races of four years ago to pick a defender to meet Sir Thomas Lipton's last challenger, *Shamrock V*, both *Yankee* and *Enterprise* broke the record for a 30-mile course, and bettered the time of *Columbia* (1901), which carried nearly twice the amount of sail. On the day this was done, sailing in a 25-mile breeze, a speed of about 10¾ knots was made for the course, ten miles of which was to windward, while the reaching leg (10 nautical miles) was sailed at a speed of close to 13½ knots.

WHEN a challenge for a race for the Cup this summer was received late last fall from the Royal Yacht Squadron, on behalf of Mr. Thomas O. M. Sopwith, we were caught somewhat unprepared. It is true that we had the four Cup yachts that raced in 1930, but only one of these, *Weetamoe*, had been altered to fit the change in the measurement rule made after that race, and it was thought that the last defender, *Enterprise*, could not be altered to conform to the new conditions without slowing her up. The other two, *Yankee* and *Whirlwind*, had not shown winning form when last in commission. Also, four years had rolled by and the new

challenger, *Endeavour*, was sure to reflect any advance in design under the rule that had been made in that time. So we had to have at least one new yacht. But in the uncertain economic situation, the half-million or so necessary to finance just one new defender was hard to raise. However, Harold S. Vanderbilt, who organized the *Enterprise* syndicate in 1930, tackled the job and succeeded in getting a group together to build a new yacht. The result is *Rainbow*, designed by W. Starling Burgess, of the firm of Burgess & Donaldson, who turned out *Enterprise* for the 1930 defense.

In addition to this new yacht, the *Yankee*, owned by a Boston syndicate, has been brought out and some radical changes made in her, which include a new bow and more sail area, intended to make her a faster boat in light and moderate weather, in which conditions she did not perform so well four years ago.

Weetamoe was also altered radically by changing the shape of her keel and recasting her lead so as to lower the center of gravity of this ballast about two feet. *Weetamoe* was tender before, and this change will increase her stability about 27 percent so that she will be able to carry her sail better in a breeze. In her early trials this summer she was a much stiffer boat than before. She also has a new duralumin mast that should prove much stiffer than the old one.

ANOTHER trial horse has been fitted out this year, *Vanitie*, owned by Gerard Lambert, and built in 1914 as one of the Cup defense candidates that year. But as she does not rate in Class J (76 feet) she is not eligible to defend, although she should prove most valuable in the observation races, as she is, perhaps, the most consistent light weather yacht in the United States.

The chief interest, of course, centers in the new yacht, which is being sailed by Harold S. Vanderbilt, who did such a good job as skipper of *Enterprise* in the last match, with C. Sherman Hoyt, John Parkinson, and designer Burgess in the afterguard. As the rule under which the yachts are designed more or less controls the dimensions, through the sail area, *Rainbow* is about the same size as her competitors, but is some two feet longer on the water and six feet more over all than Burgess's former defender, *Enterprise*. Here are the comparative dimensions of the three American candidates, and of the challenger:

	Rainbow	Weetamoe	Yankee	Endeavour
L.O.A.	126.65′	125.9′	126.0′	130.0′
L.W.L.	82.0′	83.0′	83.0′	83.0′
Beam, extreme	20.92′	20.3′	22.6′	22.0′
Draft, without centerboard	14.9′	15.0′	15.0′	15.0′
Displacement, tons	138.13	143.0	145.0	143.0
Sail area, measured, sq. ft.	7555.	7560.	7550.	7550.

Rainbow is built of bronze plating below water and steel above, the seams being flush below the waterline to give a smooth finish; while above, the steel plating is lapped at the seams, making a very strong form of construction. In order to get a somewhat wider deck to work on forward, and to make for a drier boat in a sea, the forward sections above the waterline show considerable flare, something not often seen in a sailing yacht, though it is quite common in power boats.

THE last defender, *Enterprise*, was dubbed the mechanical yacht because of the many winches and other labor-saving devices aboard her, mostly below decks. In fact, about half her crew worked below when she was under sail, winding up or easing off winches to trim the sheets, set halliards, and so on. Considerable mystery seems to have attached to these features, and the impression prevailed abroad that she was more of a machine shop than a yacht. But this was not really the case. For many years capstans, winches, and drums for halliards have been used in sailing vessels. In the case of *Enterprise*, these winches were located below deck where they would be out of the way, as it had become the practice not to house the crew aboard our modern Cup yachts. But the challenger, *Shamrock V*, did not have all these contrivances, and so *Enterprise* was criticized for using winches with which a couple of men could take in on a sheet, instead of calling upon all hands on deck.

The result of this criticism had one good effect. It brought about a change in the rule which made it necessary to provide full living accommodations for the crew on the yacht. The old practice was carrying things too far, when a 125-foot yacht could not house the men needed to sail her. So now all winches, capstans, shroud turnbuckles, and other labor-saving devices must be on deck; and bulkheads, berths, cooking, and mess gear must be fitted below, as in any yacht used for cruising. *Rainbow* is so fitted, and her deck is not too greatly encumbered by the sheet and halliard handling devices.

Perhaps the greatest engineering feat in the construction of the new boat is her mast and the manner of staying it. This mast is of duralumin, and is some 165 feet in length. It is pear shaped in section, being about 30 inches in diameter, fore and aft, by 18 inches the other way. It was made by the Glenn L. Martin Company, airplane manufacturers, and in its construction over 19,000 dural rivets were used. It is not as light as the dural mast of *Enterprise*, four years ago, but the rule now calls for a minimum weight of 5500 pounds. This new stick is about 160 pounds over that weight, but more weight has been saved in the metal mast fittings required on a wooden mast of the same weight.

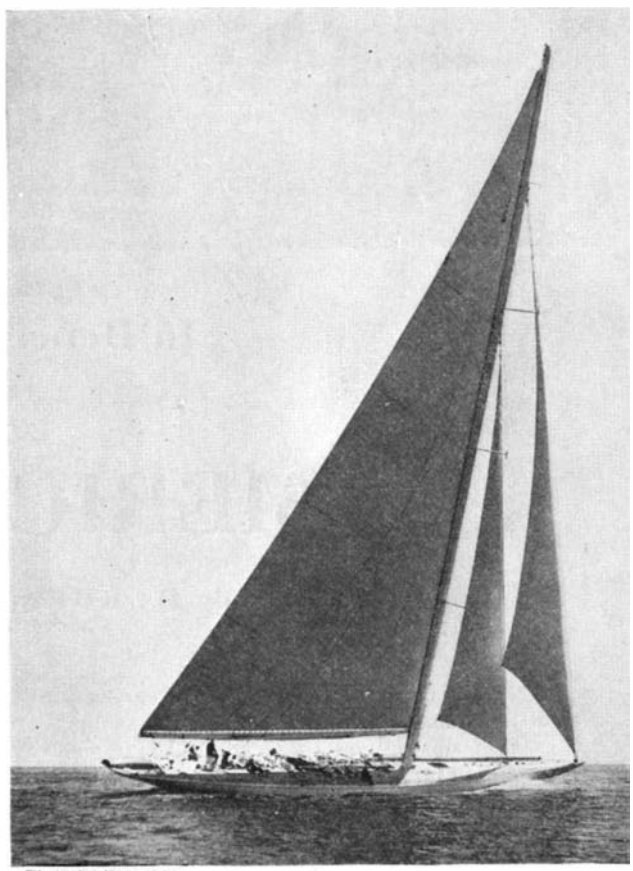


Photo by Rosenfeld

Rainbow

At the top of the mast is the sheave, or roller, which carries the main halliard, the hauling part of which comes down through the center of the hollow spar. Surmounting this is a masthead fitting carrying the eye for the backstay and a special sliphook which engages an eye on the headboard of the mainsail and thus carries the weight of the sail when it is hoisted, taking all strain off the halliard and lessening the compression on the mast due to the downward pull of both sail and halliard. When lowering, the sliphook is disengaged by a trip line, letting the halliard again take the weight of the sail.

The radical feature of the staying of this tall mast on a narrow hull which allows a spread to the stays of only 21 feet (or less than 10 feet on each side of the mast) is the use of steel rods instead of the usual wire shrouds, several of which are required on each side. These rods, which are of special steel having a high tensile strength of 215,000

pounds to the inch, are in lengths of 27 feet, or less, and are joined together by threaded turnbuckles or unions, by means of which the slack is taken up and the shrouds adjusted to the desired tension. There are only two of these sets of shrouds on each side, the upper one leading over the ends of the three sets of spreaders, and the lower one leading from the mast at the lower set of spreaders. The largest of these rods is not over one inch in diameter, the upper ones being successively smaller in diameter as they approach the top of the mast. These rods not only hold the mast more stiffly than wire shrouds, but save both weight and windage aloft, where every pound of weight counts heavily when the boat is heeled and jumping into a sea.

In the early part of the season *Rainbow* carried a normal hollow wooden boom, but early in July it was replaced by the famous "Park Avenue" boom used by *Enterprise* in 1930. This boom is triangular in section, is hollow, and

Sopwith's challenger, *Endeavour*

about four feet in greatest width on top. Across the top are many lateral tracks carrying slides attached to the foot of the mainsail. These allow the mainsail to take the desired curve, or arc, on the foot, conforming to the arc of the sail higher up, so as to make a true curve of the entire sail, instead of having the foot held in a straight line, obviously less efficient than the curve the sail takes in its higher and mid-sections, when filled out by the wind.

The British challenger, *Endeavour*, tried out in her early races a flexible boom, designed to accomplish the same object as the triangular boom just referred to. But it broke in one of *Endeavour's* trials and from last accounts the challenger is being fitted with one of these "Park Avenue" booms, which the British looked upon doubtfully four years ago.

In the case of the British challenger, we find that C. E. Nicholson, her designer, has turned out a remarkably fine yacht, and one that, in the capable hands of "Tom" Sopwith, is likely to prove the most formidable threat that we have had to meet in many years. No expense has been spared to make her the fastest yacht of her class in British waters, and she embodies just as many radical features as our new yacht. Sopwith, being an airplane manufacturer, has used his knowledge of light construction combined with strength in the fitting for her rig, and all her gear is thoroughly up to date.

Endeavour is built of steel instead of bronze, and the underwater plates are laid flush, as in the case of *Rainbow*, and are riveted through on steel strips covering the seam on the inside, and caulked. These plates are specially prepared to prevent rust or scaling, and the bottom is polished to a fine surface, equal to that of the bronze American Cup yachts. The mast is also of steel, the plates being electrically welded and strengthened internally by light steel diaphragms, following nature's method of strengthening bamboo.

AGAIN calling upon the knowledge of aerodynamics acquired in airplane development, the challenger has done much experimenting with model sails in wind tunnels to discover the most efficient combinations of the various sails in *Endeavour's* equipment. Known as a clever helmsman and skilful sailor, Mr. Sopwith can be counted on to give us a real race. He will, of course, be sailing in strange waters, which is always a disadvantage, but his boat has been carefully designed, she is well organized, and will probably be well handled throughout her campaign. *Endeavour* has been successful in her races in British waters, and while her margin of superiority over last year's *Velsheda*, and the other yachts of her class, has not been great, she has won perhaps four fifths of the races in which she has started. She is undoubtedly the best all-around yacht of her class in Great Britain.

On this side of the water, the three Cup contenders are in the midst of a hot campaign as this is written. It is still too early to predict the choice of a defender by the America's Cup Committee. *Rainbow* has won more races than either of her rivals, but she was the first one to get under sail, and her crew have had a longer time to get her shaken down and into proper trim. But, to offset this, she has not shown outstanding form up to mid-July. In a strong wind, the larger, more powerful *Yankee* still seems the best of the trio, and she is being well sailed by Charles Francis Adams, of Boston. In moderate sailing breezes the three yachts are closely matched, with *Rainbow* holding a good "edge," although the new yacht and *Yankee* had met in only a few races up to mid-season.

THE final decision looks as if it might be a close one, with the ultimate choice depending on handling and organization. If it comes down to this, it seems as if the Vanderbilt sloop would be the logical choice. The real test will come in August, when all the yachts have been thoroughly conditioned and will meet in the actual series of trial races. But on whichever yacht the call to defend is finally made, we may rest assured that ship and crew will give their best. Whether this best will be good enough to turn back the challenger, as our yachts have done in 14 other contests since 1870, only the series beginning off Newport September 15th, and continuing until one boat has won four races, will show. May the best sailed yacht win is the wish of all real sailormen and sportsmen.

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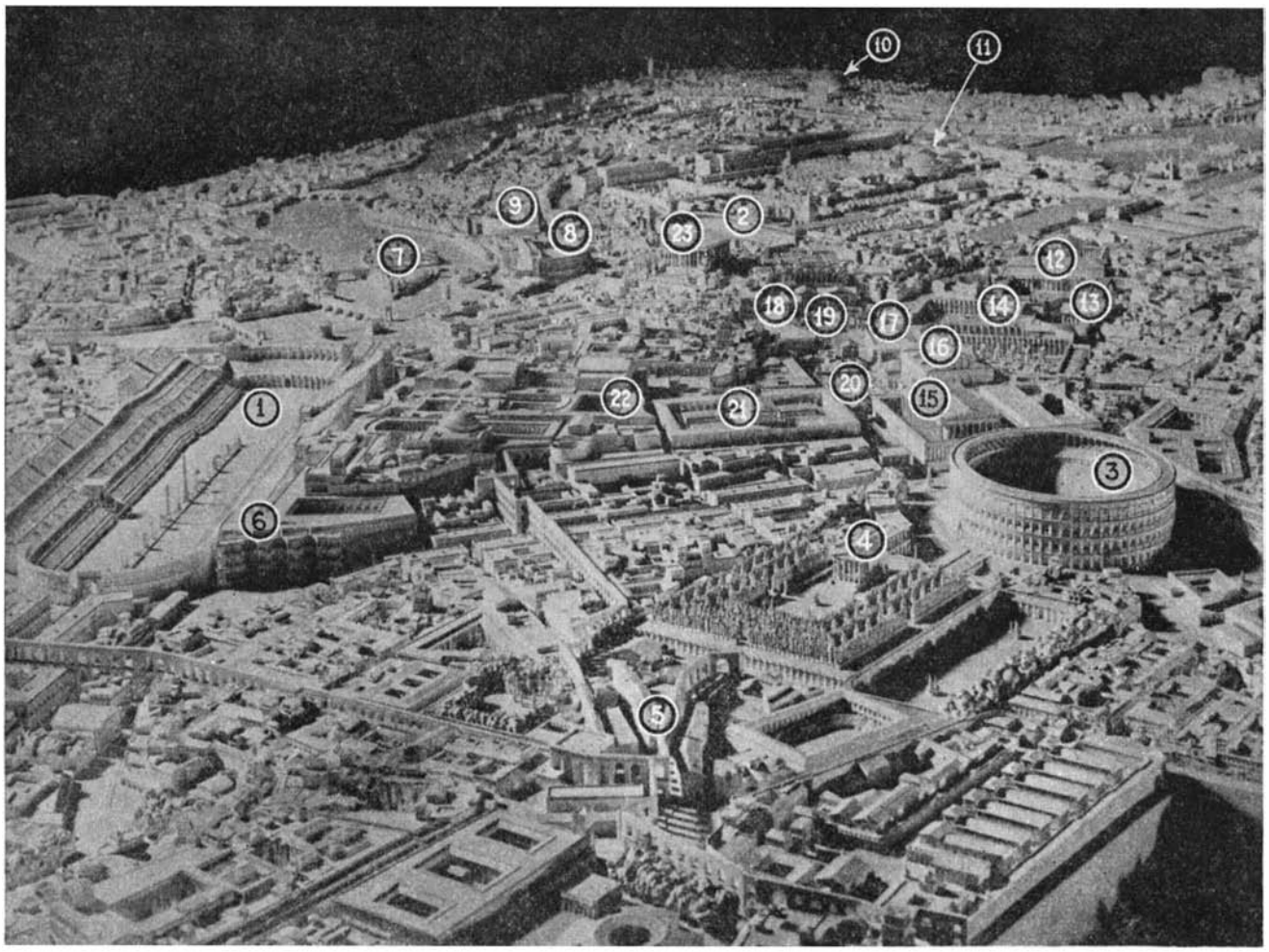
Up to July 18th (when this is written) Yankee, *the Boston yacht, had much the best of the argument. In six trials against* Rainbow, Yankee *won five races, although she was disqualified in one of these for fouling* Rainbow *at the start. Against* Weetamoe, *the Boston cutter won all of the four races in which these two met.* Rainbow *has also been successful against* Weetamoe, *winning four of the first five in which this pair started. Against* Vanitie, Rainbow *won all of the three races in which they have met, while* Yankee *won once and lost once to* Vanitie *in the two trials in which they have been paired. Practically all of these races were sailed in light to moderate winds. What will happen when these four contenders meet in a strong breeze has yet to be determined in the further trial runs.*—The Editor.



This model in clay presents the salient features of old Rome before Mussolini's archeological discoveries

Plastic Model of Ancient Rome

ROME has always lent itself to pictorial representation; now the ancient city has been reproduced in modeling clay. Through the co-operation of the Italian Information Office, in New York, we were able to secure the assistance of a prominent Italian scholar who is thoroughly familiar with Rome and the extensive work that is being carried on there. Dr. John F. Gummere, of the William Penn Charter School of Philadelphia, placed the numbers on the photograph of the clay model, reproduced above, and indicated where important archeological investigations have taken place, or are in progress.

At 1 is the Circus Maximus, which was 2000 feet long and 400 feet wide and held 125,000 people. The excavations begun in 1928 involved the demolition of the buildings encumbering the area. At 2 is the Circus Flaminius.

The Colosseum or Flavian Amphitheater, shown at 3, is one of the best known landmarks in Rome but is now a sorry wreck as the result of earthquakes as well as of greed for stone. The Colosseum took the place of the Circus Maximus, but the accommodations were smaller; the elliptical structure is 640 feet long at the major axis and 500 feet at the minor axis; 45,000 spectators could be seated and 5000 could stand on the roof. A magnificent road has been built by "Il Duce" to connect the Colosseum and the Victor Emmanuel Monument. This is one of the wonders of the new Rome.

NUMBER 4 is the Temple of Claudius, and number 5 is the immense Claudian Aqueduct which in its entirety was over 41 miles long. Number 6 is a colonnaded edifice called the "Septizonium," rounding off the view from the Via Appia, which ended here. Number 7 is the Island in the Tiber which contains the Temple of Aesculapius. The Theater of Marcellus, at 8, has been the center of much excavation. The Theater of Balbus may be seen at 9, and the well-known Mausoleum of Hadrian, 10, has been known for centuries as the Castle of St. Angelo.

The Pantheon, with its beautiful dome will be seen at 11. The buildings in the Forum of Trajan, shown at 12, have been recently restored as has also been the Temple of Mars, 13, and the Temple of Venus, 14. The Temple of Venus and Roma served as a storage space for the machinery of the Colosseum, and will be seen at 15. At the Basilica of Constantine, 16, and the Basilica Aemilia, 17, important excavations have been made.

Following the remaining numbers, we find the Basilica Julia at 18; the Temple of Castor at 19; the Temple of Julius Caesar, 20; the Temple of Apollo, on the Palatine Hill, 21; various imperial buildings at 22; and the Temple of Jupiter at 23 on the Capitoline Hill. Some of these recent and important discoveries were illustrated in our March issue. Rome seems an ever-fresh field for the archeologist and the destruction of the slums has greatly enhanced our knowledge of Roman culture and particularly of Roman architectural remains.

OUR POINT OF VIEW

Why Science Refuses

ONCE more failure has been the result of honest attempts of men of science to "get together" with those who are interested in things psychic, and to investigate psychic phenomena as an actual branch of experimental science. Last winter the professional scientists' magazine *Nature*, published in London, commented on the lack of ordered understanding among many who delve into things psychic, and pointed out a fact which most disinterested persons already know; namely, that inquiry in this field has mainly fallen to the lot of those who wish to prove what they hope to be true.

The editor of the same journal therefore proposed the formation of a body, to be called the "International Institute of Psychical Research," which would undertake to investigate psychic phenomena according to the scientific method. This organization was soon formed under auspicious circumstances so far as science was concerned, for its president was Professor (now Sir) G. Elliot Smith, the eminent anatomist-anthropologist, and its two vice-presidents were the noted zoologists, Professors Julian Huxley and E. W. MacBride. We say "as far as science was concerned," for the psychic end—that is, the other end—of the investigation was represented by a Glasgow business man who had previously been characterized in *Nature* as having little conception of the critical attitude of science. The new body was therefore condemned as not satisfying the conditions of psychical research in a university or similar institution, and as a result of the difficulty of obtaining conditions for research which were in accord with what science regularly demands of the inquiries it makes, it has already died. It died aborning, in fact.

In America attempts have been made to conduct psychic investigation by the scientific method, in which there was a liaison between university scientists and typical representatives of the psychic world, but these attempts have largely failed when it came at last to be realized by the scientists that their friends on the psychic side would not play the game. The evidence is that the psychic side does not even know the rules of the game, though it apparently thinks it does. The rules of the game are the rules governing all good science, and together their faithful practice constitutes what is called the "scientific method." Few understand or fully appreciate what the scientific method is. Few sense its exacting requirements, its stern, rigorous discipline and methodology. Outside of the world of science the best analogy with the scientific method is the rules of evidence employed in the courts. If the legal rules of evidence seem hard-boiled, let the reader study those which govern the methodology of good science; for example, as outlined in the Encyclopædia Britannica under "Scientific Method," or in the noted works on the same subject by Jevons, Ritchie and others. The rules of the scientific method are the rules of logic—tough going, some of them. Emotional and personal feelings, urges, motivations, and wishes, are utterly excluded when weighing the evidence. The jury knows no bias.

Until those who eagerly accept the psychic phenomena they see, as already proved, will actually take the necessary pains to learn just how exacting a thing the rules of the scientific method are, it seems likely that every future attempt to bring psychic phenomena to the scientists for an investigation will result in as quick a rejection as that which has just taken place in England. Thus far the psychic people, with some exceptions, have not been able to assimilate the scientific method, and in too many instances investigations have degenerated into a contest of wits. Science can but poorly play ball with that kind of players—like playing ball blindfolded, hobbled, and handcuffed.

That, and not narrow-minded prejudice, is why most scientists steadfastly refuse to give their time and energies to the investigation of psychic phenomena. When the psychic world makes up its mind to play the game, plenty of scientists will be found to show an interest in the scientific investigation of psychic phenomena.

Welcome, British Yachtsman

FOURTEEN times since 1870 have challengers appeared to compete for the America's Cup, supreme prize of yachtdom. The fifteenth challenger, T. O. M. Sopwith, British sportsman and airplane manufacturer, will bring his *Endeavour* to this country and compete, in September, with the ace of American yachts. To Mr. Sopwith and his crew our greetings; may fair winds and clear skies attend your efforts. If you win, you will gain much more than just a trophy. If you lose, come again. While you are here, the latch-string is out and you will find a hearty welcome from all American sportsmen.

Better Movies

THE various religious organizations which are co-operating in an attempt to "clean up" the movies are waging a commendable battle, and one which, if it does not become fanatical, as is too often the case with crusades, should have the approval of every right-minded citizen.

Science has placed in the hands of the motion-picture producers a mighty weapon for good or for evil. Technical developments in talking pictures have opened fields of entertainment and "sugar-coated" instruction that could never have been touched by the "silents." How the producers make use of these possibilities in the next year or so is going to have a marked effect on the future of the industry.

The producers defend themselves by claiming that they are giving the public what it wants—in most cases vulgarity and salaciousness so thinly disguised as to escape the notice only of a moron. It hardly seems possible that the greater part of the movie-going public of the United States is mainly interested in such trash. In fact, the success of a few of the attempts at producing clean, intelligent pictures belie the defense and place the onus right where it belongs—on the shoulders of the producers who release what they, in their own minds, *think* the public wants.

This is a plea, not for pictures of the goody-goody type only, but for pictures that will insult neither the intelligence of the audience, nor their sense of what is in good taste. Sophisticated drama—of the sort that has kept the classics in vogue for generations—comedy, musical comedy, clean straightforward narrative, all offer more material for moving pictures than can ever be used. Those producers who think that the public want only gutter-English, smutty dialog, situations in which sex and sexual attractions predominate, and double meaning in all jokes, have much to learn. If they persist in pandering to the lower human element, and completely disregard those who desire intelligent entertainment, they should be drastically curbed. Perhaps the present movement will accomplish the purpose. It has our sympathy and support.

A diving helmet being lowered into place on the author's shoulders

DIVING IN

By ROY WALDO MINER
Curator, Living Invertebrates, American Museum of Natural History

THE steady hum of the engine of the *Standard J.* ceased as the bow anchor went overboard.

"Hey there, you Moxie!" shouted Captain Joe Bethell, "Haul up that dinghy! You and Sweeting carry out the other anchor and hook it over that coral in the yellow patch! Hustle 'er out now!"

Soon the graceful launch was floating close to the reef, anchored securely fore and aft. The brass rope ladder splashed into the water from the starboard gangway and I was standing on it submerged to my neck. Sweeting started one of the pumps going while Moxie carefully lowered the helmet over my head. I thrust my right arm through the loop of the air-hose.

The steady clinkety-clank of the pump sounded close to my ear as I adjusted the weight of the helmet to my shoulders and started down the ladder. The edge of the water-surface appeared momentarily through the window of the helmet and vanished upward as I passed beneath it. Immediately the weight was lifted from my shoulders and the helmet seemed as light as a feather. I counted the rungs of the ladder as I descended, marking the number of feet from the surface. I swallowed once or twice to relieve the increasing pressure on my ear-drums, and at the twenty-second rung stepped off the ladder on to the white sand of the sea-bottom.

Steadying myself by grasping a ladder-rung, I looked about me. A short distance away rose the coral reef, tier on tier, to the surface. Clusters of mushroom-like coral growths formed the bulk of the reef. Purple and yellow sea-fans swayed back and forth with the motion of the water, while sea-bushes of soft and varied hue rose from slender stocks, their waving branches, extending upward in widely expanding parallel ranks, starred with hosts of feathery polyps. Caverns and arches of eroded coral, fantastic in form, showed clearly through the unbelievably transparent water or melted into the pearly blue liquid mist in the distance.

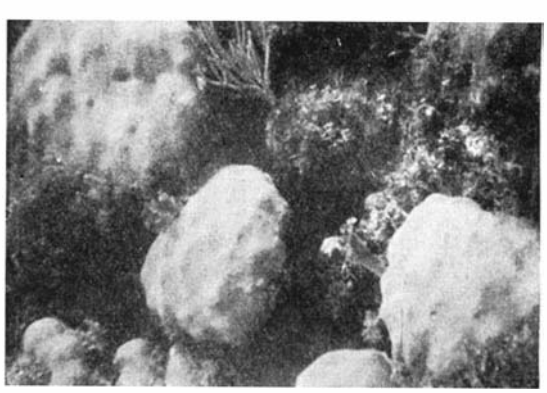
I TOOK a few steps forward, leaning against the push of the current, and glanced up. A disturbance of the water at the summit of the ladder attracted my attention. A pair of legs appeared weirdly on the rungs. The body was not visible, being concealed by the liquid mirror of the water surface. This was impenetrable to the view, but reflected an inverted image of the legs, giving the odd effect of a St. Andrew's cross! In a few minutes the rest of the figure and a helmeted head succeeded the legs, descended the ladder, and stood on the sea floor beside me. Looking through the window of the helmet, I saw the smiling features of Roswell Miller, who, with Mrs. Miller and my artist, Chris Olsen, completed the personnel of my expedition for the American Museum of Natural History.

I motioned toward the reef and we advanced slowly in the direction of an outlying brain-coral that towered above us on a fantastically carved pedestal, with a cloud of bright yellow fishes flitting around its summit like canary birds. Rounding this mass, we entered a crooked passageway which led toward one of the great overhanging arches of coral rock. As we peered within, a moving form became visible in the watery shadows, then another.

Presently, a huge parrot fish, brilliantly blue, varied with deep violet, swam slowly out of the cavern, followed by two others in stately procession. Back and forth they sailed, staring toward us, occasionally nibbling at a bit of loose coral, portions of which they crushed with their white, parrot-like beaks, releasing powdery fragments which rose in clouds as they masticated them for the filmy nourishment they afforded. We signaled to each other and edged back toward the boat. The window of a water-glass penetrated the surface beside the bottom of a floating dinghy. We motioned with our arms, and the undersea tripod splashed down through the water. The heavy underwater movie camera now came gliding down, hooked on the end of a cord.

We slowly and painfully erected the tripod, carefully adjusting it in a favorable position. One must move with deliberation at the bottom of the sea. Attempts at rapid motion were futile and exhausting, but if we moved slowly, the water supported us in half floating fashion and we progressed easily with the effect of a slow-motion film.

After the tripod was erected satisfactorily, we returned for the camera-box. I reached for it but miscalculated the distance, and my hand grasped empty water about two feet in advance of it. Distances under water are deceptive to



Several types of undersea growths photographed by Dr. Miner's expedition. *Left to right:* Mushroom-

CORAL GARDENS*

A Scientist Works Beneath the Clear Waters of the Coral Reefs of the Bahamas

the vision, because of the unaccustomed density. Groping forward, I felt the handle of the camera-box, and had no difficulty in lifting, with one extended hand, a weight that both hands could scarcely raise from the boat's deck, in the open air. We carried the box over to the tripod, placed it in position, and took turns pressing the lever that actuated the mechanism of the camera.

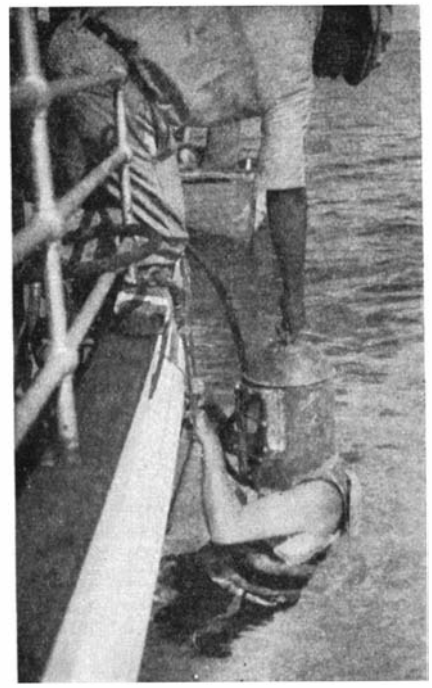
As the focus of the camera had to be set at a predetermined distance before sending it down, it was impossible to focus on a fish directly, and it was tantalizing to see beautiful queen triggers, blue angel fishes, and grotesque trumpet fishes come into plain view at a distance of 25 feet, when we had carefully arranged our focus at ten feet.

After 50 feet of motion picture film had been taken, we carried the box back to the cord which hung suspended from the launch and sent it up for Captain Bethell to rewind and return to us again. When the film had completely run out, it was sent up for Mrs. Miller to change, and a second undersea box containing color film was sent down. This was Roswell Miller's specialty, and with it he obtained beautiful motion pictures depicting the soft colors of the living corals and gorgonians and the brilliant hues of the fishes which lived among them.

Our attention was attracted by a wonderful cluster of golden yellow coral which rose in an enormous dome above our heads. It was composed of a succession of expanded mushroom-like caps, completely covered with small conical mounds which gleamed in the sunlight flickering through the ripples overhead. Like most such growths, the caps were supported by eroded columns of dead coral limestone overgrown with encrusting sponges of scarlet, or green and yellow. Clusters of coral grew vertically from the sides of the columns sculptured on both sides of their thin leaf-like expansions with close-set series of fine parallel ridges exquisitely wrought with radiating star-shaped calices. Hues of delicate rosy pink shaded into cream-yellow tints, suffused at intervals with areas of orange and purple.

WE had brought with us specimens of this coral which had been colored artificially by our artists for use in the Coral Reef Group being constructed in the American Museum. We now took these with us down under the sea, and placed them beside the living specimens for comparison so as to test the accuracy of our colors. The result was gratifying. At arm's length, they looked exactly like the real coral and blended with their living neighbors so perfectly that they could not be told apart!

One stands amazed at the wealth of detail which gradually dawns upon the vision as the attention is directed to the multitudinous forms of which the reef is composed. Here, a magnificent purple sea-bush spreads its comb-like fronds before us. Every branch is covered with thousands of transparent cream-colored polyps each spreading eight raylike tentacles around a tiny dot of a mouth, so small that it can be seen only upon close examination. The sunlight shining through their translucent crowded bodies outlines every twig of their waving, treelike home with a multiple margin of glory.

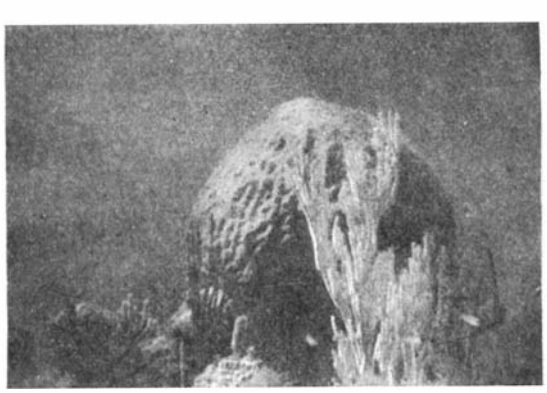


The helmet in place, the author starts down the brass rope ladder

A cluster of fluffy green clubs rises from a crevice between two rounded brain-corals. The starry blanket covering them seems to be very soft and deep. I touched it with a speculative finger. The soft clubs magically transformed themselves into a cluster of hard, finger-shaped projections of bright purple! Looking closely, I saw that the fingers were covered with thousands of pinholes, and, as I watched, one filmy form after another peered forth and gradually elongated until the purple surface of the fingers became clothed once more with fluffy green.

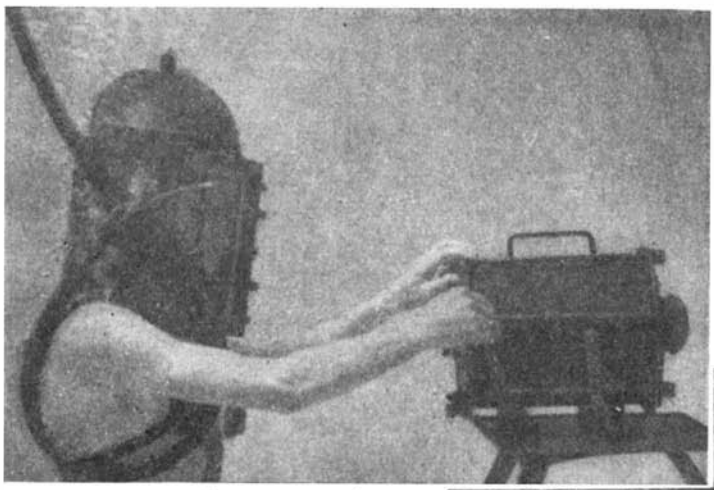
The sea-clubs, sea-bushes, sea-whips, sea-feathers, and sea-fans are all grouped together by scientists under the name "*gorgonia*." Unlike the corals, their tree-like skeletal support is flexible, being composed of a tough, horny substance invested with a crust of felted calcareous needles, irregularly shaped and of extremely small size.

The reef-forming corals resemble the gorgonian polyps in appearance and structure except that their cylindrical polyps are surmounted by many tenta-



ike *Orbicella*; Elk-horns; Gorgonians among the corals; Large *Orbicella annularis*; Fan corals

*Courtesy *Natural History*.



Above: **Using the special underwater movie camera described in the text.** ***Right:*** **Watching the divers through a water glass.** ***Lower right:*** **Painting under water, using a Monel-metal palette and special canvas**

cles in multiples of six, and have the power of laying down a skeletal structure of carbonate of lime beneath and around their soft bodies. The concerted action of millions of coral polyps builds up the immense and complicated limestone structures which form the coral reef. The coral skeletons may form crusts over the sea bottom, or may rise in dome-shaped masses like the brain and star corals or postlike growths capped like mushrooms, as in the case of the orb corals. They may be leaf-shaped or like rosettes, or sinuously petalled flower-like colonies. Among the most beautiful and striking corals of the Bahaman reefs are three species of *Acropora* which form branching structures, the most delicate and fragile of which is the fan coral. The staghorn coral builds loosely branching many-tined skeletons reminding one of the antlers of a stag. The largest and most massive of the three is the great elkhorn, or palmate coral which forms gigantic growths with branches like beams, expanding into broad, palmate tips. This species dominates the great Andros barrier reef, where the scene of the American Museum's Coral Reef Group is laid. All the other species of coral are found there, but are overshadowed by the great orchard-like groves of the elkhorn, which rise in tangled thickets of marble trees tinted with saffron.

DAY after day, whenever the weather permitted, the good launch *Standard J.* took us from clump to clump of the reefs at Rose Island, Athol Island, and Long Shoal. We had three undersea cameras, two for black and white motion pictures, and one for color film. The latter and one of the former were the ingenious contrivances of Roswell Miller. There were also two helmets and pumps, which thus enabled two persons to go under the sea at a time. We could walk about together and communicate by means of predetermined signs which enabled us to compare notes for our work. At times Chris Olsen would go down with palette and easel constructed of non-corrosive metal. He would set up his easel on a convenient clump and fasten into it an oiled canvas securely mounted on a sheet of plate glass. Then he would make sketches with oil colors directly from nature, undersea, at a depth of 15 or 20 feet. At first, he used the regulation artists' brushes with wooden handles, but whenever, inadvertently, he let go his hold on one, it would float to the surface and Moxie would have to row out with a dinghy to get it. Besides, in the wash of the tide, a brush is not steady enough for applying color. So Olsen finally used a palette knife instead, which was much easier to manage.

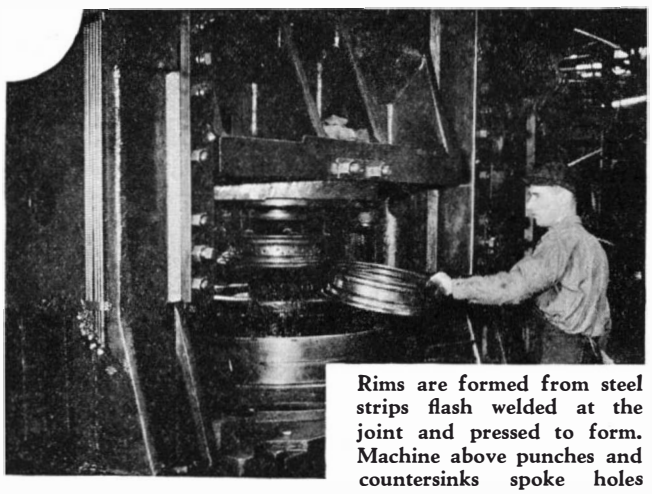
On this trip we had the pleasure of introducing to the undersea world His Excellency Sir Bede Clifford, Governor of the Bahamas, and Lady Clifford. They came down in turn and explored the face of the reef, working their way through the crevices between the coral clumps, facing the inevitable camera at a depth of 20 feet. The Bahaman officials were all greatly interested in our work, and did everything in their power to assist us.

Occasionally, when the weather was too rough for diving, we went ashore on one of the rocky cays which abound in the waters near Nassau, and, by means of hammer and hatchet, hacked off huge fragments of the eroded "honeycomb rock" of which they are composed. This rock is wrought by wave and weather into most fantastic forms; in fact, the whole surface of the cays is full of holes and passages like a petrified sponge. We obtained more than a ton of this rock and shipped it to the Museum, where we are now reproducing a portion of such a rocky cay as a part of the foreground in the upper section of the group, using the original material in the process.

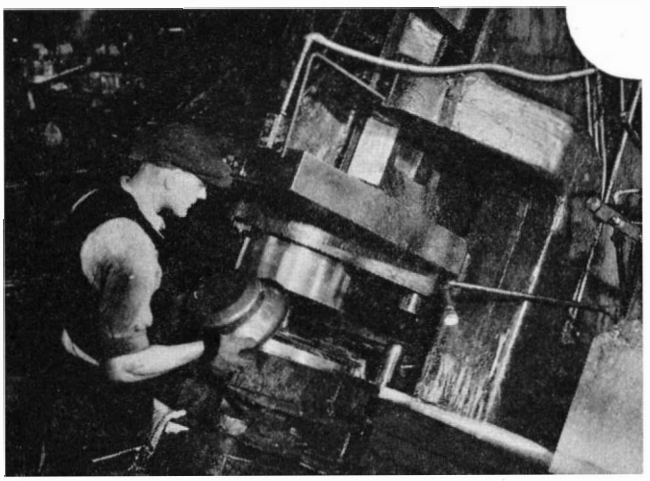
This group is now nearly finished. A few months more and the exhibit will be complete, after ten years of arduous work. During that time, five expeditions have been undertaken to the Bahamas. These five expeditions have been interpolated between long periods of work at the Museum, preparing and coloring corals, erecting the elaborate framework to support them in the group, consisting of more than seven tons of structural steel (see page 216, April 1932 SCIENTIFIC AMERICAN. *Ed.*), modeling and coloring fishes and the other multitudinous forms of undersea life composing the coral reef association. When finished, it is estimated that the exhibit will be the equivalent of 30 ordinary museum groups in size and difficulty of preparation. It will occupy one third of the entire farther end of the great Hall of Ocean Life, probably the largest museum exhibition hall in the world.

600 Wheels an Hour

An Efficient Set-Up of Special Machinery and Gravity Conveyors Makes It Possible to Turn Out Motor-Car Wire Wheels at this Speed

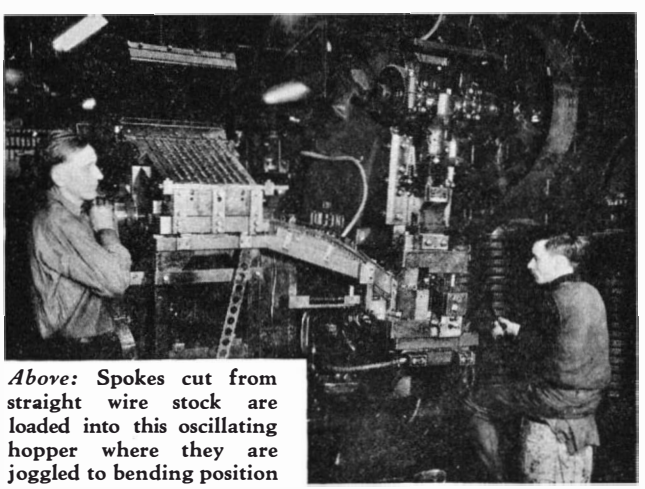


Rims are formed from steel strips flash welded at the joint and pressed to form. Machine above punches and countersinks spoke holes



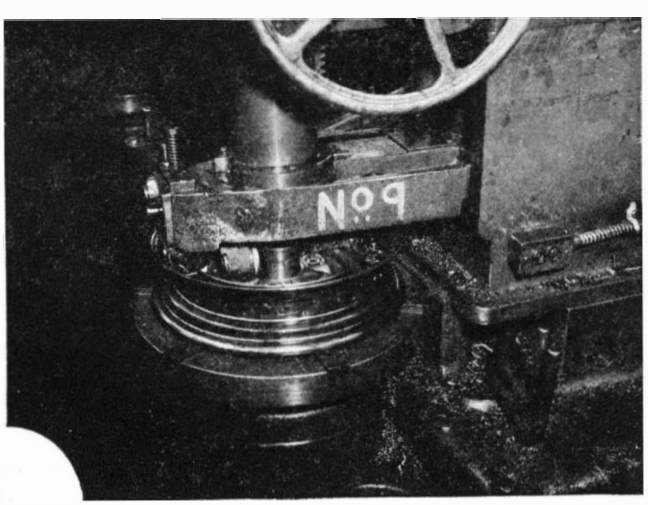
The first operation in forming Chevrolet outer hub shells is performed in this double-geared punch press. The operator is shown inspecting a stamping. To the right of the press is a spray of lubricant directed on the strip of stock which is being automatically fed toward the machine to a point where it can be grasped by the operator. This type of inclined press speeds up operations as the work is discharged and transported by gravity to next press by means of sloping runways

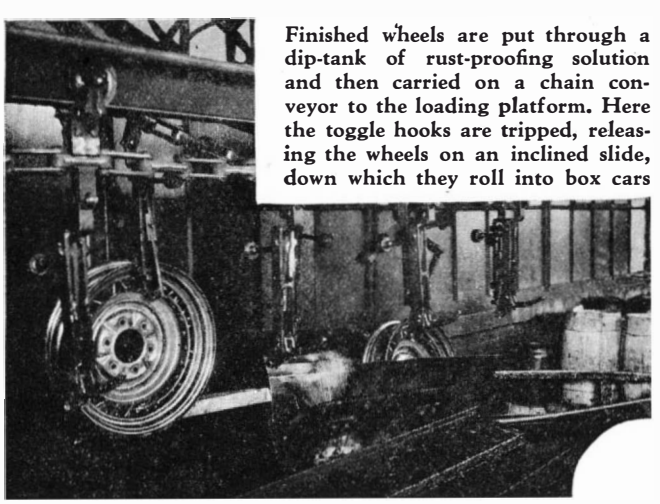
Below: Press that forms the inner hub shell. Formed shells are discharged to rear



Above: Spokes cut from straight wire stock are loaded into this oscillating hopper where they are joggled to bending position

Below: After the 48 spokes of the wheel are riveted in two operations which insure even tension on each spoke, the assembled wheel is placed in this semi-automatic machine where the hub and face of the hub side of the wheel are bored, while at the same time the hub face is finished from below





Finished wheels are put through a dip-tank of rust-proofing solution and then carried on a chain conveyor to the loading platform. Here the toggle hooks are tripped, releasing the wheels on an inclined slide, down which they roll into box cars

THE STERILIZATION LAW IN

By C. THOMALLA, M. D.

IN the new Germany today laws are being enacted which are designed to a large extent for the benefit of future generations, and usually with no regard for the approval or disapproval they may now find. In Germany all thinking and planning has as its aim the improvement of the health standards of the people, through the application of biological science. May it not be that the sufferings and sorrows of the Germany of the past, of today and tomorrow, may sooner or later become the concern of any other nation?

Germany has profited in this respect from American experiences and practices. For a number of decades 27 of the 48 American states have been establishing legislation to prevent the propagation of hereditary defects, thus interfering with the transmission of feeblemindedness, idiocy, mental disorders or pathological criminality. The German sterilization law of recent origin, however, caused an unprecedented alarm all over the world. Although the scholars as well as laymen of a great variety of nations considered it a landmark in the history of mankind, and welcomed and celebrated it as a diversion from the wrong road thus far traveled by humanity, there were groups which for various reasons characterized the German "Law for the Prevention of Hereditary Diseases in Posterity" as a return to barbarity and to the unchristian customs of the Huns. Nevertheless we Germans accept this charge, jointly with those 27 enlightened and progressive states of America, as well as with many a Swiss canton and the Scandinavian countries, and we are glad to learn of approving voices raised in such other nations as Hungary, Czechoslovakia and more recently in England—voices which urge the enactment of similar laws.

OF the many justifications which exist for sterilization laws, the most elementary and obvious ones are those in regard to cost. Take, for example, the cost of education: For each sound and healthy pupil Germany pays annually from public funds the sum of 75 Reichsmarks. For a so-called *Hilfsschulkind*—that is, a feeble-minded pupil—several times that sum is required. For an inmate in a reformatory, that is, for an asocial type, psychopathic or otherwise, it costs the German people 20 times as much. An insane person costs the state and the taxpayer from six to eight marks daily. Insane persons of criminal potentiality who require special attendance and watch in isolated quarters cost up to 20 Reichsmarks daily. The majority of the gainfully employed individuals in Germany do not earn nearly as much as the state has to pay for supporting degenerate, idiotic, criminal and insane persons. In a state which is desperately fighting for its existence, as is Germany, it is a simple problem of arithmetic whether to allow for all eternity the procreation of defectives, thereby most heavily burdening financially the working people, or whether to interfere before it is too late with the career of the worst and most costly of this kind of defectives.

ON these pages we present the third article of our series on human sterilization. This article was secured through the German Embassy at Washington, and is therefore regarded as an officially sanctioned statement of Germany's aims in connection with racial and national eugenics.

In a later number we expect to present an article by the Reverend Ignatius W. Cox, S.J., Ph.D., Professor of Philosophy at Fordham University, a Jesuit institution, and this will represent the views of those who are opposed to human eugenic sterilization.—*The Editor*

IT must be pointed out, however, that in addition to the mentally diseased, a certain group of physical defectives of a hereditary nature will also fall under the sterilization law, such as the hereditary blind and the hereditary deaf and dumb. These otherwise mentally competent persons, many of whom are frequently highly qualified, do not cause any expense to the state (excepting the costly period of their training). They are in a position to earn their own living. Nevertheless the legitimate associations of these groups themselves declared that they were in favor of this law, which, after all, is supposed to prevent the transmission of such tragic cases into future generations. The voluntary approval of the law by the associations referred to, indicates an existing appreciation for the action of the government.

The acceptance of the sterilization law, both by the government and in the opinion of the people is, however, preeminently due to the danger that in the future inferior types may numerically outbreed the higher types. Professor Lenz, who occupies the chair of race conservation in the University of Berlin, offered a hypothetical example which everyone may check with regard to its soundness. Suppose that Germany in 1630 had possessed a population of which 50 percent were white and 50 percent colored. If, then, during the last 300 years the colored population had increased by four children at intervals of 25 years, and the white population by only three children at intervals of only 30 years, then 90 percent of the people today would have been colored, and only the remaining fraction white. Substitute for colored such qualities as hereditarily weak, asocial, indolent, idiotic, incapable, and for white substitute high type, industrious, intelligent, brave, and so on, and you will recognize how quickly an entire nation may degenerate.

IN Germany the higher types have at present only one or two children. Families of healthy heredity very rarely have a number of children. Moreover, the higher type, in view of their good school and professional training, do not decide to marry much before their middle thirties, while the inferior type, feeling no responsibility whatsoever, give birth to children ordinarily between the ages 18 and 25, or even earlier, and these offspring are destined to become public charges. In other words, within a single century two hereditarily healthy children of a high type family will in the best case have only 16 descendants while, on the other hand, the five inferior type children of a family of weak heredity will bring forth during the same period 3125 descendants even at the statistically lowest rate of increase characteristic of the asocial group. However, since these children have a relatively high death rate, or do not beget more children, half of the number mentioned may well be subtracted from this sum. But this still leaves nearly 1600 descendants of the inferior type—that is, a hundred-fold increase over the

GERMANY

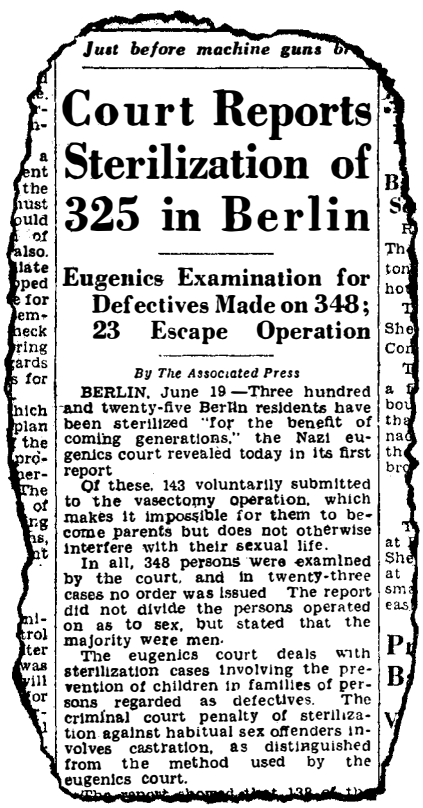
higher type. The bad outbreed the good.

That is the gigantic danger against which Adolf Hitler wants to protect Germany. A people will deteriorate when its best hereditary stock is losing out—that stock from which leadership should be replenished. During the rule of the now overthrown system in Germany a limitlessly liberal attitude toward this matter artificially promoted the increase of inferior types at the expense of the healthy. Through exaggerated welfare measures those deplorable pathological types were enabled to marry and to bring children into this world. To quote a particularly striking example, it even happened that criminals and mentally defective persons were given parole from penitentiaries and other institutions, in order to permit them to enter the matrimonial state and propagate. If, on the other hand, any welfare agency called for funds, in order to ward off sickness or a general run down condition in a healthy family, none of the state, municipal or other budgets contained provisions for such purposes. A fundamental change has occurred in that respect. The sterilization law in itself will have an educational effect, since it will make the entire nation more conscious of biological problems.

THE sterilization law is the result of much thought, and has been worked out and tested to its last detail. Each physician in the German nation must report to the health officer any case of hereditary disease which comes to his attention. The diseased will be given medical advice which is required by law in each case. If he is capable of taking an intelligent view of his own situation he may himself make application for sterilization. Otherwise his guardian or the competent health officer is obliged to do so. The application will be submitted to a Hereditary Health Court composed of two legal officers and two medical specialists in eugenic problems. The physicians of this particular court examine the hereditary diseased, and conduct inquiries into the respective conditions of his entire family. This procedure will ascertain whether or not the pathological case under discussion is likely to be a hereditary one. Eight clinically defined diseases are designated by the German sterilization law.

In addition, severe cases of alcoholism, in which the persons afflicted are otherwise mentally unfit, are subject to the provisions of the law. If, after the conclusion of the examination and inquiries by the physicians of the Hereditary Health Court, a case is clearly established, the operation will be ordered and performed by well trained surgeons or gynecologists in a hospital specifically appointed by the Court. It is also provided by the law that the physician who performs the operation may not be chosen from among those who had participated in the preliminaries of the case.

Should the person to be sterilized object to the decision of the Hereditary Health Court, appeal can be made to



Just before machine guns br

Court Reports Sterilization of 325 in Berlin

Eugenics Examination for Defectives Made on 348; 23 Escape Operation

By The Associated Press

BERLIN, June 19.—Three hundred and twenty-five Berlin residents have been sterilized "for the benefit of coming generations," the Nazi eugenics court revealed today in its first report.

Of these, 143 voluntarily submitted to the vasectomy operation, which makes it impossible for them to become parents but does not otherwise interfere with their sexual life.

In all, 348 persons were examined by the court, and in twenty-three cases no order was issued. The report did not divide the persons operated on as to sex, but stated that the majority were men.

The eugenics court deals with sterilization cases involving the prevention of children in families of persons regarded as defectives. The criminal court penalty of sterilization against habitual sex offenders involves castration, as distinguished from the method used by the eugenics court.

the Supreme Hereditary Health Courts. The latter are located in larger cities where, as a rule, special medical authorities can be called into the case. If such courts sustain the decision the sterilization can be enforced, unless the case is to be appealed. The possibility of compulsory sterilization guarantees that the law will be carried out in the most important and unusual cases.

There are also, however, clauses in the law which are of a mitigating character. Where, in insanity cases, the persons afflicted are deemed to be inmates of asylums for life, they will not be sterilized. Persons who voluntarily enter an asylum (which assumes the responsibility to see that no reproduction will be possible in any way) are exempt from sterilization, even in the face of Hereditary Health Court decisions.

Since conscientious objections of a religious nature figure so prominently in the propaganda against Germany and its sterilization law, they need to be mentioned at this point. It is, by the way, a historical fact that up to the middle of the 19th Century the choir boys of the Sistine Chapel were submitted to castration, in order to preserve the quality of the high treble voices of the boys. Apparently no conscientious scruples were raised against such operations, although they were obviously of a much more severe character than sterilization! On the other hand, nowhere in the entire creation of Divine origin, where the laws of God determine natural life—neither in the vegetable nor animal kingdom nor even among primitive peoples—is it possible for the defective and lower types to increase profusely. It was only because of a hyper-civilization that hereditary inferior types (which rather remind us of animal-like behavior than of the image of God) could, without any responsibility, propagate their kind without limit. If, on the other hand, men of the 20th Century have successfully used their God-given mind for the discovery of means which will guarantee the health and happiness of future generations, would it not rather be their further duty to prevent the coming into existence of unhappy human beings who would only become the source of trouble and sorrow for the rest? National socialist Germany considers interference with unfit life to be a sound application of the true Christian love of one's fellow man.

STERILIZATION simply involves the separation of the spermatic ducts or of the tubes, by means of a minor operation. Persons subjected to it will suffer no effects on their physical or mental capacities, nor will they be restricted in the enjoyment of any pleasures life may offer. Furthermore, the sterilization procedure is to be made in individual cases a matter of the greatest secrecy.

It is only natural that the *negative* character of the sterilization law, the struggle against hereditary diseased offspring, will be supplemented to the fullest extent in national socialist Germany by *positive* measures. Hereditarily healthy families, especially those with many children, are to be given ample recognition and privileges. The sterilization law in force since January 1, 1934 will protect future generations in Germany from the pressing financial support thus far required by hundreds of thousands of hereditary defectives. The danger of their overwhelming growth, and the resultant interference with the lives of the hereditarily healthy, is banned forever.

The great Ziggurat at Ur, a staged tower erected about the 23rd Century B. C. by Ur-Nammu. It is exactly like the Tower of Babel, which was built by the same king, and was the main religious building of the city. It is in fair condition today

EXCAVATIONS AT UR*

By C. LEONARD WOOLLEY, M.A., Litt.D.
Director of the Joint Expedition of the British Museum and the Museum of the University of Pennsylvania to Mesopotamia

(Concluded from August)

IN the course of our work we have learned quite a lot about the people of Ur. We were able to discover something of their handicrafts and even of their ideas, because, dug down into the flood silt, there were the graves of the people who had survived the flood, not necessarily people who had seen it, but a generation or two after it, and under the flood deposit there were plentiful remains of the antediluvian inhabitants. In the graves we found skeletons laid out rigidly straight, that being an entirely different burial custom from what obtained later: the Sumerians of our royal cemetery laid their dead on the side, with the legs bent and the hands brought up before the face in the attitude of one asleep. At the feet were put clay vessels for food or drink, thus showing presumably some belief in the journey of the soul to a future life. Those vessels, made without the wheel, are extraordinarily well made, with thin walls, well balanced, well shaped, and sometimes decorated with painted patterns, which, though simple in their geometrical elements, are extraordinarily well composed, beautifully adapted to the shape of the vessel, and they really make of these antediluvian pots the finest products of the potter's art that you get in the whole of Mesopotamia throughout all its long historic age. With them there came, both in the graves and in the pre-flood dwellings, queer figures of baked clay, with very slender modern bodies and grotesque heads, with reptilian faces and elongated dome-like skulls, like some modern sculpture! These are not portraits of women but figures of goddesses or demons worshipped by the people, whose religion must have been largely a religion of fear.

AT first sight there is nothing that is common to the great cemetery. You first of all get the apparent breach between the cemetery and what we call the Jemdet Nasr period, with its polychrome vessels. Then there is another break in culture and we come to what we call the al'Ubaid period, with something apparently radically different. But is it a difference? That is the question we have to answer. There are certain things which make one modify one's view as to these changes. We must have changes where we are dealing not only with centuries but with thousands of years. But if we can get links running all through, they are far more precious than all the diversities necessary in human progress; they prove much more than the variations do and they may even provide the answer to the particular problem we have set out to solve.

First of all, there is the great Ziggurat of Ur, the staged tower erected about the 23rd Century B.C. by Ur-Nammu. It is exactly like the Tower of Babel, which was built by the same king. This huge mass was the main religious building of the city. It dates to only 2300 B.C. and is extraordinarily well preserved. Was it first built in 2300 B.C.? Is there any link which can carry this back? Because the Ziggurat, or staged tower, which is a common feature of every great Sumerian city, is certainly a mark of the distinctive culture of the people.

*Courtesy the *Journal of the Royal Society of Arts*. Photographs by the Joint Expedition.

If we can trace it back beyond the cemetery period, we shall have done something to prove our point of historical continuity. This tower stood on a platform, and on the platform there stood round the Ziggurat a whole range of religious buildings, mostly now destroyed, whose ground plan we have been able in part to recover. We dug through those ruined buildings on the Ziggurat platform and at a lower level we discovered an earlier range of buildings well enough preserved for their ground plan to be made out in every detail with absolute accuracy, so that here we have the ground plan of the Ziggurat platform as it was, not in 2300 B.C. but in 3100 B.C., that is, just after the close of our great cemetery period, and the buildings reproduce almost exactly the buildings of many centuries later. They were imitated by successive builders, so that continuity from 3100 B.C. was faithfully maintained for at least 1000 and probably for 2000 years.

Does it go any further? The terrace on which the Ziggurat stands is surrounded by a very heavy wall of mud brick about 35 feet thick and faced on the outside with limestone. It rests upon a much older and a wider wall, which follows exactly the same lines and contains within its area buildings which reproduce exactly the later buildings. This building must, from the character of its brickwork, go back to something like 3700 B.C., that is, it is older than the whole of our royal cemetery, and yet the link which binds it to 3100 B.C. is absolutely perfect. Every wall of this old building is reproduced in the later, and therefore the tradition does go back. But it goes back further than that. Inside the platform of the Ziggurat of 3700 B.C. we dug down, and we found first one wall and behind that another, walls built again of bricks of an entirely different type, which we know, by comparison with excavations carried out on other sites, such as Warka, the ancient Erech, go back to something like the fifth millennium B.C. Yet the tradition is exact, and there was already then standing and dominating Ur such a Ziggurat—on a smaller scale, certainly, but similar in nature—as we found was built in the 23rd Century B.C., and such a Ziggurat as was last restored by King Nabonidus of Babylon in the 6th Century B.C. The continuity is perfect from the 6th Century B.C. back to the fifth millennium B.C.

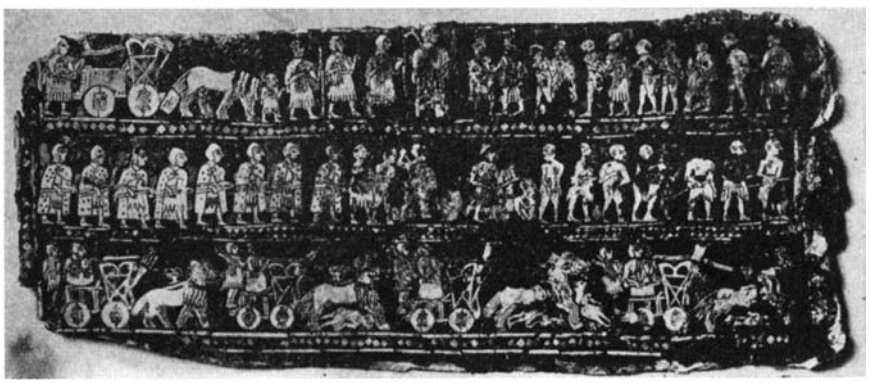
I have mentioned civilization. Of course, the treasures of gold and silver and mosaic, and so on, do indicate a civilization of a high order, but, when we use the term "civilization," what exactly do we mean? What connotes civilization as distinct from advanced but barbarous culture? I should say that civilization connotes a certain proficiency in art and technical science, such social organization as almost necessarily implies city life, where at any rate the State maintains its supremacy over the individual by a recognized system of law, while still allowing the individual free play for his character and for his predilections, and in the third place, I should desiderate for civilization a knowledge of the art of writing, for only when you have writing can you be certain of the preservation of thought, can you be sure that inventions once made will not be lost, that traditions inherited will not disappear with a subsequent generation, but that there is that regular and ordered progress without which civilization is static and really ceases to exist.

In Mesopotamia we have the art of writing. I suppose that to most people the cuneiform script, in its appearance, is familiar enough—those queer signs composed of wedge-shaped lines formed by the pressure of a chisel upon the surface of the wet clay. There you have finished writing, as it has been familiar to us for a long time. Fully developed, its character is obvious, but, if you take an earlier example, you find that the wedge-shaped line is absent. We have from the royal cemetery, for example, a golden bowl with an inscription on the side of it, but it has not got the wedge-shaped line. It is not cuneiform, properly speaking; it is linear writing, which is the precursor of cuneiform. It is only the shape of the composing line that is different—the signs are the same—so there the tradition is exact. Then, underneath the cemetery, where we found clay jar sealings, we also found tablets covered with writing, but these again are purely linear and not cuneiform, and I think that, with a certain amount of imagination, one can feel that behind the signs there are pictures. They are a little more naturalistic than the cuneiform signs. That is particularly noticeable in some tablets found by the Oxford Expedition at Jemdet Nasr, where the signs are clearly drawn, and we get a step further back in writing. The man was not doing exact pictures, but he had something in his head which he drew with a point instead of by pressing his chisel edge into the clay, and so we approach nearer to picture making.

On a contemporary seal impression that we found at Ur there is an inscription and this has a definitely pictorial element in it: instead of the signs being built up of straight lines there are

Above: **Calf's head of gold and lapis lazuli decorating the front of the harp of Queen Shub-ab. The inlay is original, the wood is restored.** ***Below:*** **A bull's head of gold, with beard, eyes, hair, and horn tips of lapis lazuli. From king's tomb**

curves, and we get closer to something naturalistic. At Erech or Warka there have come to light clay tablets on which the writing is reduced to a minimum and there are simply pictures, not signs at all, the actual objects being drawn with a sharp point in the wet clay. We cannot date these, but they again go back beyond the period of Jemdet Nasr and are almost certainly about contemporary with the last years of the al'Ubaid art, with its painted pottery. Here we get the art of writing carried back to its beginning. In Mesopotamia we can trace it from the finished script to the faint gropings after a script that we get in the pictograph. That again, I think, is a proof of continuity that cannot be overlooked.



The inlay stela from Ur. Scenes from war, made up of pieces of shell cut and engraved and mounted on a background of lapis lazuli. Found 1927-1928 season

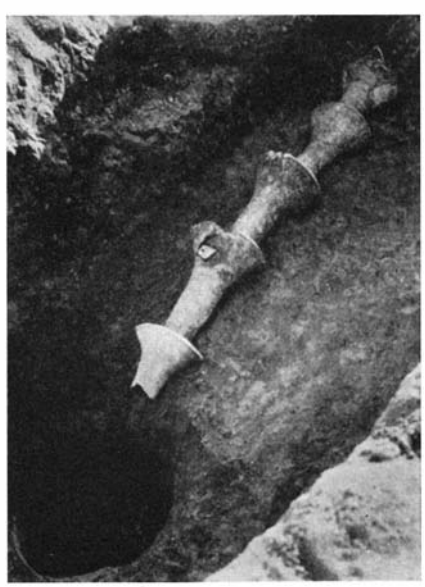
AGAIN, we find the continuity in objects. Digging below our royal cemetery we found older remains, rubbish mounds, which contain objects thrown out from the temples, and among those objects are quantities of jar sealings. People took a clay jar which contained wine or something else and tied a piece of cloth over the mouth, and over that cloth they spread wet clay and on the wet clay they stamped their seal in order that the jar might not be tampered with. That clay jar sealing is exactly like the sealing wax over the cork of a modern wine bottle, and the seal was impressed in exactly the same fashion. Underneath our royal cemetery, and therefore belonging to an earlier date, we found such jar sealings. On one of them, rather crudely done, there is a representation of a chariot, with two men in it, drawn by donkeys. The subject is curiously familiar to us, because, though the jar sealing must date from about 3750 B.C., it is simply a forerunner of the great "Standard" of Ur, on which, in mosaic of shell and lapis lazuli, there are the same chariots drawn by donkeys and with fighting men and the driver in them. Here is a link which binds the great cemetery with its immediate past.

Then we can take another thing, the cylinder seals which people carried and with which they signed the written documents of their time. They are so common that they are a most precious record.

I think that in what I have told there is enough to prove to most people that the remarkable civilization illustrated by the royal tombs did not spring out of the blue. Of course, it could not do that; but it was not introduced from abroad into a barbarous country. It was the result of a long and slow process of evolution, and that civilization was built up by degrees in the country in which we find it. Its roots are there as well as the flower. By excavation in Mesopotamia we are able not merely to discover a remarkable and hitherto unsuspected phase in the life of one country, but we can trace it almost to its origin, and in that we are doing no unimportant thing. I have suggested that this art of the great cemetery has profoundly influenced later ages. I have shown how the forms of architecture continued have been inherited by ourselves. One could expatiate on that side of the subject for a very long time indeed. We find in Egypt, before the First Dynasty, numerous imports from Mesopotamia, which seem to imply that the Sumerians supplied to the barbarous people of Egypt, as they were then, just that impetus which enabled them to start out for themselves and to develop the remarkable and independent civilization which is familiar to us as the civilization of the Nile Valley. We do know for a fact that the Sumerians imposed their culture upon surrounding peoples and so impressed it upon their successors, the Babylonians, that, civilized as the Babylonians were, they made no new discoveries at all; they hardly advanced beyond what their predecessors had known and they preserved civilization rather than invented it. We know, too, that the Sumerians sent out the ancestors of the Hebrews with all the traditions of law, civilization, religion and art which they had themselves evolved in their home country and which the Hebrews never entirely forgot, but by which they were profoundly influenced.

The Sumerians were an extraordinarily important people, and the more we look at them the more we see that they were essentially modern. Modern man goes back as far as we can say we are able to understand the feelings of the man of the time. If we can look at the early Sumerians and read their writing, study their works of art and understand their buildings and more or less grasp their civilization, if we can know from what they have done that in our circumstances they would do as we are doing and that, similarly, we in their circumstances should have done as they did, then we are fully at home with them.

THEY are modern man, distinct altogether from those paleolithic and neolithic peoples with whom we do feel terribly at sea. Modern man probably goes back to something like 6000 B.C. We have him extraordinarily well exemplified in the Sumerians, and, because their influence never died out and they have played a great part in the history of human progress, when we watch their earliest beginnings, and trace them up from those beginnings to a flower of art, we are watching, so far as we know at present, the earliest efforts made by man to rise above himself and to develop that extremely complicated and complex form of life that we call civilization, and we are observing the process not merely in a forgotten and unimportant corner of the earth but in the main stream of human life. The more we learn about it, the better we can understand the progress which man as a whole has made, and I think, therefore, the better we can understand history in general, both in the past and in the present.



Plumbers in Ur did lasting work. This is an early pipe drain leading to a cesspool beneath one of the re-excavated buildings of the city

As the obsolete jetty looked after dynamite had cut pilings off below the surface and before being dragged from the sand by a horse team

As a water jet displaced the sand the dynamite charge on a lath submerged to the required depth against the pile that is to be cut

BEACH BLASTING*

By STEPHEN J. RYAN

SEVERAL years ago the Borough Council of Beach Haven, New Jersey, constructed four jetties of oak and chestnut piling along the beach to protect it from erosion. The piles were driven 25 feet deep into the sand in long double rows. These clusters of pilings on the beach were apparently satisfactory but after Beach Haven had begun to develop rapidly as a summer resort, the authorities decided to erect stone jetties extending out into the ocean for a distance of 100 to 125 feet. The wooden jetties were no longer necessary and, as it was desired to increase the size of the bathing beach and to extend the board-walk, the Council decided to remove the unsightly wooden projections. Workmen endeavored to pull each pile out of the sand by the use of a large tripod and block and tackle, aided by a water jet. This process was found to be too costly as the largest number pulled out in a day by several men was 25, and the average much less than that.

The Borough Council then decided to try dynamite and an explosives expert of the duPont Company was requested to look over the job. Advice was desired as to whether or not it would be practical to cut off the pilings at a safe distance below the surface of the sand by the use of dynamite.

The explosives expert asked the Mayor and Council to purchase a small quantity of dynamite and some electric blasting caps for a "test day." The result of the "test day's" work was the removal of 133 oak pilings, each ranging from eight to ten inches in diameter. Eighty-two sticks of quarry gelatin dynamite and about 50 electric blasting caps with eight-foot lead wires were used for that performance.

IT was then decided to use 60 percent straight nitroglycerin dynamite and to try the propagated-detonation method in which the shock of one explosion sets off other charges in the same line. This worked with complete success and due to the fact that an electric blasting cap for every charge was rendered unnecessary the cost was further reduced.

It is, of course, impossible to push or drill a hole through loose sand to place a charge of dynamite, for the hole closes as fast as made. Therefore, several lengths of fire hose were run from adjacent fire hydrants to the point of operation and connected with a water jet device consisting of a piece of one-inch pipe ten feet long.

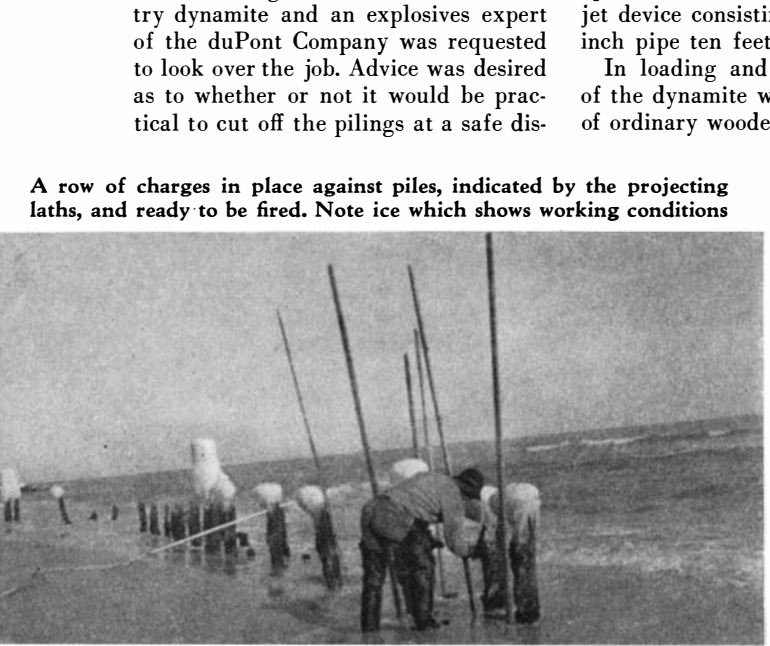
In loading and shooting, two sticks of the dynamite were bound to the end of ordinary wooden laths with twine. In placing these charges the jet of water was pointed into the sand beside the pile. As the water displaced the sand the dynamite tied to the end of the lath followed the jet down to whatever depth was desired. Each lath was marked at a point six feet from the dynamite so that a uniform depth of charge was assured.

Eleven such charges were planted against a like number of pilings for each shot. The primed charge, consisting of three sticks of dynamite, one of which was primed with an electric blasting cap, was placed against the center pile and the two-stick charges, without caps, were placed against each of the five pilings extending on each side. After each shot, a crater was left in the sand and it was easy to determine whether each pile was cut off cleanly. Occasionally a small extra shot was needed.

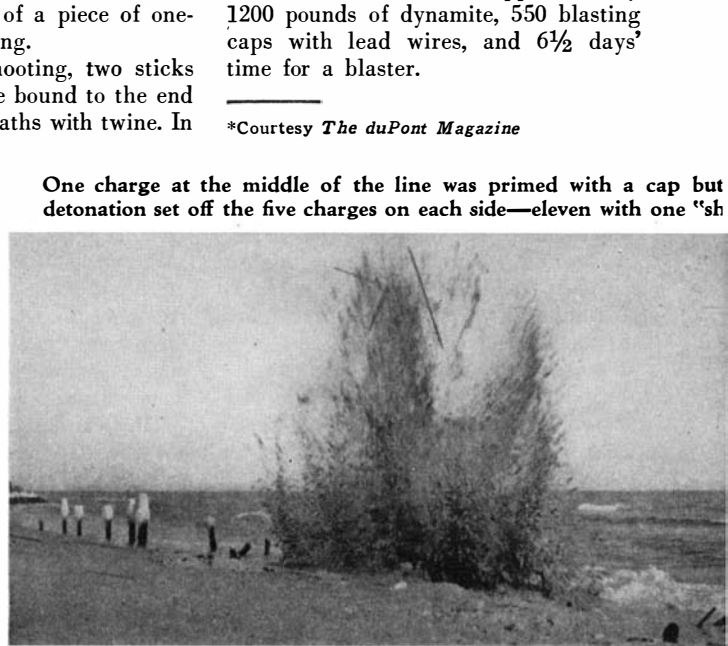
By using this method and placing eleven charges each time, it was possible to load, connect, and shoot 1500 piles in 6½ days or a daily average of 230 pilings. The total cost of cutting off the 1500 piles was 26½ cents each. This includes the cost of approximately 1200 pounds of dynamite, 550 blasting caps with lead wires, and 6½ days' time for a blaster.

*Courtesy *The duPont Magazine*

A row of charges in place against piles, indicated by the projecting laths, and ready to be fired. Note ice which shows working conditions



One charge at the middle of the line was primed with a cap but detonation set off the five charges on each side—eleven with one "sh



STARS ON PARALLEL TRACKS

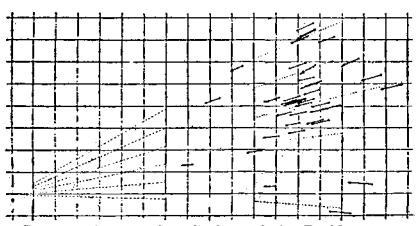
By HENRY NORRIS RUSSELL, Ph. D.
Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington
Retiring President of the American Association for the Advancement of Science

FROM immemorial times, watchers of the sky have recognized the presence of clusters of stars here and there in the heavens. The most conspicuous of these, the Pleiades, is one of the most widely known objects in the heavens and received its name in classical times. Two or three other clusters also bear Greek or Latin names: the Hyades, a widely scattered group in Taurus; the small, compact Praesepe in Cancer, which looks to the eye like a hazy patch and is resolved into its separate stars only by a field-glass; and another scattered group farther east in the sky, known as Coma Berenices and commemorated in a poem of Catullus. Other clusters, too closely packed to be resolved into separate stars by the unaided eye, are found between Perseus and Cassiopeia and between Scorpio and Sagittarius. With the telescope, of course, dozens and hundreds of fainter clusters have been recognized.

Star groups of this type are generally called "galactic" clusters, to distinguish them from the fainter and more remote globular clusters. As their name indicates, they show a very marked preference for the region of the Milky Way, and are rare in other portions of the sky, though Coma Berenices is almost at the north galactic pole. The large apparent size of this cluster, and the brightness of the stars composing it, many of which are visible to the naked eye, suggest that it is much nearer than the average—a conclusion confirmed by fuller investigation. Though its direction from us is nearly at right angles to the Milky Way, it is therefore not very far from the central plane of our system.

THERE can be no doubt, from mere inspection, that a close cluster like the Pleiades is a real physical aggregation of stars. The probability that six stars, conspicuous to the naked eye, should lie in so small a region of the heavens on a mere chance distribution, can be calculated and is excessively small. For more scattered groups this argument is less conclusive, and considerations of probability show that some "field" stars in front of the cluster or behind it are projected in the heavens upon the real cluster. To distinguish these, we must have recourse to the motions of the individual stars, which have been accurately determined in a number of cases.

All the bright stars of the Pleiades, for example, are moving together in the sky at very nearly the same rate and, moreover, have nearly the same radial velocity—facts which put their real physical connection beyond all possible doubt. In the Hyades the majority of the stars show a similar common proper motion and are receding from the sun at about the same rate. But here and there one is found with quite a different motion, which is evidently an accidental intruder. The bright star Aldebaran is



Courtesy Astronomical Society of the Pacific

Motions of the Hyades Cluster. The arrows represent motion in 50,000 years, also the direction of motion. Though the motions appear to be convergent, they are actually parallel, the convergence being only a perspective effect. These stars are all traveling along in one cluster

the most notable of these. This decisive test shows that Praesepe and Coma Berenices, like the groups already named, are real physical clusters, though in the latter case there are a good many superposed field stars.

It has been told long ago in these columns how Professor Boss, from his accurate catalogue of proper motions, showed that the apparent motions of the stars of the Hyades converged toward one point in the sky. This is an obvious effect of perspective, for a cluster which is receding. Spectroscopic observations confirmed the recession and made it possible to determine the actual distance of the cluster, which is 40 parsecs or 130 light-years. The Pleiades are almost four times as far away, and Praesepe about the same distance. For the double cluster in Perseus, the estimated distance is 5000 light-years, and many galactic clusters must be remoter.

The searching test by proper motion has revealed several clusters too wide to be conspicuous to the eye. A notable one is found in Ursa Major. Of the seven stars of the "Dipper" (which, by the way, is the only American constellation, the name being practically unknown on the other side of the Atlantic), five are moving together, and evidently form a widely scattered cluster. Hertzsprung's careful study shows that various apparently disconnected stars, notably Sirius, share this motion and really belong to the group. An enormous aggregation of more distant and very brilliant stars in Scorpio and Centaurus, and the Southern Cross, was first recognized by Kapteyn. Its brightest members are 200 or 300 light-years from the sun, and the extent of the cluster, or stream, must be fully as great.

THE common motion of the stars of any one of these groups is the strongest indication of a common origin. The mere fact that they keep together in space is as good a reason for supposing them to be really related in some way as is the similar motion of a flock of birds in the sky. Moreover, as we shall see, there are many forces which tend to cause the motions of the cluster stars gradually to differ from one another, and so ultimately to disintegrate it, while there are no known influences which would cause stars originally unrelated, or with random motions, to congregate into a group moving together. Moving clusters, then, may give us some insight into the remoter past of our galactic system. At interstellar distances the only force which needs to be considered is gravitation. The influence of this on the motions of clusters has been discussed by Eddington, Jeans and, very recently, by Professor Bok of Harvard, to whose results the present summary is much indebted.

Suppose, first, that there was a cluster of stars, entirely isolated in space, which would not even attract one another. Each star would then move on a straight line with uniform speed, indefinitely. If the original motions were strictly parallel and equal, the cluster would remain together forever. But, if the motions differed ever so little, the stars would gradually draw apart and the group would spread out.

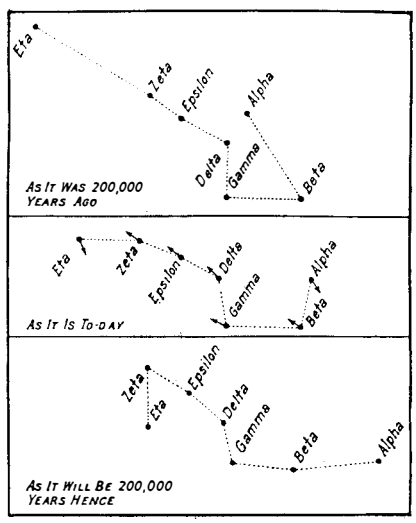
Of course, the stars actually attract one another. If their motions in space were originally exactly the same, so that they had no motion relative to one another, their mutual attraction would

cause them gradually to fall in toward the center of the group, and the cluster would collapse at a slow but ever-increasing rate. This catastrophe could be avoided by setting the stars into slow motion; each one would then describe an orbit around the center of the whole mass, influenced somewhat by the attraction of its immediate neighbors. With a proper adjustment of velocities, the cluster might maintain itself for an extremely long time. Individual stars would move in sweeping curves, usually not of very simple form, and would successively visit many parts of the region occupied by the cluster. But, as some stars left a given portion of this region, others would come in to take their places, and the general appearance of the group might remain practically unaltered.

THE stars which form the known clusters are so widely scattered that these orbital motions would be very slow. The Pleiades, for example, form a group about three parsecs, or ten light-years, in radius. Professor Bok estimates the total mass as 250 times that of the sun. A simple calculation shows that a star revolving in a circle at the outer limit of the group would have a period of some 30 millions of years. Those nearer the center would move somewhat more rapidly; but, even so, their orbital motions would be so small during the century or less covered by accurate observations of their position, that little or no perceptible change would be detectable. This is a comparatively dense cluster. For the Hyades, the calculated rotation period is 80 million years, and for the Perseus cluster about 140 millions. Though no sensible change in such bodies can be expected within the interval of accurate human observations, the longest of these periods is but a small fraction of the known age of the Earth.

It is altogether probable that these vast clusters are at least as old as our planet, and we may therefore believe that during their past history their individual stars have circulated about the center many times, and their detailed configuration has been completely changed again and again. Had there been present originally stars whose motions were much more rapid than the others, they would have escaped from the gravitational attraction of the general mass in a relatively short time (from 20 to 50 millions of years), so that only those which were originally orderly and slow-moving remain for our recognition.

Even if utterly isolated in space, such a cluster could not exist forever. Now and again, though at rare intervals, two of its stars would pass very close to one another (say no farther than the earth's distance from the sun), and their velocities would be greatly altered by mutual attraction. During some of these encounters one star would be slowed, and the other speeded up so much as to enable it to escape from the cluster. This process, though slow, is substantially irreversible, since the ejected stars wander off into remote portions of space, and the chance of an incoming star passing close to a cluster member in such a way that its motion is slowed and it is captured is excessively small. This disintegrative process, although real, is



The Dipper consists of five stars moving together and two stars, Eta and Alpha, which merely happen to be in line with this cluster at the present period. From Leaflet 28, Astronomical Soc. of Pacific

however so very slow-acting that it is of little importance in comparison with two others.

The first disturbing force arises from the general attraction of the great mass of stars composing the Milky Way. If this attraction were exactly the same in amount and direction at all points within the cluster, it would have no disintegrating effect. All stars in the cluster would move in similar curves, describing some vast orbit about the greater mass; but there would be no tendency to drag the stars apart, and none to pull them together, save their own mutual attraction. But the actual attraction of the Milky Way, especially if its mass is considerably concentrated in a central region, is not of equal strength at all points, nor does it act in parallel lines, but in directions converging toward this center. The differences, whether in amount or direction, between these galactic attractions, constitute forces tending in some regions to draw stars in toward the center of the cluster and in others to pull them away.

These "tidal" forces, though very small, are unremitting in their action, and they will pull any cluster to pieces if given time enough, unless the attraction of the general mass of the cluster itself upon the component stars is sufficiently great to counteract them. This demands that the cluster shall have a tolerably high density. Bok calculates that a mass equal to the sun's, for every ten cubic parsecs of space, is required. This would put stars like the sun about seven or eight light-years apart, which is hardly closer together than the randomly moving stars are in our neighborhood. The star density in the Pleiades is at present about 20 times this; that of the Hyades is much smaller and between two and three times the critical value.

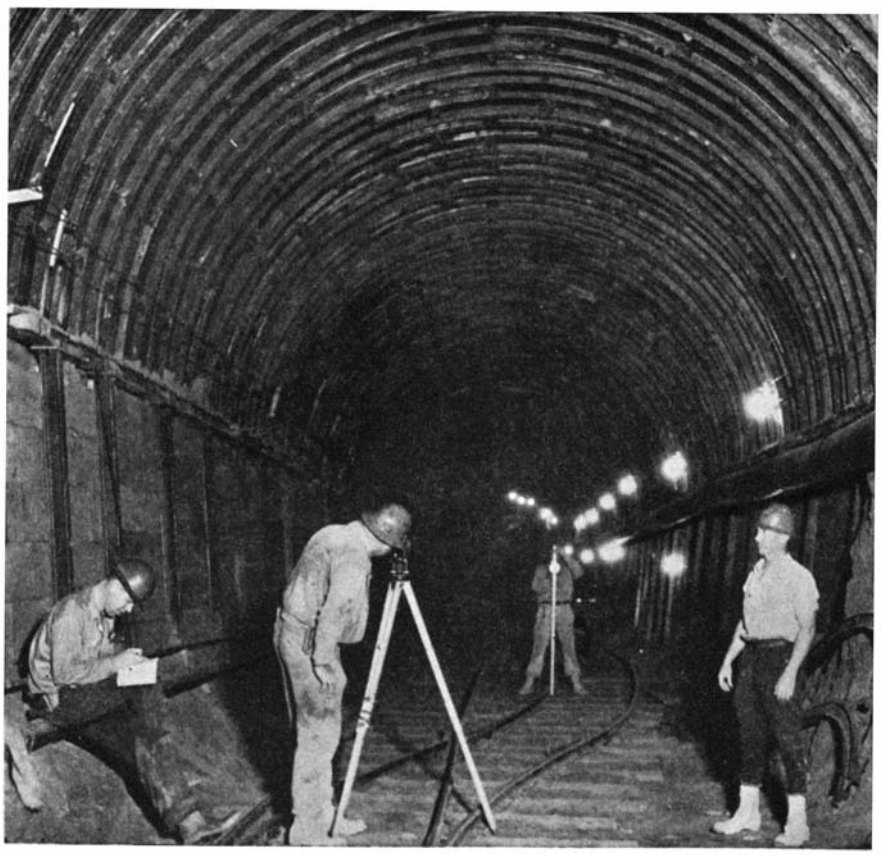
WERE these tidal forces alone at work, a dense cluster like the Pleiades would be kept together indefinitely by its own attraction. But there is another disintegrative force. As the cluster moves through the general field of stars, those which it approaches will pass right through it. The chance of a collision of a cluster star with an outsider, or even of a very close approach, within planetary distances, is extremely small. But, nevertheless, each interloper, as it passes through the cluster, will disturb by its attraction the motions of the cluster stars. It is easy to see that the effect of this attraction will be to pull each star toward the nearest point of the track of the stranger (the forward and backward components balancing out). For a cluster moving through a field of stars at rest, these attractions would evidently tend gradually but steadily to increase the motions of the cluster stars in directions at right angles to its own motion, without modifying perceptibly the velocities in the direction of the general motion. These more rapid motions would in time carry the cluster stars farther from the center, before they were drawn back by the general attraction, and the cluster would gradually spread out in a direction at right angles to its own motion.

In the actual case, the intruding stars are moving in all directions, and the cluster is moving too, so that the effects are more complicated, but not greatly different in kind. Professor Bok's calculations show that a cluster such as the Hyades would expand by less than 10 percent in the next billion years. After two billions of years its greatest diameter would be 25 percent larger than now; but by this time its density would have shrunk near the critical value, and the tidal forces of galactic attraction would begin to get in their work. A little more than two and a half billion years hence, the spreading will become much more rapid, and within three billions of years the cluster will become practically disintegrated into widely separated stars. The Pleiades, with its greater present density, should last ten times as long; but, even so,

(*Please turn to page* 165)

BUILDING THE WORLD'S

By ROBERT D. SPEERS
Metropolitan Water District of Southern California



Surveyors in the Valverde tunnel checking the accuracy of the bore

BREAKING record after record, a seasoned army of hard-rock miners is pressing forward, out on the California desert, on the largest tunnel driving program ever undertaken in the history of engineering. They are excavating 29 eighteen-foot bores, totaling 91 miles in length, through the rocky hearts of the bleak mountain ranges which lie as barriers between the Colorado River and the Coastal Plain of southern California.

Through these tunnels eventually will be turned a billion gallons of water daily from the Colorado River to serve the 13 municipalities which comprise the Metropolitan Water District of Southern California.

This 91 miles of tunnel constitutes the most important link in the 220,000,000-dollar Colorado River Aqueduct system, the total length of which will be 241 miles from the Colorado River to the main terminal reservoir. In addition, 144 miles of huge distributing mains are to be built to carry the aqueduct water from the terminus of the main line to the cities to be served.

At the head of this undertaking is F. E. Weymouth, who occupies the position of general manager and chief engineer of the District. One of America's distinguished engineers, Mr. Weymouth was for many years chief engineer of the United States Reclamation Bureau and was the builder of many of the outstanding reclamation projects in the West. With the late Arthur Powell Davis, he prepared the designs and estimates for Boulder Dam, sister project to the great aqueduct, construction of which he is now guiding.

UNDER Mr. Weymouth's direction, an army of 4400 men, working from more than 30 desert construction camps, is driving tunnel at the rate of three and one-half miles per month.

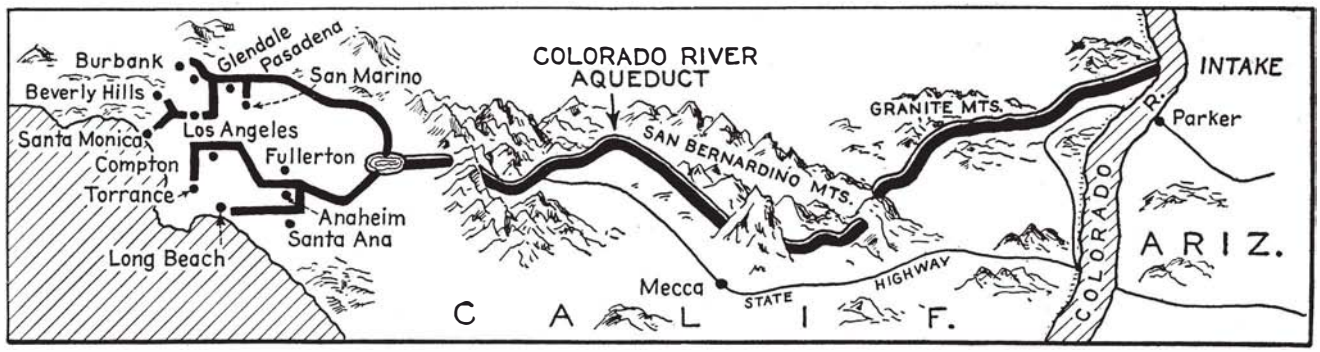
Thirty-three miles of this tunnel, located in the San Bernardino Mountains in the heart of California's desert region, is being excavated by forces employed directly by the Water District. The remaining 58 miles of bore is under contract to 13 large construction companies which are working under the direction of District engineers.

Longest of all the 29 aqueduct tunnels is the East Coachella bore, 18 miles from end to end, and being driven by Water District forces. Engineering studies reveal that from 15 to 20 years would be occupied in the excavation of the huge bore if the work were to be carried forward in the conventional manner; that is, from its two portals alone. Since the total construction period of the aqueduct project will be approximately six years, it is clear that some other method was necessary in order to shorten the length of time required for tunnel construction.

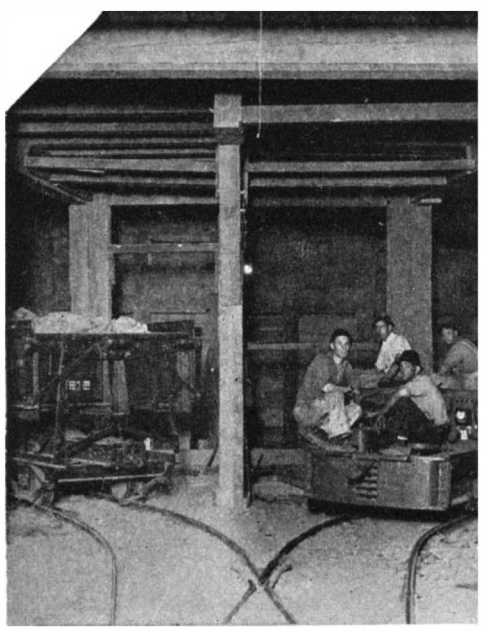
INSTEAD of attacking the tunnel from its two portals, District construction forces drove four horizontal adits, or access tunnels, into the mountainside to the line of the main bore. At the junctions of these adits and the main tunnel, crews commenced working on the bore in two directions—east and west. For each adit, then, two working faces were opened, making it possible for eight crews to attack the tunnel instead of two, as would have been the case had work been carried forward from the two portals. The access adits constitute in themselves sizable pieces of the tunnel construction, varying from 600 to 3000 feet in length.

A similar problem confronted engineers on the aqueduct's second longest bore—the 13-mile San Jacinto tunnel, which pierces a flank of one of southern California's loftiest peaks. Topography at this point was such, however, that it was impracticable to drive in horizontal adits as was done on the Coachella bore to give access to the tunnel line. Engineers therefore reached the tunnel from above, sinking a vertical shaft to a depth of 796 feet to the tunnel line. At another point they compromised between the horizontal and vertical methods of approach by sinking a shaft down to a depth of 246 feet, and then driving a horizontal cross-cut for a distance of 935 feet, linking the base of the shaft with the line of the main tunnel. In addition, San Jacinto tunnel is being attacked from its west portal,

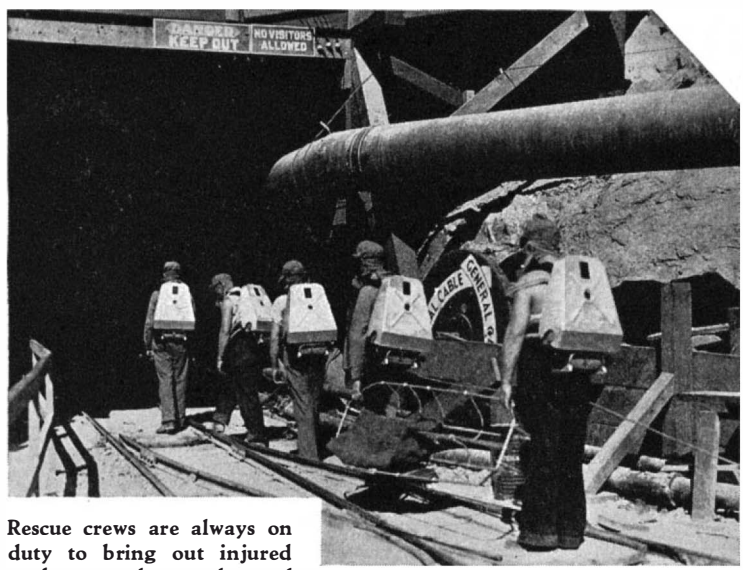
LARGEST AQUEDUCT



Map of the route of the Colorado River Aqueduct, showing terminal branches



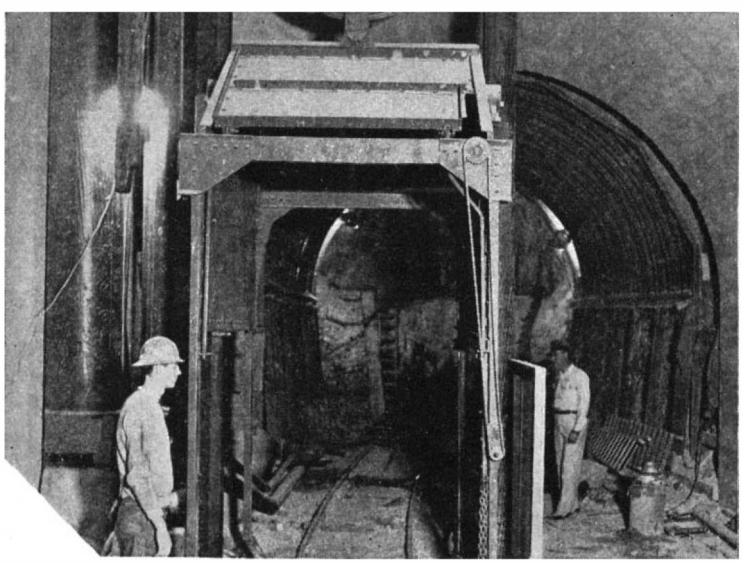
Tunnels are so long and so large that switching facilities are provided, as shown, at the junctions of the adits and tunnels

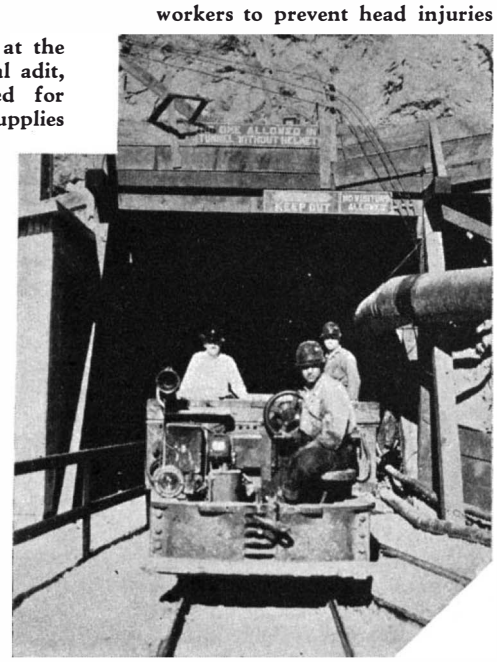


Rescue crews are always on duty to bring out injured workers or those exhausted by the intense summer heat

Below: A storage-battery locomotive. Note steel helmets on workers to prevent head injuries

Below, left: A scene at the lower end of a vertical adit, showing elevator used for conveying men and supplies





making a total of five headings being worked on the bore.

These methods of attack are being used, also, on several of the other longer aqueduct tunnels. Eight-mile Iron Mountain tunnel, for instance, is being driven from one portal and one shaft; West Eagle Mountain tunnel, five miles long, is being driven from one portal and one adit; Valverde tunnel, seven miles in length, is being attacked from four shafts; Copper Basin tunnel No. 2 and Whipple Mountain tunnel both are being driven from adits.

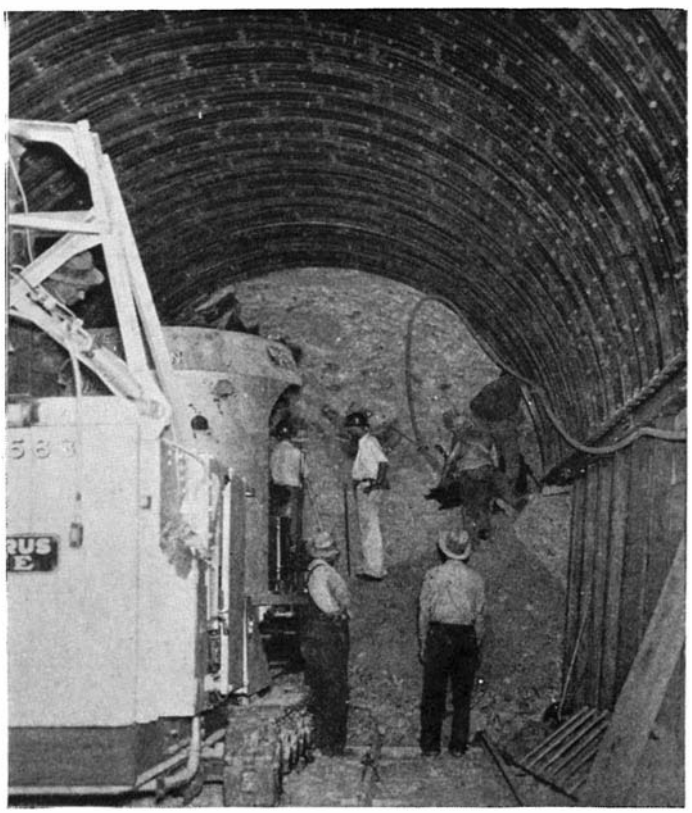
Many of the aqueduct's shorter bores, of course, are being excavated in the more conventional manner; that is, from the two portals, or from a single portal.

ONE of the notable features of the great undertaking, no matter which method is used, is the hair-splitting accuracy that is necessary in order to bring the various tunnel sections together with nicety. To accomplish this the Water District maintains a crew of engineers and surveyors whose task it is to check constantly upon the progress of the work and see that the construction forces are adhering to the tunnel line. Working with precision instruments, they can detect the slightest deviation in grade or angle.

Operating far underground, these surveying crews are confronted with many problems not encountered in similar work on the surface. One of these is the lack of adequate light for some of the finer observations. To overcome this difficulty, a powerful lamp has been developed which allows only a fine vertical sliver of light to escape. Transitmen are able to sight upon this slender beam from great distances down the tunnel. For other types of observations, pocket flashlights are suspended from the roof of the tunnel.

The fundamental routine of actual tunnel driving is much the same all along the far-flung construction front. It consists of three repeated steps—drilling, blasting, mucking—over and over again. Drill carriages, mounting as many as four or more pneumatic or automatic drills, are in general use along the aqueduct line. From 20 to 60 holes, from six to twelve feet deep, are drilled in the tunnel face, loaded with explosive, and fired. After the blast, the shattered rock is loaded onto waiting cars and hauled out to the dump. On tunnels where vertical shafts are used, the cars usually are hoisted, one by one, on cages.

Several types of mucking machines are in use along the aqueduct line. The one most generally in operation shovels up the muck in an electrically operated dipper, tosses the broken rock onto an endless belt which conveys it to an empty dump car attached to the rear end of the machine. Other types have swinging booms, designed to operate in the cramped space of a tunnel, which drops the muck directly into the cars.



At the working face of one of the tunnels. Steel liner plates are installed as work progresses, in order to avoid cave-ins

In many of the tunnels, cars are shifted by means of a pneumatic hoisting arrangement called a cherry-picker, which lifts the empty cars vertically off the tracks to permit loaded ones to pass under. In some cases ingenious devices have been perfected, combining the functions of a drill carriage and a car-shifter.

In most of the tunnels motive power for the dump trains is provided by huge storage-battery locomotives capable of pulling trains of from five to ten dump cars with a capacity of four to six cubic yards. In a few of the workings the locomotives are operated by means of trolleys.

Much of the aqueduct tunnel is through solid rock and stands unsupported. Both timber and steel support is used when soft or shattered sections are encountered. All of the tunnels will be lined with concrete before the aqueduct is put in operation.

With desert summer temperatures ranging as high as 130 degrees, special attention has been given by District engineers to proper ventilation of the tunnels. Exhaustive studies of the subject have revealed a number of interesting facts. It was found that, regardless of the temperature of the air being blown into the tunnel, it reaches the face at approximately the same temperature as that of the rock within the tunnel; that rock temperatures vary from 72 degrees to 101; that broken rock formations are considerably cooler than hard, dense rock.

Gigantic though it is, tunnel driving is by no means the only important phase of aqueduct construction. Siphon building, pumping, conduit construction, and power-line construction from Boulder Dam, are a few of the other sections of the project which will be, and even now are being, taken in stride by the aqueduct builders.

STRICTLY independent of each other, and yet wholly interdependent one upon the other, are the Colorado River Aqueduct and Boulder Dam projects. The aqueduct, being built by the Metropolitan Water District, depends upon Boulder Dam for proper regulation of the Colorado River and for cheap electric energy needed to pump the aqueduct water over the mountain ranges lying between the river and the Coastal Plain. Thirty-six percent, or 400,000 horsepower of the power generated at Boulder Dam will be used for this purpose.

On the other hand, Boulder Dam, being built by the Federal Government, depends upon the operation of the aqueduct for economic success. This is true because the Water District will be the Government's largest customer for both water and power. The revenues to be derived from the sale of these two commodities will in a large part amortize the cost of the dam project.

Few as yet realize that the aqueduct overshadows the dam in size. Cost of the dam proper is about 100,000,000 dollars, whereas the aqueduct bond issue, voted in 1931, was for 220,000,000 dollars. The rapid progress being made and economies which have been effected indicate that the project will be built at a cost under that figure; but even so, it will represent an investment twice as large as that required for the construction of the Federal dam.

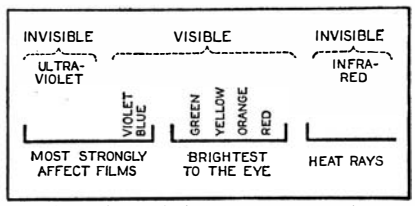
Color Filters

Provide the Advanced Amateur Photographer With a Fertile Field for Experimenting

By WALTER CLARK, D.Sc.

WHEN a beam of sunlight is passed through a glass prism, it is split up into a band having the colors of the rainbow. These colors appear in the order shown in the accompanying diagram, and they form what is known as the spectrum.

For general picture making, the infra-red rays are of no account because ordinary or even panchromatic films are not affected by them. On the other hand, the ultra-violet has a very strong effect on all films. Although only a small proportion of the ultra-violet gets through a camera lens, even this small amount sometimes has to be taken into account. There is practically no ultra-violet in the light from an incandescent lamp, but there is a fair amount in sunlight.



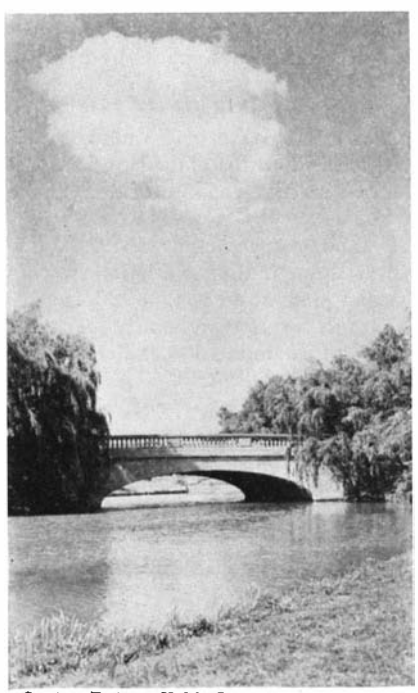
The colors of the spectrum, as they are of interest to the photographer

ORDINARY film is affected by the parts of the spectrum ranging from the ultra-violet through to the middle of the green. Verichrome behaves similarly, although it is much more affected by green and yellow light. Super-sensitive panchromatic and panatomic films, on the other hand, respond to the ultra-violet and the whole of the visible spectrum right through to the red.

Because of the intensity of the ultra-violet, violet, and blue rays in sunlight, most of the recording of images on a film is produced by them. The sensitiveness to the other visible colors is, therefore, largely swamped by the effects produced by these rays.

If the chief effect on a film is produced by these rays, the tones in the photograph will not appear correct in the same sense that the eye saw the subject. We can, however, cut out the violet and ultra-violet, so that they do not reach the film, and then a more natural-appearing picture will result. This is done by placing a piece of colored glass or gelatin, a "filter," over the lens of the camera.

The filters most commonly used are pale yellow in color; this is the color which results if the ultra-violet and violet are removed from white light. All yellow glass and gelatin is not satisfactory, however, because some kinds that may appear to the eye to be the right color, actually let through some ultra-violet and the filter is largely ineffective.



Courtesy Eastman Kodak Company

Using a filter with panchromatic film brings out fine cloud effects

Suppose we were photographing a landscape with clouds in the sky, and we used a film which responded only to ultra-violet, violet, and blue light. In our picture we should not be able to distinguish between the clouds and the sky if we gave enough exposure to give detail in the landscape. Clouds and blue sky are both rich in ultra-violet, violet, and blue, but there is a very marked difference between them. The light from clouds, being white, actually contains a lot of green and red light, while that from the blue sky does not. Therefore, we must use a film that will respond to green, or to green and red light, and put over our lens a filter that does not let through much ultra-violet, violet, and blue.

Since the filter cuts out some of the light that would otherwise affect the film, it increases the exposure that must be given. The amount by which the exposure must be increased is known as the "filter factor." It indicates the number of times by which the exposure must be increased when using a filter, as compared with the exposure necessary without the filter. The deeper the yellow color of the filter, the more violet and blue it removes, or "holds back," and consequently the higher is the filter factor. At the same time, the deeper yellow filters give more "correction"; that is, for example, they cause white clouds to show up more clearly against blue sky.

Filter factors are shown in the following table:

Filter	*N. C. Film*	*Verichrome*	*Panatomic*	*"SS" Pan*
K-1	3½	2½	1½	1½
K-1½	6	4	1½	1½
Kodak Color	6	4	—	—
K-2	8	4½	2	2

THE K-1 filter is pale yellow and is intended as a correcting filter when short exposure is of more importance than a high degree of correction. The K-1½ and Kodak Color filters are somewhat darker, and give better correction, although requiring somewhat longer exposures. The K-2 is a still darker yellow filter, giving the best correction possible with ordinary and Verichrome films, and practically full correction (recording tones as the eye sees them) with the panchromatic films. It is the best all-round filter for use outdoors with "SS" pan and panatomic films.

In landscape work the yellow filter performs another valuable function. It gives sharper detail in distant objects. On the majority of summer days, the distant hills and other objects in a landscape appear somewhat hazy. If they are photographed on ordinary or ortho films without a filter, they appear "flat" and without detail. This is because the haze scatters blue light and so tends to blur the detail of objects seen through it. While haze scatters blue light, it does not scatter green light so much, and red light still less. So, if a yellow filter is placed over the lens to cut down the diffused blue light, it is possible to photograph through the haze and the detail in the distant objects will be sharp.

With the "sky filter," one half of which is yellow, and the other half clear, the sky is photographed through the yellow part of the filter, while the landscape is photographed through the part that is not colored. The exposure for the landscape is thus not increased, and the filter shows up the clouds against the darker sky. This filter can not take the place of a general purpose filter.

SUNDIALS AND THEIR CONSTRUCTION—VI

Lines of Declination; Signs of the Zodiac

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

ANCIENT diallists often placed upon their dials certain lines, called lines of declination, which recorded the entrance of the sun into the various signs of the zodiac. This gave them a measure of time, because it takes the sun about a month to pass from the beginning of one sign to the beginning of the next. Feast days, holy days, events of importance, and the time of year were also shown by these lines. If one wished to be facetious he could add lines commemorating birthdays, wedding anniversaries, and so on.

Today such lines are usually used for ornamentation rather than for the utilitarian purposes of not many centuries ago. Since the location of these lines on the dial plate depends upon the position of the sun, they have not entirely lost their usefulness even in this day and age. They have an educational value, for by them one may obtain a clearer conception of the motion of the earth in relation to its all-important luminary—the sun.

The sun, in its apparent movement among the stars, traces out a path called the ecliptic, the plane of which is inclined to the plane of the celestial equator at an angle of about 23½°. During one half of the year the sun appears north of the celestial equator, and during the other half south of it. The sun's distance north or south of the equator is called its declination, and is expressed in degrees and minutes of arc. The declination varies from day to day. The amount of this declination, for each day, at apparent noon, is given in the table, where the northern declination is preceded by a plus (+) sign and the southern declination by a minus (−) sign. Although data have been omitted, which may be easily obtained from any good almanac, this table is inserted because it is not always found in a convenient form for use in the construction of the lines of declination.

IT will be necessary for the reader to become familiar with other parts of the dial not previously mentioned, that are essential in the construction of the lines of declination or other furniture. The nomenclature and definitions of these essential parts are given below.

1—*The nodus.* This is a descriptive term introduced by the authors. In order to trace out the path of the sun on any particular day, the shadow of the whole style cannot be used. We must therefore select some point on the style for this purpose, which will be called the *nodus.* The nodus may be at the apex of the style; or at any other point along the style that is convenient, in which case it could be designated by a small, thin bar laid crosswise on the style, or by a notch cut in the style, so that the shadow cast by the nodus may readily be discerned on the dial plate, in sharp contrast to the shadow of the whole style.

2—*The perpendicular style.* A line drawn through the nodus, intersecting the dial plate at an angle of 90°.

3—*Foot of the perpendicular style.* The point where the perpendicular style intersects the dial plate.

4—*Height of the perpendicular style.* The distance measured from the nodus to the foot of the perpendicular style.

5—*The horizontal line.* This line is seldom placed on dials, although it plays an important part in making a dial useful. It is a line drawn on the dial plate at the intersection of a plane passing through the nodus, parallel to the plane of the horizon. The lines of declination need not extend beyond the horizontal line. The approximate time of sunrise and sunset may be deduced from the points among the hour lines where the lines of declination intersect the horizontal line.

RATHER than clutter the reader's mind with many diagrams and lines, only those necessary for a proper understanding of the method of construction will be used. Although the fundamental principle of plotting a line of declination on a dial plate is the same for all dials, each type of dial will be treated separately so that the reader will have no difficulty. The horizontal line for each type will be shown.

Each example will show the construction of the lines representing the path

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1	−23 2	−17 9	−7 39	+ 4 28	+15 1	+22 2	+23 8	+18 5	+8 22	− 3 6	−14 22	−21 47
2	22 56	16 52	7 16	4 51	15 19	22 10	23 4	17 50	8 0	3 29	14 41	21 56
3	22 51	16 34	6 53	5 14	15 37	22 18	22 59	17 34	7 38	3 53	15 0	22 5
4	22 45	16 17	6 31	5 37	15 54	22 25	22 54	17 19	7 16	4 16	15 19	22 13
5	22 38	15 59	6 7	6 0	16 12	22 32	22 49	17 3	6 54	4 39	15 37	22 21
6	−22 31	−15 40	−5 44	+ 6 23	+16 29	+22 38	+22 43	+16 46	+ 6 32	− 5 2	−15 56	−22 29
7	22 24	15 22	5 21	6 45	16 46	22 44	22 37	16 30	6 9	5 25	16 14	22 36
8	22 16	15 3	4 58	7 8	17 2	22 50	22 31	16 13	5 47	5 48	16 31	22 42
9	22 8	14 44	4 34	7 30	17 18	22 55	22 24	15 56	5 24	6 11	16 49	22 49
10	21 59	14 24	4 11	7 52	17 34	23 0	22 16	15 38	5 1	6 34	17 6	22 54
11	−21 50	−14 5	−3 47	+ 8 15	+17 50	+23 5	+22 9	+15 21	+4 39	− 6 57	−17 22	−22 59
12	21 41	13 45	3 24	8 37	18 5	23 9	22 1	15 3	4 16	7 19	17 39	23 4
13	21 31	13 25	3 0	8 59	18 20	23 12	21 52	14 45	3 53	7 42	17 55	23 9
14	21 20	13 5	2 36	9 20	18 35	23 16	21 43	14 26	3 30	8 4	18 11	23 13
15	21 10	12 44	2 13	9 42	18 49	23 19	21 34	14 8	3 7	8 27	18 26	23 16
16	−20 58	−12 24	−1 49	+10 3	+19 3	+23 21	+21 25	+13 49	+2 44	− 8 49	−18 42	−23 19
17	20 47	12 3	1 25	10 24	19 17	23 23	21 15	13 30	2 21	9 11	18 57	23 22
18	20 35	11 42	1 2	10 45	19 31	23 25	21 4	13 11	1 57	9 33	19 11	23 24
19	20 23	11 20	0 38	11 6	19 44	23 26	20 54	12 51	1 34	9 54	19 25	23 25
20	20 10	10 59	−0 14	11 27	19 56	23 26	20 43	12 32	1 11	10 16	19 39	23 26
21	−19 57	−10 37	+0 10	+11 48	+20 9	+23 27	+20 31	+12 12	+ 0 47	−10 38	−19 53	−23 27
22	19 43	10 16	0 33	12 8	20 21	23 27	20 20	11 52	0 24	10 59	20 6	23 27
23	19 29	9 54	0 57	12 28	20 33	23 26	20 8	11 32	+0 1	11 20	20 19	23 27
24	19 15	9 32	1 21	12 48	20 44	23 26	19 55	11 11	−0 23	11 41	20 31	23 26
25	19 0	9 9	1 44	13 8	20 55	23 24	19 43	10 51	0 46	12 2	20 43	23 25
26	−18 46	− 8 47	+2 8	+13 27	+21 6	+23 23	+19 30	+10 30	−1 9	−12 23	−20 55	−23 23
27	18 30	8 25	2 31	13 46	21 16	23 21	19 16	10 9	1 33	12 43	21 6	23 21
28	18 15	8 2	2 55	14 5	21 26	23 18	19 3	9 48	1 56	13 3	21 17	23 18
29	17 59	− —	3 18	14 24	21 35	23 15	18 49	9 27	2 20	13 23	21 27	23 15
30	17 43	− —	3 42	14 43	21 45	23 12	18 34	9 5	2 43	13 43	21 37	23 11
31	−17 26	− —	+4 5	— —	+21 53	— —	+18 20	+ 8 44	− —	−14 3	— —	−23 7

A table of the declination of the sun for each day of the year, at apparent noon. Equinoxes and solstices in bold type. Compiled from American Ephemeris

of the shadow cast by the nodus when the sun has a declination of 0°, and when the sun reaches its greatest northern and southern declination. The first is often referred to as the equinoctial line because, when the shadow of the nodus falls upon it, the sun is at the equinoxes, marking the beginning of spring and fall when the day and night are said to be of equal length.

The lines showing the sun's greatest northern and southern declination were called the tropics; and on old dials were labelled the Tropic of Cancer and Capricorn, respectively. They note the longest day (beginning of summer) and the shortest day (beginning of winter) of the year. These lines may also be referred to as limiting lines, for between them all other lines of declination must fall.

THE following are the instructions for the construction of the lines of declination on the equatorial dial. (Note: Obviously, in all types of dials, the size, shape, and all the parts must be known, before the lines of declination are constructed.)

Since the plane of the equatorial dial lies in the plane of the celestial equator, it is evident that all of the lines of declination cannot be placed upon it. When the sun has a declination of 0° the shadow of the nodus will not fall upon the dial; and when the sun is south of the equator no shadow will be cast upon the upper or north face.

If the location of the shadow of the nodus were marked when it reached each hour line throughout any particu-

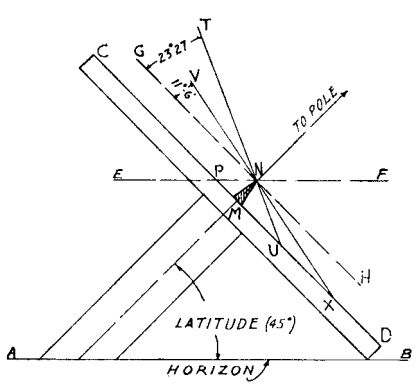


Figure 1

lar day, and a line drawn through those points, a portion of a circle would result, with the foot of the perpendicular style as its center. For this reason it is much easier to draw the lines on an equatorial dial than on other types.

In Figure 1, *AB* represents the plane of the horizon, *CD* the dial plate, *N* the nodus, *MN* the height of the perpendicular style, and *M* the foot of the perpendicular style.

For the horizontal line: Through *N* draw *EF* parallel to *AB*, intersecting *CD* at *P*. (Angle *PNM* is equal to the latitude of the place—in this case 45°.)

Take the distance *MP* and lay it off from the foot of the perpendicular style *M* (Figure 2) to *Q*, on the 12 o'clock line. Through *Q*, same figure, draw the line *PR* perpendicular to the 12 o'clock line.

Then *PR* will be the horizontal line for this dial.

FOR the lines of declination: Since the equinoxes cannot be shown on an equatorial dial, the line of declination for April 19 will be substituted.

From the table the greatest northern declination is found to be 23°27′, on June 21; and 11°6′ north on April 19.

Then, in Figure 1, draw the line *GH* parallel to *CD*. This represents the plane of the celestial equator.

With a protractor lay off the angle *GNV*=11°6′ north; and the angle *GNT*=23°27′ north.

Produce the lines *VN* and *TN* until they cut the dial plate, as at *X* and *U*.

Now take the distances *MU* and *MX*, and lay them off from the foot of the perpendicular style *M* (Figure 2), to *T* and *W*, respectively.

With *M* as a center and radii *MT* and *MW*, describe the arcs *STU* and *VWX*, respectively. Thus will *STU* and *VWX* be the desired lines of declination.

For all other lines of declination repeat the work precisely as shown.

WHAT time will the sun rise, when the sun reaches its greatest northern declination, on June 21?

In Figure 2, the arc *STU* represents the path of the shadow cast by the nodus on June 21. This arc cuts the horizontal line *PR* at *U*. *U* lies between the hours of 4 and 5 in the morning.

Estimate the distance from the point where the hour line of 4 crosses the horizontal line, to the point at *U*. This will be found to be about 10 minutes. Therefore, the sun will rise at 4:10 A.M. apparent time, on June 21, in 45° north latitude. This time may be converted into Standard Time by the method described in the preceding article. According to an almanac, computed for 45° north latitude, the sun will rise on June 21, at 4:12 A.M., apparent time. The reading of the dial compares favorably with the almanac.

Likewise, the time of sunset may be obtained.

THE Zodiac is a zone in the sky 16° wide (8° on either side of the ecliptic) in or near which the planets and sun appear to move. Beginning at the point on the ecliptic, which marks the position of the sun at the vernal equinox, this zone or belt is divided into 12 parts of 30° each, called signs. The signs derive their names from the constellations with which they coincided, about

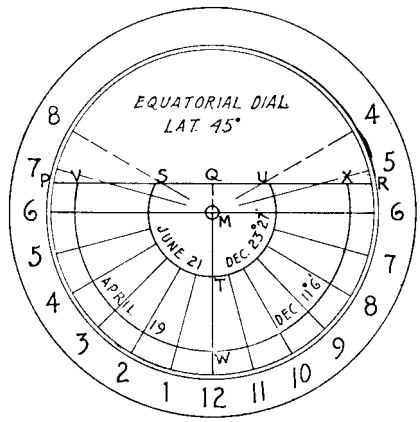


Figure 2

2000 years ago (today, shifted about 30°).

The lines of declination noting the entrance of the sun into the various signs meant much to the ancients, who were well acquainted with the meanings and omens attached to each. These lines are found on many old dials and they were referred to as the arcs of the signs, by early diallists. The entrance of the sun into the sign of Aries marked the beginning of spring; its entrance into the sign of Cancer marked the beginning of summer, and so on.

The present-day usefulness of the dial would be increased if the names of the constellations were inscribed upon it, as well as the attendant signs. In order to do this, find the date upon which the sun enters a constellation or sign. From the table observe the declination of the sun on that day. Then proceed, as described above, to plot the line of declination for that day on the dial plate. Place the symbol or name of the sign or constellation at the extremities of the line.

One must not lose sight of the fact that, because of the precession (retrograde motion) of the equinoxes along the ecliptic, each sign has moved backward 30°, into the constellation west of it, so that today the sign of Aries is in the constellation of Pisces, and so on. The signs are independent and they have no connection with the position of the sun in the constellations.

●

The construction of the lines of declination for dials whose planes lie oblique to the axis of the earth will be described in the next article.

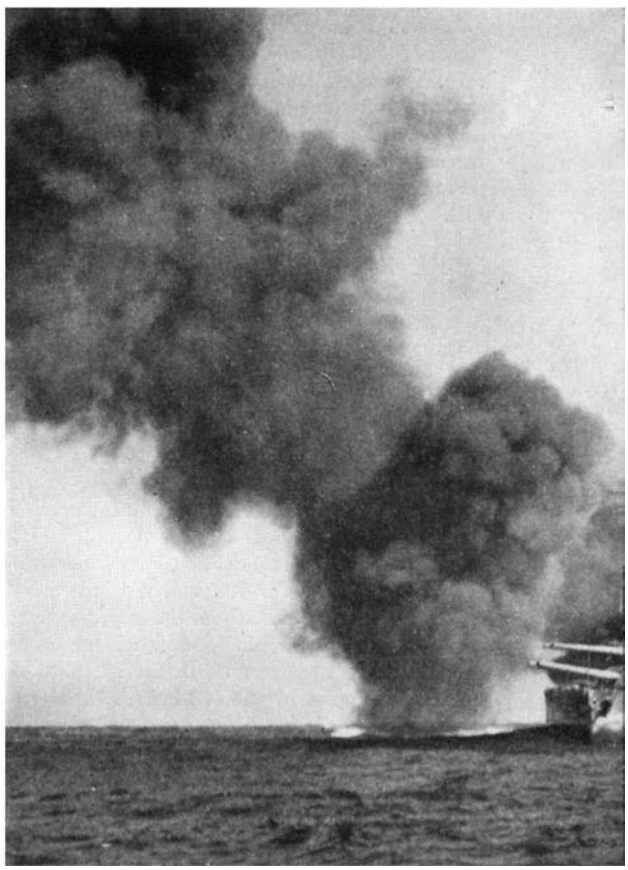
●

NOTE BY AUTHORS: The paragraph reading "The sun . . ." and so on, page 198 of the April number, middle column, should be corrected to read: "Except for the few months of summer between the equinoxes (when the sun has a northern declination) the sun will not shine upon this dial between 6 A.M. and 6 P.M. Therefore, on a pillar dial it is necessary . . ." and so on.

Concluding Article of a Two-Part Discussion on the Battleship as a Necessary Naval Unit

WHY THE B

By JONAS
Commande



WHILE it really takes a war—the real test—to prove most military contentions, there has been so much experimentation along all lines that technical experts are unanimous in their belief that the old bulldog, the battleship, has no superior afloat when it comes to giving and taking punishment; and, after all, upon this ability of a fleet rests the decision of the issue which is so vital to the nation and its defenses.

While the cost of a battleship is large in comparison with that of smaller types of surface vessels, there is grave doubt that there would be any economy in a lighter type. With reduction of protection comes greater vulnerability. One shell or one bomb in a vital spot in the cruiser type and a great loss is at once sustained. On the other hand, the battleship will undoubtedly take much punishment and still be able to carry on for a great period of time.

The main assault upon the surface ship has come from enthusiastic exponents of aviation. Doubtless the opinions of some have been given with all sincerity, and some of their assertions are grounded on fact. But in general the subject is presented in a form which is entirely misleading. Statements such as "Why build a mighty battleship to be destroyed by one plane?" or "How Cuba could drive our whole Navy from her coasts with an effective air force!" and "Why a Navy, when Italy could bomb New York City and Chicago by sending over General Balbo with his air squadrons?" are absurd, though they catch the eye. They will not withstand a common-sense analysis of fact, nor can they be substantiated by experience or the real test in actual warfare.

The history of warfare has shown that for every offensive weapon an effective defense has been devised. In the World War everything known to science —from air barrages to poison gas—was tried, but the decision was usually arrived at by the doughboy himself, using effectively the two most primitive of weapons, the bayonet, or his rifle as a club.

FIFTEEN years ago bombers could, under picked conditions, unmolested and unopposed, undoubtedly sink a surface vessel. Under the same conditions, but with more difficulty, they could accomplish the same thing today. Yet in the meantime naval construction has advanced and means have been devised to lessen the vulnerability of ships to direct hits from bombs, by heavy horizontal protective decks covering all vital spots. Huge blisters, or extending compartments on the sides below and above the water line have been added to protect against bombs that are not direct hits, that explode close enough to the ship to cause damage. In addition, the effectiveness of the anti-aircraft batteries is not to be discounted. There remains the most effective form of defense against aircraft—the aircraft themselves. The fleet is always accompanied by swift plane carriers with squadrons of fast fighting planes that are capable of taking to the air with great rapidity and would be most effective against the slower and heavier enemy bomber.

History repeats itself in that the ingenuity of man always rises to provide an effective defense to any offensive weapon. During the World War the North Sea was an ideal place for submarine and mining operations. Both took their toll of British ships during the early stages of the war. Then paravanes, that ripped out mines and made them impotent, were devised and attached to heavy surface ships. Destroyer screening operations and depth bombs were developed to fight the submarine and, as a consequence, the British Grand Fleet swept this limited area, which was infested with hostile mines and submarines, suffering but negligible loss.

The naval expert today feels that the fleet has ample protection from enemy aircraft. Means have been devised to combat air attacks with a fair margin of safety.

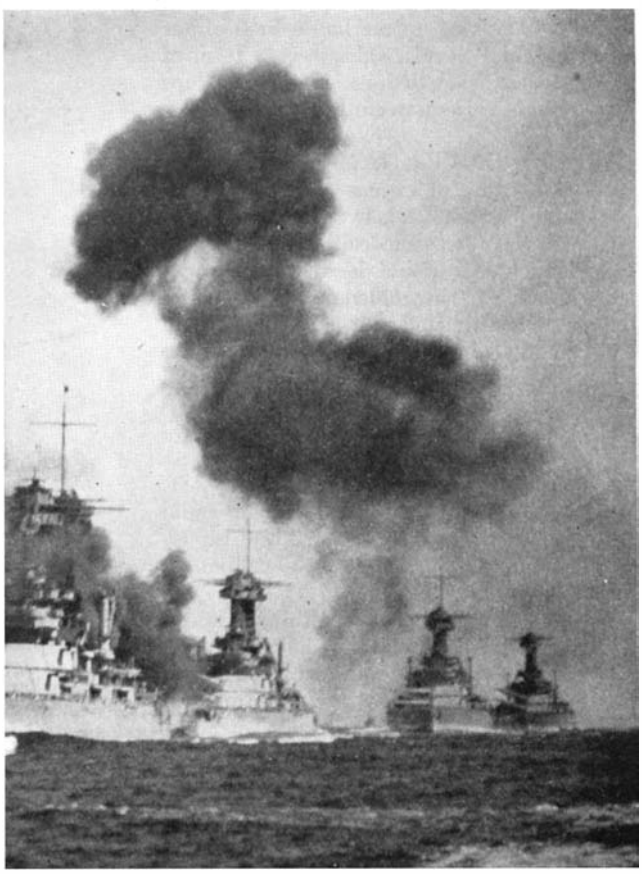
The Air Forces of the Navy have been

BATTLESHIP?

The battleship is the very backbone of our sea power.

Claude A. Swanson

I. INGRAM
U. S. Navy



developed to a particularly high state of efficiency. There has been intelligent and active co-operation between commanders of the air and surface forces to provide sound and adequate defense from hostile air attack. This important question is continually under advisement and each big maneuver develops something new in making our Fleet a more effective and efficient first line of defense.

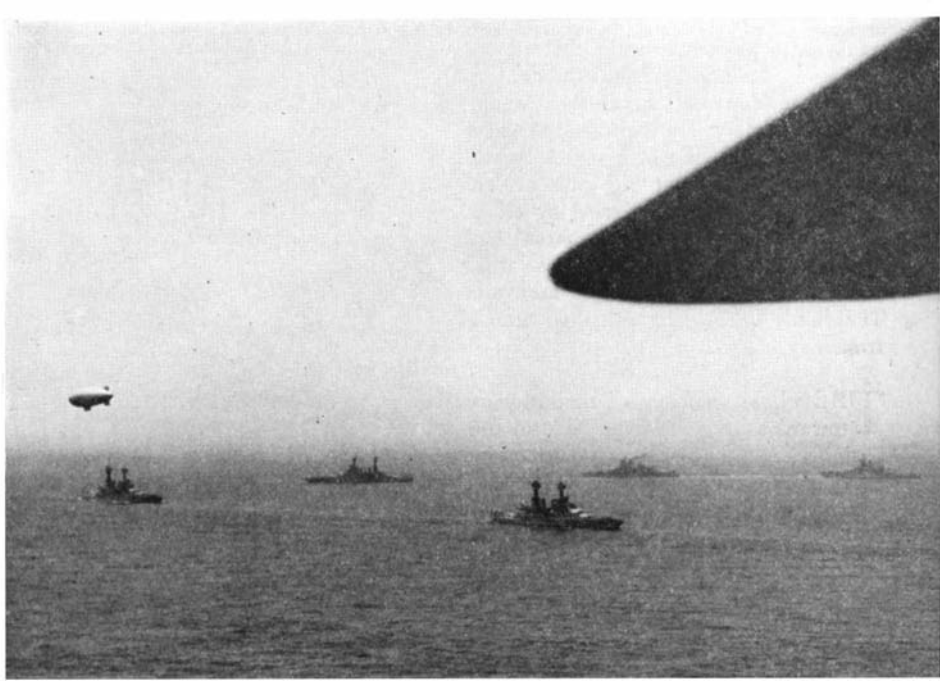
While there has been a marked advancement in aircraft during the past 15 years, the situation remains the same in respect to the possibility of air raids on this country launched from either Europe or Asia. It will be many years before an air squadron, loaded with effective bombs and necessary fuel, can negotiate the great expanse of sea and still do us much harm. The only avenue from which we are susceptible to air attack will be through planes carried on surface ships or located at advanced bases. In either case this is a problem for the Navy, and in this problem command of the sea will play an important part. Effective raids by air and successful blockades to our shipping can only be carried out when we have relinquished command of the sea, and naturally will be most difficult of accomplishment so long as our battle line remains intact.

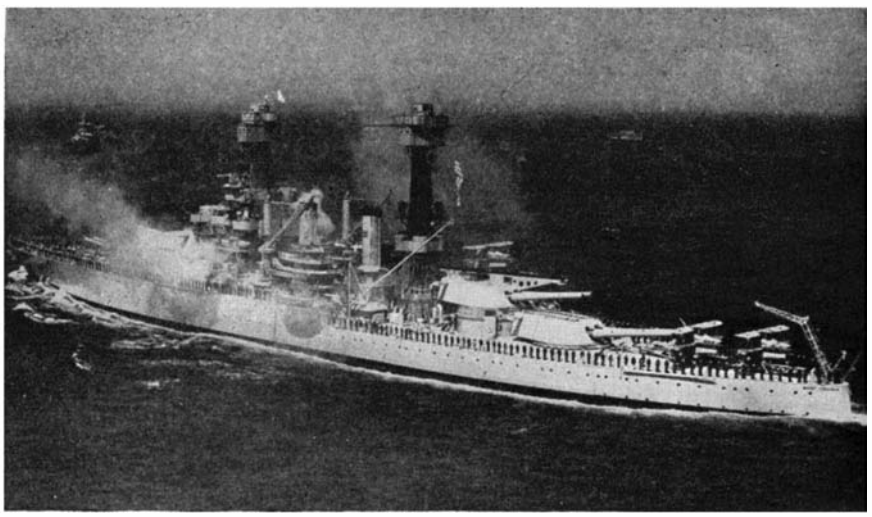
From a technical standpoint the naval constructor faces a difficult situation in the design of a warship to embody the following qualities: (1) Structural strength; (2) Nautical qualities; (3) Radius of action; (4) Armament; (5) Protection; (6) Underwater protection; (7) Aircraft protection; (8) Speed; and (9) Habitability.

That it must embody so many qualifications to perform its functions is the explanation of its size and power. Although the battleship costs less per ton to build and to operate than any other man-of-war, cost has not been a deciding factor in past construction. Obviously the battleship must be the most powerful type afloat. The larger it is, the better it can be safeguarded from air, surface, and submarine attack. Its main armament must be superior to that of any other type of vessel and should be capable of effective fire at extreme ranges. Vertical armor, adequate to keep out the projectiles of a size corresponding to those fired by her own guns, must be fitted. There must be an armored deck of sufficient thickness to keep out aircraft bombs and projectiles fired at long range. The damage caused by torpedoes, mines, and aircraft bombs exploding under water alongside the ship must be localized and restricted by an intricate system of subdivision of the underwater body. Neglect of any of these characteristics makes the ship vulnerable to some form of attack. A progressive reduction in size would reach a point at which the necessity for a large cruising radius in the case of powers lacking bases would force on them a sacrifice in the fighting characteristics of their capital ships as compared to those of other powers possessing a chain of bases. The restriction of capital ships to a small displacement, in effect making them powerful cruisers, would render them incapable of performing the functions previously described and would vastly increase the relative importance of merchant vessels converted to fighting ships.

EXPERIENCE leads us to the confident belief that vessels of the battleship class can, in an emergency, be maintained in a safe and economical operating condition for 40 years from date of completion, which is not true of vessels of intermediate size due to their lighter construction, for the very reason that the lighter ships are necessarily of much lighter construction filled with high speed machinery, and under service conditions will deteriorate much faster than the larger ship.

In speaking of displacement, this





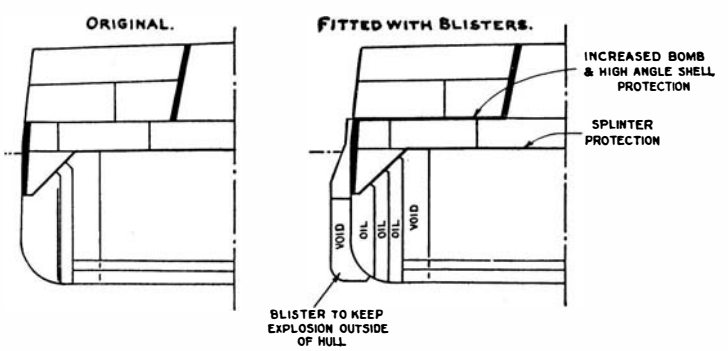
The U. S. S. *West Virginia*, our most powerful battleship

characteristic is practically the summation of all other characteristics. The battleship is distinguished from all other types of fighting ships principally by its ability to withstand successfully all forms of attack to which it may be subjected; by its ability to go when and where desired and to remain as long as may be required in spite of opposition; and, finally, by its ability to deliver the heaviest blows against an adversary. All of these qualities are reflected in the characteristics, and the sum total of them all involves the great displacements to which battleships have gone. This country can design and build, as well as any other country, battleships of any desired displacement, but the qualities outlined above will suffer with reduction in size below the standard allowed by the Washington conference.

The technical considerations herein discussed show some of the difficulties attendant upon the reduction in size and make it evident that to limit battleships to 25,000 tons or less not only ties us down to weak battleships but allows no leeway for improvements to counteract the developments in offensive weapons which may be expected to take place during the life of a vessel. All of these weapons except big guns are, it must be remembered, carried by other craft as well as by battleships so that comparison of our battleships with foreign battleships alone is of no avail. They must be able to withstand attack from any source.

THE whole tendency of limitation is toward asking the impossible of the designer. A reduction to 25,000 tons or less for battleships will only cause dissatisfaction with this type of vessel and inevitable doubt as to its being any longer the backbone of the fleet. We must frankly accept the principle that it is impossible to build small ships that are able to resist all forms of attack.

The fundamental purpose of a Navy is protection from attacks by sea. Naval opinion is unanimous that the battleship is the backbone of our sea power, and our sea policy demands such a ship. Hence it is well to know the relation existing between the characteristics of a battleship and displacement or total tonnage.



Sections of modern battleship with and without blisters

This question will undoubtedly be the greatest technical contention at the coming Naval Conference. The issue will to a great extent hang upon armament.

It is possible to install 12-inch, 14-inch, or 16-inch guns on a battleship of any size from 20,000 tons up and still retain some semblance to a battleship; the number of guns will decrease with the increase in caliber and the caliber affects other characteristics, especially protection and speed. The question of gun caliber may be settled by statesmen on the score of economy or international expediency, but we cannot escape the consequences of arming new ships with guns of materially less power than are carried by the majority of the battleships making up the battle lines of our principal naval rivals. It is a form of naval suicide to force individual ships to fight more powerfully armed enemies.

MOREOVER, it is impossible, because of expense, to start off all fleets simultaneously with new ships carrying the same caliber of guns, although this would be the fairest way of solving the problem.

It is estimated that a 25,000-ton ship could be built to carry eight 45 caliber 12-inch guns or four 45 caliber 16-inch guns.

A 30,000-ton ship could carry twelve 45 caliber 12-inch or six 50 caliber 16-inch guns.

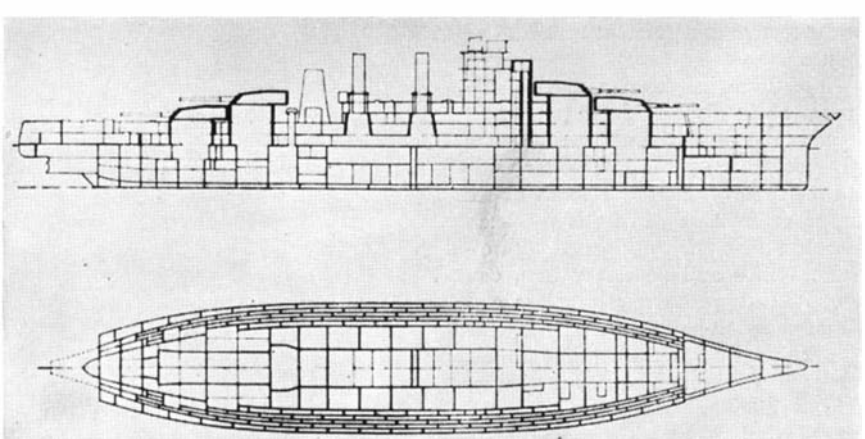
A 35,000-ton ship could carry fifteen 50 caliber 12-inch or nine 50 caliber 16-inch guns.

The last ship, however, would be difficult of design with 12-inch guns, as five triple-gun turrets would be an inefficient arrangement.

The fact that the weight of projectiles fired varies as the cubes of the calibers of the guns is the big argument for the larger gun. Our Navy being "sold" on the efficiency and effectiveness of the 16-inch gun makes this the desirable armament for our particular needs.

The naval architect has been successful thus far in the development of the battleship to withstand attacks successfully from any other source and it is

(*Please turn to page* 163)

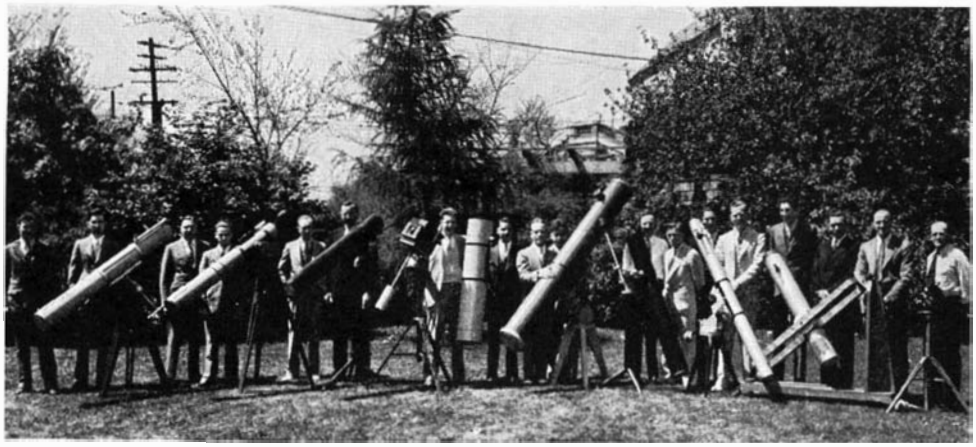


Underwater compartmentation of a recent battleship

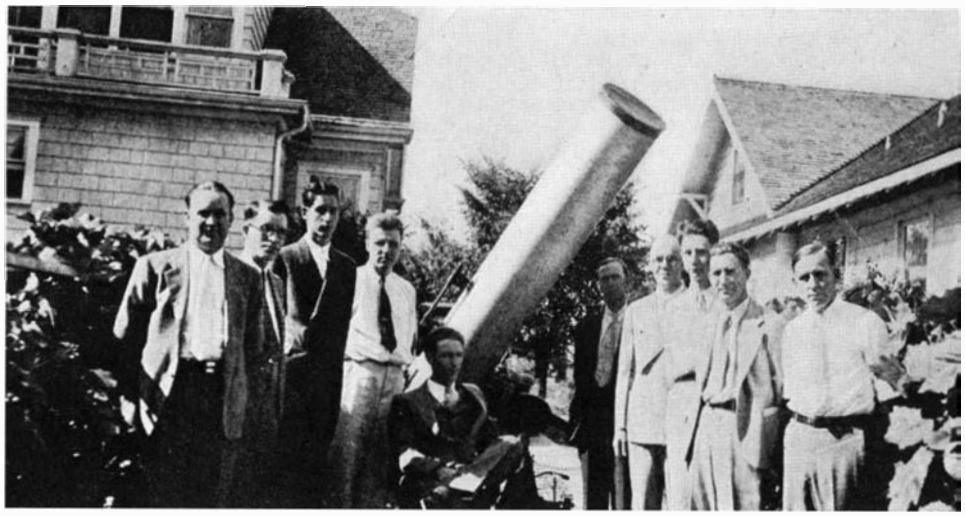
New Hobby Clubs Create Constantly Spreading Interest in

TELESCOPE MAKING

TO clubs organized earlier in Springfield, Vt., Rochester, Los Angeles, Pittsburgh, Chicago, Tacoma, Cincinnati, Buffalo, Boston, Indianapolis, Jamestown, N. Y., New Orleans and Teaneck, N. J., must now be added clubs in three other cities, shown in the photographs on this page.

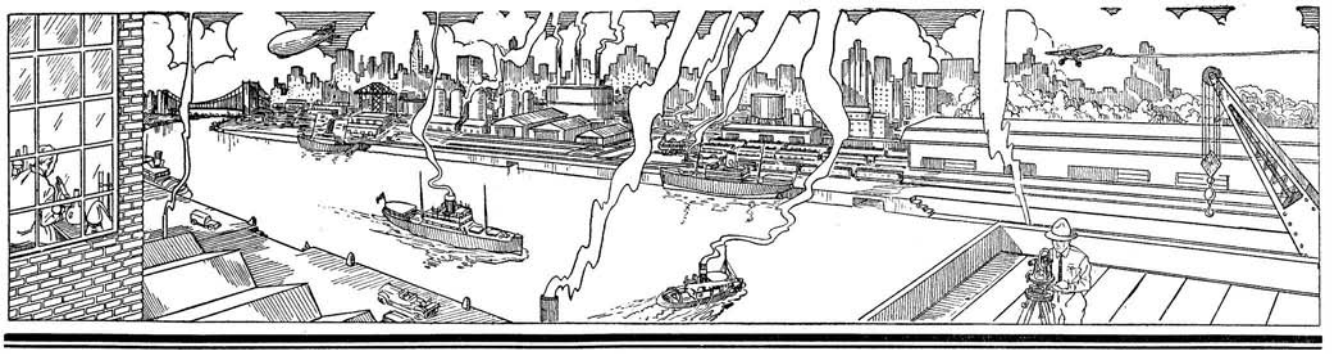


Right: **Members of the Amateur Telescope Makers of Dayton. (Loren Shumaker, 1608 Wyoming Street, secretary)**



Left: **A few of the 25 members of the Amateur Telescope Makers of Kansas City. (Dana V. Bidwell, 5525 Woodland Avenue, is the secretary)**

Below: **A meeting of the Telescope and Microscope Sections of the Westinghouse Club of Pittsburgh, an organization limited to the employees of the Westinghouse interests in and around Pittsburgh, Pa. (Fred C. Wilharm, Box 63, Homewood Station, Pittsburgh, chairman of both sections), with the Astronomical Section of the Academy of Science and Art of Pittsburgh (Leo J. Scanlon, Pres.)**



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN

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

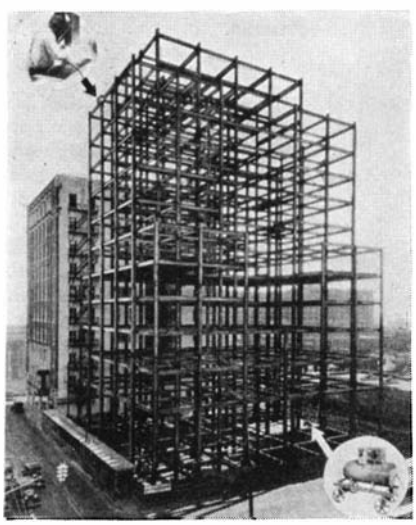
A. E. BUCHANAN, Jr.

Lehigh University

Remote Control for Arc Welders Cuts Costs

SAVINGS up to 500 dollars per year per welder—higher quality welds—increased weld output—these are results claimed for a new remote control device for arc-welding machines announced by The Lincoln Electric Company. No additional cables or other apparatus need be carried by the operator.

With this device, known as "Lincontrol," the operator taps the electrode on the work



Using remote-control arc welding in fabrication of a tall building

several times—the voltage is automatically raised! A larger number of taps and the voltage is lowered! Thus by merely tapping the electrode—making and breaking the electrical circuit—the current output of the generator is controlled.

With "Lincontrol" the operator can work at any distance from the machine and regulate the current accurately without making trips back and forth to adjust the controls.

When work is begun in the morning, the welder is cold. After the machine is warmed up the current setting should be changed. Without remote control, the operator either uses the original setting with resultant lower speeds or makes a trip to the machine, thereby wasting time. Changing from horizontal to vertical welding or vice versa demands a change in electrode sizes. If the operator is working in the hold of a ship, for example, this change, requiring a resetting of the controls, probably means many minutes of lost time.

In shipyard work, the average welding operator spends approximately 15 percent of his time in actual welding. "Lincontrol" increases the operating factor as much as 100 percent, according to the manufacturer.

There is a definite and substantial saving in time wherever welding is done at a distance from the machines, as in the case of shipyard and structural work, boiler and tank shops, pipe lines, steel mill work, and dozens of other applications.

Silver Soap

IN view of the social triumphs that the ad writers are attributing to the use of certain soaps these days, we can't help wondering what marvelous results they will conjure up for a newly patented soap containing metallic silver as a germicide—if it is ever put on the market. According to the patent specifications, the silver soap disinfects without discoloring. The silver is incorporated as powder, foil, leaves, or flakes and is then "activated" by superficial electrolytic oxidation or by treatment with hydrogen peroxide, permanganate, or other oxidizing agents. Soluble or difficultly soluble silver compounds, and sodium perborate, sodium pyrophosphate, peroxide, or other substances containing active oxygen may also be added.—*A. E. B.*

Warming Up the Rifle

INSTRUCTIONS for the sighting-in of hunting and target rifles, writes Louis Schauppner in *The American Rifleman*, usually designate that the sighting-in should be done "after firing warming shots." Mr. Schauppner relates some of his experiences with warming shots and reaches the conclusion that sighting-in of target rifles should be done after warming up the gun but that hunting rifles should be sighted-in without warming shots. He relates an interesting series of experiments which he conducted shooting prairie dogs, which showed that at about 80 yards range a cold rifle barrel placed shots about one inch low at seven o'clock. After six or seven shots, the point of impact raised so that the bullets were hitting the point of aim.

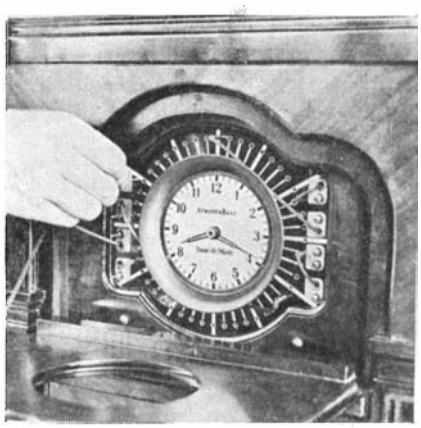
Since the hunting rifle is ordinarily used for only a comparatively few shots during the day, it appears logical, therefore, to sight-in the rifle with a cold barrel, as practically every shot will be fired under similar conditions. On the target range, on the other hand, shots are fired in rapid succession so that the barrel warms up; checking up of the sights for target work should, therefore, be done with a warm barrel.

Automatic Radio Tuning

A RADIO set which tunes in different stations according to a pre-selected schedule, starting and stopping and changing automatically over a 12-hour period, has been perfected by A. Atwater Kent, radio engineer and manufacturer.

Once set, the "tune-o-matic" receiver provides any combination of programs desired, and after turning itself off at night will go on again in the morning and serve as an alarm clock. It looks like any other large all-wave radio except for an electric clock set into the front panel. While the mechanism is described as a complicated problem in radio engineering, the operation is simple.

A series of small holes around the edge of the clock's face mark the quarter hour periods and serve as connecting channels between the time-clock arrangement and



How cords are used to "pre-set" the new automatic radio receiver

the tuning mechanism. The latter has 16 outlets in the form of miniature telephone switchboard cords, two to each of seven stations and providing for fourteen different program periods, with two extra cords for intermission periods. The cords are plugged into the holes at the desired program periods, and the radio then operates automatically, shifting from station to station and program to program, stopping itself and starting again exactly as scheduled. If the self-tuning mechanism is not turned on, the set operates like any other.

Bread Frozen—Still Fresh When Thawed

FREEZING bread with dry ice to keep it fresh is the latest trick of the baker's art, reported to the German science journal, *Die Umschau*. When the bread is thawed out again it is as good as new, it is claimed. A patent on the process has been applied for.

"Scientific American" Model Plane Prizes Awarded

AT the 1934 National Championship Model Airplane Meet, held in Akron, Ohio, June 27-29, prizes of three yearly subscriptions to SCIENTIFIC AMERICAN were awarded to the following successful contestants in the Indoor Stick Model Contest for contestants 21 years of age and over:

Carl Goldberg, Madison, Wisconsin, flew his indoor stick model for a world's record of 22 minutes, 54.6 seconds. This flight was inside the Goodyear-Zeppelin Airdock where all indoor flying was conducted. His model has a wing area of 150 square inches and span of 40 inches. The propeller's diameter is about 16 inches. The wing and empennage is covered with microfilm. The model's total weight, including rubber motor, is .165 ounce. This flight was all pure self-propelled flight, no thermal currents or soaring, just plain powered flying for almost 23 minutes. The motor is a single loop of rubber strand 7/64 by 1/32 of an inch. The length of rubber is about 36 inches and the ends are tied together to form a loop.

Mr. Ernest A. Whalen and Mr. Donald Lockwood were awarded the other subscriptions on the basis of having placed second and third in the same contest (indoor stick model) and showed an all-around performance in other events.

These annual meets are for National Aeronautic Association junior and senior members only. There are several thousand such members who fly model airplanes. The records are given official status by virtue of the Association's affiliation with the Federation Aeronautique Internationale.

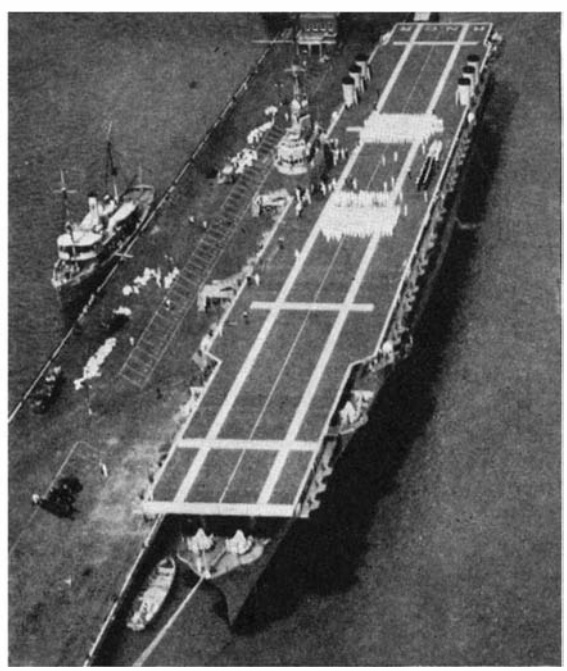
Too Many Chemists?

"ARE there too many chemists?" asks the editor of *Industrial and Engineering Chemistry*. Faced by the fact that many college trained chemists are out of work and that more and more young men and women are studying to become chemists, members of the profession are wondering whether industry will be able to absorb the supply. *Industrial and Engineering Chemistry* points out that "we have 160,605 lawyers, judges, and justices; 153,803 physicians and surgeons; 22,000 architects; 61,905 college presidents and professors; 71,055 dentists, 102,086 civil engineers and surveyors; 57,837 electrical engineers; 54,346 mechanical engineers; 11,970 mining engineers; 29,613 librarians; and under the broad classification of chemists, assayers, and metallurgists, 37,068. All of these occupations appear overcrowded.

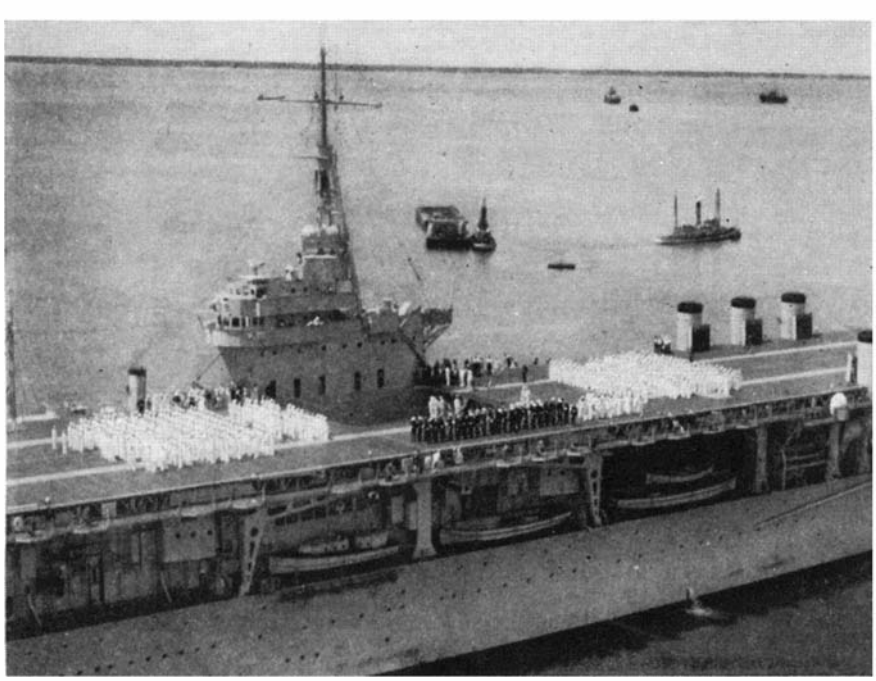
"Last year, 417 people received the doctor's degree in chemistry; probably a minimum of 7000 received the degree of B.S. majoring in chemistry. There are no doubt as many as 30,000 in our institutions of advanced learning with chemistry as a primary interest. It is unlikely that all of these people will find places satisfactory to them for the practice of chemistry."

In spite of the fact that there seems to be no prospect of satisfactory jobs for all these chemists, the fact remains that employers have difficulty, even today, in finding the kind of men they want for chemical jobs. The chemist who has specialized in some particular phase of his science, who has delved a little deeper than anyone else into his chosen subject and who has developed ideas of his own for improving products or reducing production costs is not likely to be unemployed very long.

Young men and women considering a career in chemistry should realize in advance that being a chemist gives no guarantee of a job but that there will always be rewards for the few who can stand out from the crowd in ability and in willingness to work.—*A. E. B.*

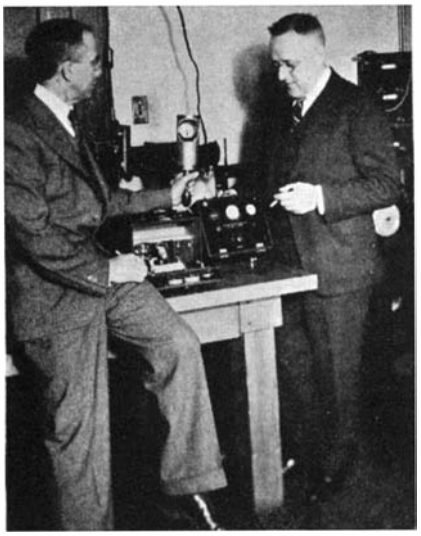


Our newest aircraft carrier, *Ranger*, first American ship to be designed from the keel up as a carrier. These two views show some features that differ from our other carriers. *Ranger* is of 13,800-ton displacement, is 727 feet long, and carries 72 planes of various kinds. Two other new ones, *Enterprise* and *Yorktown*, are now under construction



Quality in Eggs

AN actual test with results measured scientifically has again disproved a notion or opinion widely held. Some poultrymen have believed that it was possible to overdo efforts to breed a strain of poultry capable of high records in egg laying. They said that the greater number of eggs a hen lays the poorer the quality of the eggs. Poultry



Equipment used in measuring ultra-violet radiation by the "cupful"

specialists of the United States Department of Agriculture had no evidence to substantiate this idea, but the idea was important if true. So they investigated.

It is recognized that the proportion of thick albumen in relation to thin albumen in the white of an egg is one of the reliable indicators of egg quality. Eggs with a high proportion of thick albumen stand storage better, and they fry or poach better when fresh. The result of actual tests showed that there was no relation between the number of eggs a hen laid and the proportion of thick albumen in the eggs. Some of the heavy layers produced eggs with a high proportion of thick albumen, whereas others produced eggs with a smaller proportion. This was also true of the hens that laid relatively few eggs.

The investigators found that there are individual and breed differences in quality as well as in quantity of eggs. They suggest, as a consequence, that it may prove possible to select strains of poultry that lay quality eggs with a high percentage of thick albumen. Whether it would pay to do so would depend on marketing arrangements that would insure a premium price for quality.

Ultra-Violet Measured by "Cupful"

A NEW ultra-violet meter that "tunes in the sun," and, upon selecting a band of radiation, measures its biologically-effective ultra-violet content by the "cupful," has been developed by Dr. M. Luckiesh and A. H. Taylor.

The new meter is encased in a small portable cabinet, approximately eight by ten by seven inches in size. It is equipped with a photo-electric cell which is connected to the meter by means of an extension wire. Inside of the cabinet is a vacuum tube hooked up with a sensitive counting relay which is similar in appearance to the odometer of an automobile.

In operation, the photo-electric cell, when actuated by the ultra-violet radiation, passes a small current which accumulates on a condenser until it reaches a sufficient quantity to "spill over" and turn the counting relay. This process is repeated as long as the photo-electric cell is exposed.

The new meter is being used at Nela Park to measure the ultra-violet output of Sunlamps. Being portable, it can be used by anyone, anywhere, for similar measurement. Physicians, for example, may use the instrument to measure the exact amount of ultra-violet they give their patients.

Cities that advertise the relative health-merits of their climates may now easily announce the average amounts of beneficial ultra-violet they receive in the course of a month, year, or period of years. For example, Miami and Los Angeles might announce the comparative amounts of ultra-violet received over a given period.

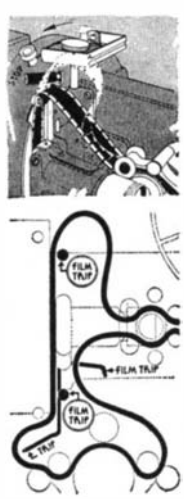
Dialyzing Milk

COW'S milk in an infant's stomach forms curds which are larger and harder to digest than breast milk. Also it is deficient in lactalbumin or whey protein, held to be essential for infant growth. By adding water, fat, lactose, and a dialyzed whey protein powder, cow's milk becomes an improved substitute for breast milk.

The whey protein powder has been produced from cow's milk by electro-dialysis, in which the ash content is lowered, according to Paul D. Watson of the United States Department of Agriculture in *Industrial and Engineering Chemistry*. About 30 percent of this powder is necessary in properly modified milk.—*A. E. B.*

Automatic Movie Film Safety Stop

IN order to prevent breaking motion picture film in an amateur projector due to losing a loop during projection, the Animatophone machine is equipped with four



Mechanism that stops the film in a movie projector before breakage

automatic film trips which stop the machine before any damage can be done. The accompanying illustration shows how this is accomplished. If at any one of the four points indicated the film pulls against an automatic trip, a clutch lever is immediately thrown out of operating position, cutting off both power and light.

Perfumed Gasoline

IN spite of their energetic claims that their gasolines will impart stream-line action to your old car or lift the pyramids a couple of feet, it appears that our gasoline companies have been missing a trick, for it is now possible to "doctor up" the motor fuel so as to eliminate the odor of exhaust gases. Just imagine the possibilities in advertising a gasoline that will leave behind the sweet perfume of gardenia or lilac as you drive through the city!

The process for ameliorating the smell of the exhaust gases of internal combustion engines is covered in a recent patent which claims that an agreeable smell can be imparted to the exhaust gases of internal combustion engines using any desired type of fuel by adding small amounts, four grams or less per gallon, of an artificial musk compound or an arylalkylketone. Both substances have the property of resisting combustion under the conditions prevailing in internal-combustion engines and are adapted to impart to the exhaust gases a pleasant odor which enables the pungent smell of the half burned oil to be modified as desired.—*A. E. B.*

Self-Contained Sprinkler

MAXIMUM protection at minimum cost characterizes a new automatic chemical sprinkler system for use in factories, warehouses, stores, schools, hospitals, basements of dwellings, and other places now without sprinkler protection. In water sprinkled plants, the system may be installed in remote spaces or for special hazards such as paint and lacquer rooms, or in storerooms and vaults requiring special protection not only from fire but water and chemical damage as well. The system is particularly attractive for buildings beyond public water mains, as well as for galley and engine room of pleasure craft.

The Firetox system comprises one or more aluminum units suspended from the ceiling and providing protection for a given number of cubic feet of space. Should a fire occur within the area protected by a unit, the excessive heat develops a pressure within the unit and melts the low-melting-point solder of its sprinkler head. This releases under pressure a chemical spray which, in contact with heated air, becomes a non-poisonous gas blanket five times heavier than air. This gas blanket settles down on the blazing area and, by diluting the oxy-

A self-contained sprinkler for fire protection, showing its small size

gen, extinguishes the fire without water or chemical damage. No piping is necessary. The units are entirely self-contained and fully automatic.

Numerous tests and actual fires indicate that these units operate within two or three minutes of the start of a fire in the protected area. The fire is mastered in a few minutes. Necessary listing and approval have been obtained from Underwriters' Laboratories and Factory Mutual Laboratories for use under conditions specified.

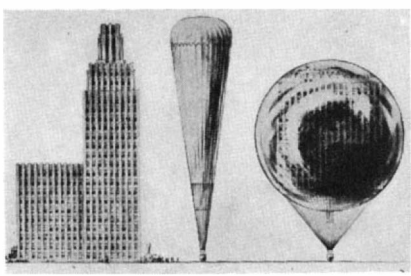
Aids for Stratosphere Flight

THE newspapers have given the public more than adequate information on the plans and prospects of the stratosphere flight by Major W. E. Kepner and Captain A. W. Stevens, under the auspices of the National Geographic Society and the Army Air Corps. We would like to give our readers a photographic view of some of the devices and methods that are an integral part of the expedition which, at the time of writing, is waiting favorable weather for the take-off.

The balloon is the world's largest, and has a capacity of 3,000,000 cubic feet. Its top will be at a distance of 300 feet from the gondola. The gas release valve must of necessity be placed at the top of the balloon, where it will have the greatest chance of rapid release. Therefore, to open the valve at the top of the balloon by means of a rope does not seem very practical, since there is a possibility that the rope might become tangled. Accordingly, Captain Stevens has invented a special compression valve to release hydrogen gas from the bag. A rubber hose will extend between the gondola and the top of the balloon. Compressed gas admitted to the rubber hose will open the valve by exerting pressure on it against the action of a spring. The design of such a valve is a very delicate affair. The valve must not only open against the action of the spring and on the admission of the compressed air, but it must also shut absolutely tight when the pressure is turned off, and the setting of the valve in the comparatively flexible balloon is a matter which the engineers have worked out very carefully indeed.

The gondola is a metal sphere eight feet four inches in diameter, built up somewhat like the sections of an orange, of an alloy which is 95 percent magnesium. The shell, without its fittings and instruments, weighs 450 pounds. Photograph 4 shows the ball near completion at the factory of the Dow Chemical Company. The workers are attaching an air-tight hinged manhole cover. A second manhole is situated on the opposite side of the sphere. The small openings are observation portholes. The flyers will be sealed in with a supply of air, but the manholes can be quickly opened from within. The construction of the sphere from welded "orange peel" sections and two circular pole pieces is apparent in the photograph.

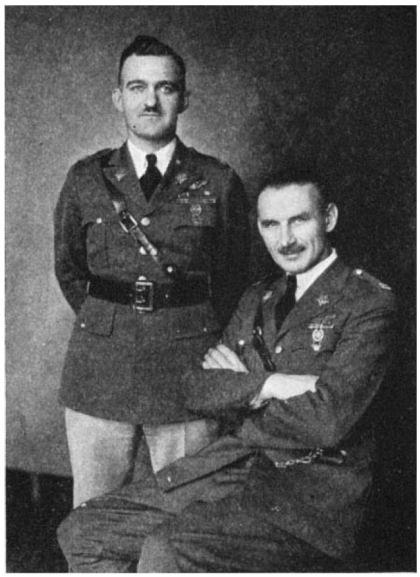
For navigational purposes it is important to know the temperature of the hydrogen gas in the balloon. Captain Stevens has



Center: **Balloon at start, and at** *right,* **the balloon fully extended**

accordingly devised an interesting instrument which will be placed in the bag and will be read through a window in the gondola. This consists of an inner and outer strip of metal having different coefficients of expansion. Under temperature influences the outer and inner strips will have different expansions, and accordingly will actuate the indicator, which the navigator will observe.

When leaving the ground the balloon will have the shape shown in one of the illustrations, between the tall building and the balloon in its circular form. It will, at



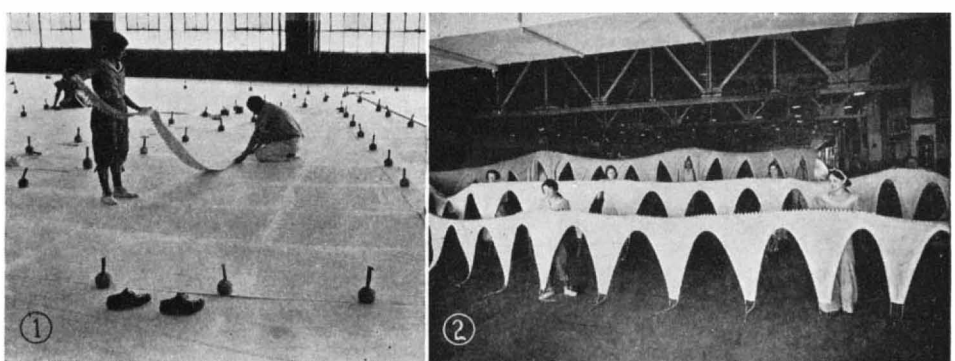
Major William E. Kepner
Captain Albert W. Stevens

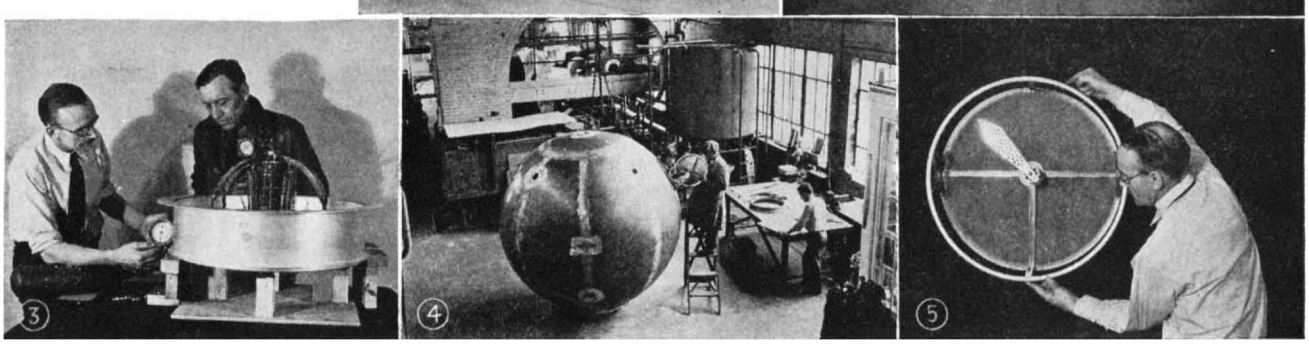
that time, be less than one tenth filled with hydrogen, which will gradually expand as the balloon rises to the thinner and rarer air. When the balloon is ready to rise, its top will be more than 300 feet above the earth—higher than a 27-story office building. At the top of its flight, nearly 15 miles above sea level, the hydrogen will have fully expanded, and the balloon will have become a sphere 180 feet in diameter. It will then be large enough to enclose an 11-story cubical building.

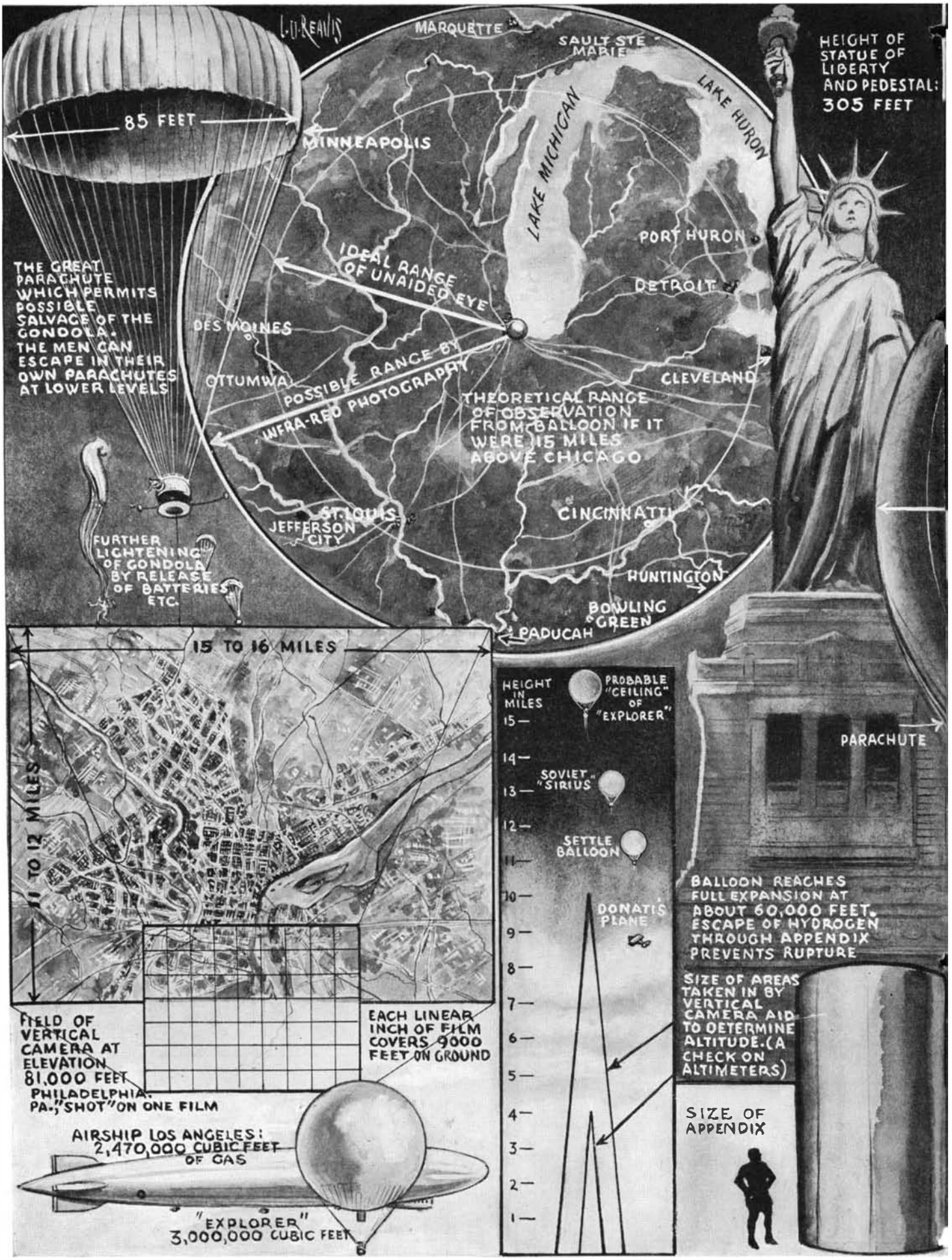
● **Other details of the stratosphere balloon are given in the two-page drawing on pages 148 and 149**

No needles and thread were used by the balloon tailors. Sections of rubber-impregnated balloon-cloth are pasted together with rubber cement, and the seams are covered with rubber tape. These are necessary pre-

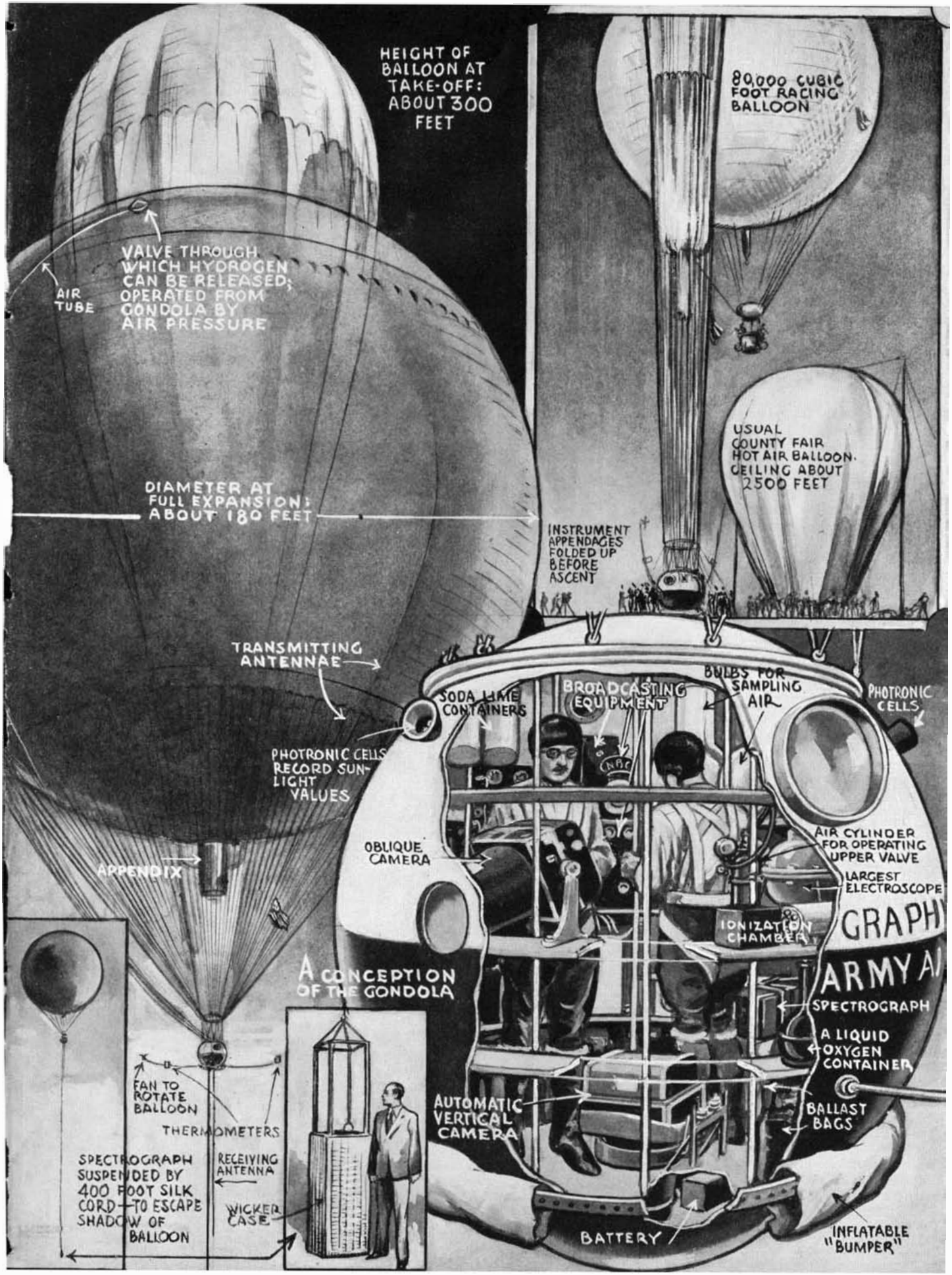
Some of the details of the balloon designed for stratosphere flight. 1: Laying out the rip-panel. Note weights that hold the material in place. 2: From the scallops of the catenary band will hang the ropes that support the gondola. 3: Compression valve described in text. 4: Placing an air-tight manhole cover in the gondola. 5: Gas temperature indicator for the bag







Some of the details of the stratosphere balloon that is, at the time of writing, awaiting favorable weather



for the take-off. Note particularly the tremendous range of observation possible at a height of 15 miles

cautions to avoid gas leakage. During this process the fabric is held in place, not by pins, but by 10-pound lead weights. When working on the cloth the workers wear cloth shoes to avoid grinding grit into the delicate surface. The cotton fabric used will cover three acres of surface. Two of the workers are shown, in photograph 1, holding a wedge-shaped panel with scalloped edges. This panel is the rip-cord, and will be torn out by the balloon pilot by jerking a rope just as the gondola reaches earth.

The gondola must, of course, be securely fastened to the outside of the balloon, and the "catenary band" shown in photograph 2 will be cemented as a belt around the balloon to distribute the load as much as possible. From each of the 160 scallops a rope will extend downward to form bridles that will support the gondola with its load of men, instruments, and ballast.—*A. K.*

A Circular Wing Airplane

TWO of our photographs illustrate a novel form of aircraft which is quite conventional for the most part, except that the regular airplane wing is replaced by a circular surface 15 feet in diameter. On the circular wing a rear flap is mounted, which, when depressed, helps to increase the maximum lift of the wing, just as on an airplane wing. At the tips are two movable surfaces which evidently act as ailerons. Steven P. Nemeth, the designer of the craft, informs us that with 110 horsepower a high speed of 135 miles per hour has been obtained, and that the low speed is satisfactory.

Our guess is that on the debit side there is likely to be much more induced drag than the ordinary airplane wing, because of the low aspect ratio and high tip or end losses. On the credit side there should be

Above and right: **Two views of the airplane with 15-foot circular wing**

a greatly delayed stalling point; that is to say, a stalling point much above the usual angle of incidence of 15 or 16 degrees. *A. K.*

A Novel Amphibian Gear

OUR readers are, of course, familiar with amphibian gears in which some form of retractible wheel chassis is added to the flying boat hull or the seaplane floats. In Germany, a novel amphibian under-carriage has been produced in which large inflated balls of rubber are used instead of wheels.

Tests so far have been made only on land, and the light airplane has got off and landed fairly well. With big enough rubber balls there is no reason why there should not be sufficient flotation in the water, and no very great difficulty in alighting on the water.

In a water take-off, the water resistance will be much greater than that of the planing under-surface of a float. That is where this tempting simplification of the amphibian gear may fail.—*A. K.*

Air Liner Headlights

GONE are the days of projecting headlights on airplanes. On the new Boeing transport, landing lights are now completely enclosed, a compartment in the leading edge of the wing housing a locomotive-type, sil-

Headlight in an airplane wing

vered glass headlight reflector, a special globe, and a courtesy light which shows red on the port side and green on the starboard side. The outer glass is curved, conforming to the wing contour.—*A. K.*

Bonding An Airplane

SOME useful tips on bonding an airplane are given by Rex Martin of the Department of Commerce in a recent issue of *Sportsman Pilot*. By bonding, of course, is meant electrically connecting together all metal parts of an airplane into one electrical mass. Some day bonding may be eliminated. At present it is quite impracticable to use radio effectively on ships which are unbonded.

Mr. Martin gives the following five good reasons for bonding an airplane:

1. To increase the electrical capacity between the airplane and the antenna of the radio set.

2. To prevent absorption of the radiated energy of the radio set by metal parts which are electrically isolated from the main metal mass of the airplane.

3. To eliminate the danger of sparks between two metal members between which there exists a difference in electrical potential, caused by the collection of a static charge.

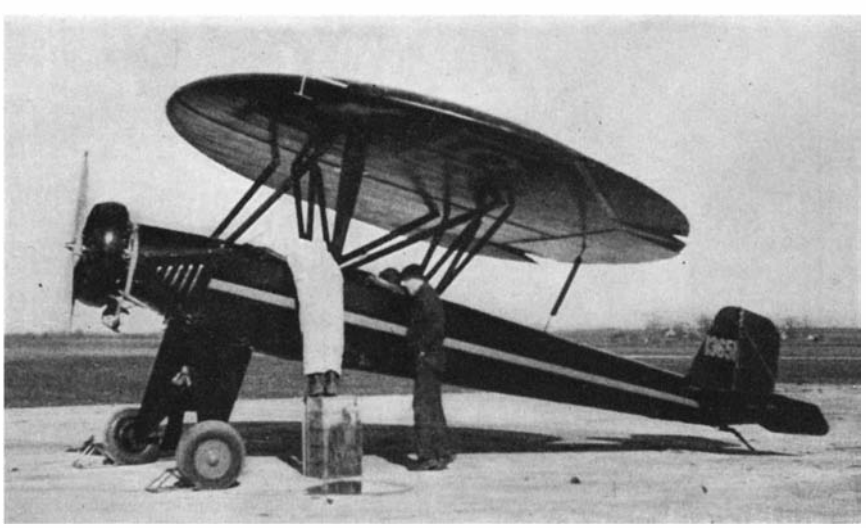
4. To eliminate noises produced in the radio receiver which are caused by the varying resistance between rubbing or vibrating metal parts.

5. To protect the radio shielding from electrical disturbances by lowering its resistance.

The bonding itself is simple in principle but lengthy in execution. For example, on wooden wings, a flat copper strip, not lighter than 1/64 by 1/4 of an inch should be attached by brass nails to the inside faces of the spars. A copper network is in fact formed, which connects to the metal fuselage. All the fittings, including strut fittings, drag strut and brass wire fittings, control hinges, and so on, are connected to this copper strip network. Particular importance attaches to the joints made by welding, soldering, and riveting. Control surfaces are bonded to the main metal mass of the structure by means of flexible braided copper wires. Wherever flexible cable is likely to come in contact with the network structure, insulation with fibre is provided. Oil tanks, gasoline tanks, and all plumbing are similarly bonded by braided connections across the hose connections.—*A. K.*

Laminated Paper Does Not Expand or Contract

THE Neenah Paper Company, in conjunction with Mr. Garrett B. Linderman, an engineer of Pittsburgh, has developed a new laminated paper which consists of two sheets of paper pasted to a center core of very thin aluminum foil. The metal foil in the center can be of other material besides aluminum, such as electrolytically deposited copper, or lead, though the widest application seems to lie at present in using aluminum foil as a center. This foil may vary in thickness from .005 of an inch either heavier or lighter, depending on the individual requirements.



By cementing the two sheets of paper to a center core of aluminum, it has been found that the paper will not expand or contract under varying humidity conditions, provided the correct adhesive is used. This makes the paper especially suitable for recording instruments, charts of various kinds, or for any purpose where extreme accuracy is demanded.

The development of special adhesives, which have been perfected, gives a waterproof adhesive and also a highly heat resistant adhesive.

Besides the instrument field itself, this paper has been used very successfully for topographical maps and other chart work where the expansion and contraction of a normal sheet of paper would cause decided inaccuracy.

One other field in which it seems that there should be great possibilities for this paper is in the making of architectural drawings with washes or for water-color prints where the problem of buckling is always present.

Adjustable Engine Cowling

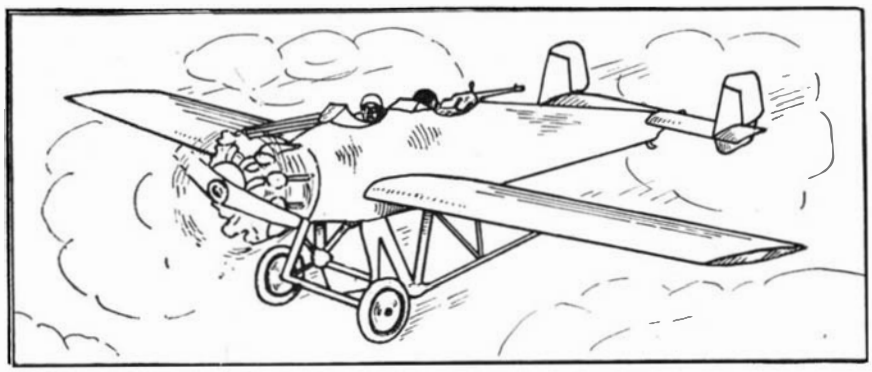
IN take-off or climb the air-cooled engine is working at full power while the airplane is moving forward at a comparatively low speed. For this condition, therefore, it would be desirable to have a large opening at the rear or exit end of the N.A.C.A. cowl which almost invariably protects the air-cooled engine from excessive head resistance. Otherwise the temperature of the engine will run too high.

On the other hand, at top speed in level flight, particularly at altitude, the same rear-end opening is not necessary for cooling; it could be cut down and thus save head resistance.

Starting with this simple argument the engineers of United Aircraft have designed and successfully tried out an adjustable cowling which enables all conditions to be met in the best possible manner, controls the engine temperature, and allows the top speed to be improved some six miles an hour.

The new adjustable cowl is shown in two of our photographs, applied to a large Pratt & Whitney motor. The device consists of a standard N.A.C.A. cowl having an adjustable trailing edge or skirt. This skirt is made up of a continuous series of metal flaps, pinned along their leading edges to the trailing edge of the cowl. These flaps are so connected to a manual control that they open fanwise, preserving a substantially unbroken cowl surface, but one which flares out decidedly at the trailing edge as the flaps open.

The extra weight is only 16 pounds, and the device has proved thoroughly worth while both in trial flights and wind-tunnel tests.—*A. K.*



Split tail surfaces make this plane a more effective fighting unit

"Dry Ice" in Machine Shop

SOLID carbon dioxide, popularly called "dry ice," may, at a temperature of 112 degrees below zero, Fahrenheit, compete with heat in securing "shrink fits" for machine parts.

W. H. Swanger of the National Bureau of Standards, who has been conducting experiments with solid carbon dioxide reports that machine shop practice may come to accept the new method of applying excessive cold instead of heat in shrinking metals.

When it is necessary to secure a metal band to a shaft, the usual practice is to heat the band. Expansion allows it to be slipped into place, and as it cools it contracts to a tight fit. However, by "refrigerating" the inside part, or shaft, it can be shrunk materially. The band is slipped on and when the shaft warms to room temperature it expands again to normal size, and a tight fit is secured.

Relatively a curiosity five years ago, the domestic production of frozen carbon dioxide has in recent years exceeded 40,000 tons. Now that it has become commercially available, Mr. Swanger believes that the shrinking of metals with excessively low temperature will be adopted as an engineering method, and will find extensive use.—*Science Service.*

Firing Through the Tail Surfaces

THE classic maneuver in air fighting is to dive on the enemy's tail, where he cannot protect himself because the rudder hinders his firing to the rear.

In a Junkers two-seater fighter built in Sweden, this hazard of aerial combat is cleverly avoided. The rudder and fin are split up into two parts and mounted at the end of the horizontal tail surfaces. The rear gunner thus has ample range of fire to the rear. If such designs are generally adopted the aces will have to think up new methods of attack!—*A. K.*

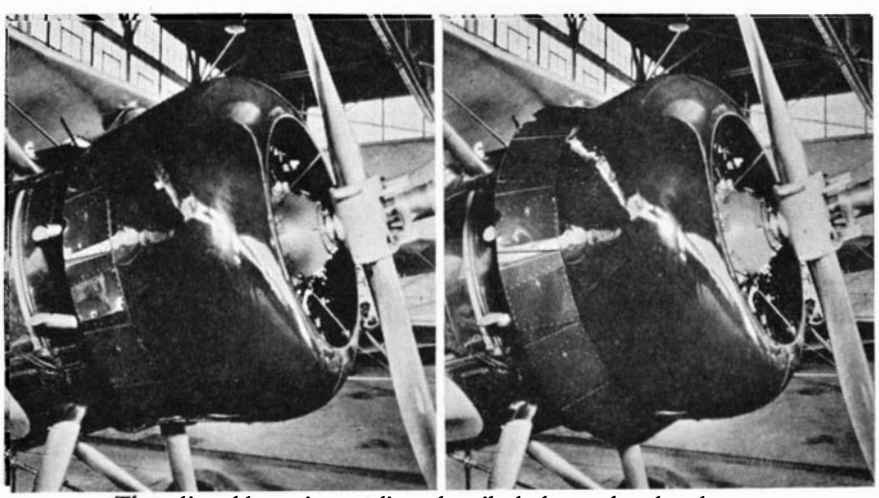
Diphtheria Toxoid

THE Division of Laboratories and Research of the New York State Department of Health has discontinued the general distribution of diphtheria toxin-antitoxin mixture which it has continued to supply upon request since diphtheria toxoid was made available to physicians nearly two years ago. Experience accumulated during this period has demonstrated the superiority of toxoid. Immunity is acquired in a shorter time and the percentage immunized has been higher than with toxin-antitoxin mixture. Moreover, toxoid does not contain horse serum, so that there is no possibility of sensitization to subsequent injection of prophylactic or therapeutic preparations derived from the horse.

Toxin-antitoxin was a mixture of killed and unkilled germs, alternated and weakened in virulence by being run through the blood, generally, of horses. Toxoid is killed diphtheria germs.

Sodium Chlorate Weed-Killer

HOME gardeners as well as farmers and horticulturists will be interested in recent successful experiments with sodium chlorate as a weed-killer. Tests have been carried out by several different experimenters working independently, and all agree that the treatment is both effective and cheap. *Chemical Industries* reports that tests carried out at a temperature of 40 degrees, Centigrade, and soil humidity of 24 percent, show that the toxicity of sodium chlorate in the soil sinks to nil at the end of six weeks, while in a fresh and relatively dry soil the salt maintains its toxic properties for more than two years. Results in the wet soil are due to the decomposition of the chlorate with the liberation of oxygen and the production of sodium chloride. It has also been tried out in cereal cultivation in the endeavor to



The adjustable engine cowling, described above, closed and open

secure a comparison with sulfuric acid, with the finding that the chlorate process is more economical than the sulfuric acid, and easier to use.

From other literature it appears that a 10 percent solution (one pound per gallon of water) is required for the eradication of large grasses and docks; a 5 percent solution for herbaceous weeds and small grasses, while small annual weeds require a 2½ percent solution.—*A. E. B.*

Unemployment and Fertility

THE birth rate among wage-earning families who suffered serious loss of income on account of the depression was 39 percent higher in the period of 1929-32 than among their neighbors whose incomes were not reduced following 1929. These findings are reported in a recent issue of the *Milbank Memorial Fund Quarterly* by Edgar Sydenstricker, in charge of the foundation's division of public health activities, and G. St. J. Perrott, consultant to the United States Public Health Service, following a house-to-house investigation of occupation, employment, income, births and ill health in 8000 families in eight typical cities. The authors believe this study to be the first of its kind ever undertaken.

It is considered significant that families forced to shift from a higher to a lower income level were found to have a higher birth rate during the depression years than those families who were able to remain in the class from which the downward shift was made.—*Health News* (New York State Department of Health).

Gold from the Sky

SCIENCE'S first recorded discovery of gold that has fallen from the sky to the earth was reported by Dean Gillespie of Denver. This unique discovery was announced before the meeting of the American Association for the Advancement of Science.

A stony meteorite found near Melrose, New Mexico, was analyzed by H. G. Hawley of the Niniger Meteorite Laboratory in Denver. Minute amounts of gold were detected. Just to be sure, this unusual result was checked by an American Smelting and Refining Company assay.—*Science Service.*

Tear Gas Fountain Pen Held To Be "Pistol"

IN the case of People *versus* Anderson, 260 New York Supplement 329, Anderson was convicted in the Court of General Sessions for New York County of criminally having in his possession a firearm without a written license therefor, and appealed to the Supreme Court, Appellate Division, First Department.

The evidence disclosed that the alleged pistol had about the size and appearance of an ordinary fountain pen made of very heavy metal, without a butt, trigger, or sight, and about five inches long. It was equipped with a device which could be snapped like a trigger, and was primarily intended for the discharge of tear gas. The evidence further disclosed that bullets could be discharged from the device.

Associate Justice Martin delivered the opinion of the Appellate Division, affirming the conviction and holding that the device

was a "pistol" within Penal Law N. Y. § 1897, subd. 4.

His opinion, in part, is as follows:

"There may be a chemical explosion with gunpowder in the instrument here under consideration. There is combustion and those other elements present that constitute it a firearm. The language of the statute clearly intended to prohibit the possession, without a permit (Penal Law, supra), of an instrument such as this, for it provides 'any pistol, revolver or other firearm.' . . ."

If You Make "Dry Points" Professionally or for Fun

THIS is good news for the etcher who sallies forth with plates for a day's picture making. It's aluminum now for the dry-pointer! A third less weight to carry out; a third less to carry home.

The Alumilite process makes aluminum hard enough to last through many prints—one test plate running to over 600 impressions before showing signs of wear.

Artists find advantage too, in the color of the metal. It can be sketched upon just as if it were a piece of hard, smooth grey board. It will stand erasure perfectly. There is quite a story about this use of aluminum in the September, 1933, issue of *The Charette*—A Little Journal of Rejuvenation published every month by the Pittsburgh Architectural Club.

"Synthetic Rubber" Tires

THE "synthetic rubber" tire is now an accomplished fact! These relatively insignificant words tell a story of tremendous economic significance. They indicate the

Tires of "synthetic rubber" have the appearance of ordinary tires

successful solution of a long fight to insure for the United States a source of rubber goods and particularly tires which would make us independent of foreign producers of rubber in the event of a war. Uninterrupted movement of supplies, foodstuffs, and matériel of war would be vital to our national defense plans during war time and transportation would certainly be crippled were rubber tires not available.

Tires made entirely of Du Prene, the so-called synthetic rubber developed by the duPont company and announced in SCIENTIFIC AMERICAN about two years ago, have been built by the Dayton Rubber Manufacturing Company, and severe tests have proved these as tough and durable as tires made of natural rubber.

This new tire is not to be considered a competitor in peace times of the tire made from the natural product. This could hardly be the case with plantation rubber costing only about one tenth the price of Du Prene. However, during war time one dollar or more per pound for Du Prene would not be a factor worth considering when the security of the nation is at issue.

Portable Bath Shower

A SHOWER spray that is compact, light in weight, and requires no permanent installation has recently appeared on the market. The shower, as shown in the illustrations, is provided with a large suction disk which permits it to be attached to any smooth flat surface. It can be used with any type of bath tub and can be placed at any desired height. Used as a spray for the shoulders and chest, it gives an invigorating shower without wetting the hair. Placed higher on the wall it serves the purpose of a standard overhead shower.

The portable feature of this shower makes it adaptable for other uses than in the bath. Attached to the wall or mirror over the

***Right:* New portable shower, and *left,* drawing of four uses to which it can be put in the home**

wash bowl it can be used for shampooing the hair.

This little unit weighs less than 1½ pounds and is equipped with a faucet connection which has been designed to permit use with almost any type of faucet.

Diabetic Children Not Retarded Mentally

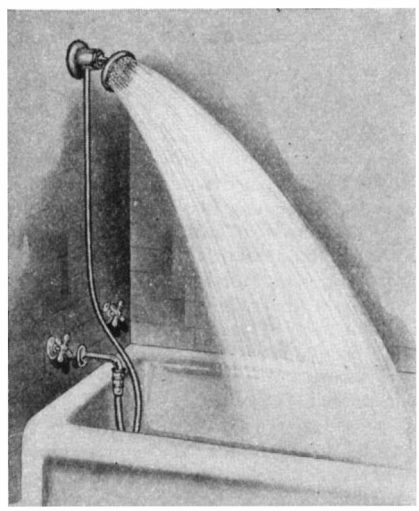
CHILDREN suffering from diabetes and taking insulin for the control of that disease measure up in intelligence as equal to normal children, it was revealed by tests of 78 diabetic children reported to the American Association for the Advancement of Science by Dr. Howard West, Amytis Richey, and Mary B. Eyre, of Claremont College.

Re-tests after an interval of over eight weeks showed that, except for some exceptional cases, the individuals did not vary significantly in test score with variations in control of the disease.—*Science Service.*

Paint From Milk

WILL the cows still be "contented" when they discover that milk is being used as a raw material for paint? Casein paint has an advantage of high reflectivity, resulting in approximately the same effect under artificial illumination as in the daytime. Of course, casein (curd) has been precipitated from milk for years and made into a wide variety of moulded articles, but its use as a paint base is something of a novelty.

Says Arthur D. Little in his *Industrial Bulletin*: "Casein paints formerly were based on whiting and other low-grade pigments, but today the better grades contain the finest high-quality pigments. No longer are the coatings muddy and transparent when wet. The most advanced manufacturers now make this paint up in paste form, so that mixing for use is much quicker and easier than when the old fashioned powder was used. Some even mill the pigment and may combine a certain amount of oil with it. Highest-grade paints give extremely smooth coatings which dry rapid-



ly, without fume or odor, entirely flat and gloss-less.

"Because of the porosity of its films, casein paint is not recommended for the long-time protection of wood or metal, outdoors. This very porosity to water vapor is not always a disadvantage, however, for it permits casein paints to be applied to plaster while it is still wet, and does not interfere with the proper drying out of the plaster thereafter. Casein paints also have high lime-resistance, a rare quality in paints, so that they may be used over cement or lime mortar, even while these are still wet.

"Casein paints are not to be thought of as highly competitive with oil paints. The latter are best on smooth woodwork, and especially outdoors. Casein paints fill the great need of a decorative and light-reflecting paint which can be applied easily by brush or spray, early, and over even the roughest of materials. While not glossy, its surface is smooth and absolutely free from tackiness. It is singularly resistant to the accumulation and retention of dirt and grime, making this type of coating particularly suitable for use in cellars, warehouses, and factories, as well as for all temporary constructions."—*A. E. B.*

Chicken Feathers in Pens, Buttons, Insulators

CHICKEN feathers may come into the market disguised as fountain pens, buttons, and various novelties now made from other plastic materials if research carried on at Iowa State College becomes commercialized.

Immense quantities of chicken feathers are produced every year. Many of these are utilized in such well-known articles as pillows and feather beds but large quantities go to waste. These feathers may be dissolved in caustic soda and then thrown out of solution in a new form by acids. This new material may be molded to any shape and hardened by formaldehyde.

The finished material is said to be fairly hard, very elastic, an excellent electrical insulator, and resistant to water, heat, dilute acids, and alkalies. Somewhat similar plastics are being made commercially from milk casein.—*Science Service.*

Coin-Operated Time Switch

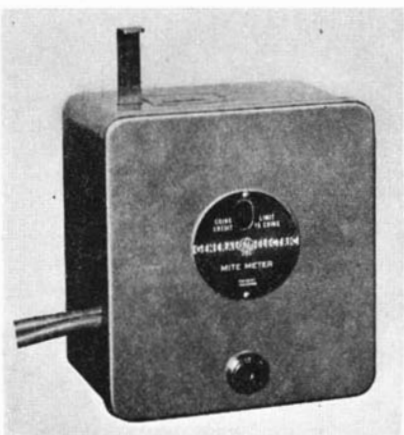
A NEW coin-operated time switch, specifically designed for connection between an electric refrigerator or similar device and the electric supply, has been announced by the General Electric Company. The purpose of the device is to disconnect the refrigerator or other device from the electric supply unless periodic stipulated payments are made into the coin switch.

It is not necessary to destroy the refrigerator service cable, or in any way mutilate it. Its plug is simply inserted in a receptacle within the coin switch; the cover of the switch is then locked against tampering. The plug of the time switch is then inserted in the usual wall or baseboard receptacle of the home.

Coins (25-cent pieces only) are credited by inserting them in a slot in the top of the switch and depressing the lever. Up to 15 coins can be credited in advance of use, and a small window makes it easy to see how many coins are ahead within the switch. In excess of 100 coins can be held by the switch.

The standard time interval is 24 hours, calling for one 25-cent piece a day, but intervals of 6, 8, 12, 15, 20, 30, 40 and 48 hours are available. The change from one interval to another is made easily, by inserting different gears.

In addition to its application with electric refrigerators, where part payments on installations are collected by the coin boxes, the switch can be used in similar installations of other equipment, and also for the rental of washing machines and other devices in apartment houses.



Time switch operated by a coin

Soft Teeth and Cereals

THE results of research conducted for the (British) Medical Research Council by Dr. Mellanby, and published by His Majesty's Stationery Office, London, suggest that if cereals are to be fed to infants, plenty of Vitamin D must also be fed. An abstract of Dr. Mellanby's Special Report No. 191, Diet and Teeth, contained in *Nature* (London) states that: "the main

(*Please turn to page* 159)

THE AMATEUR ASTRONOMER

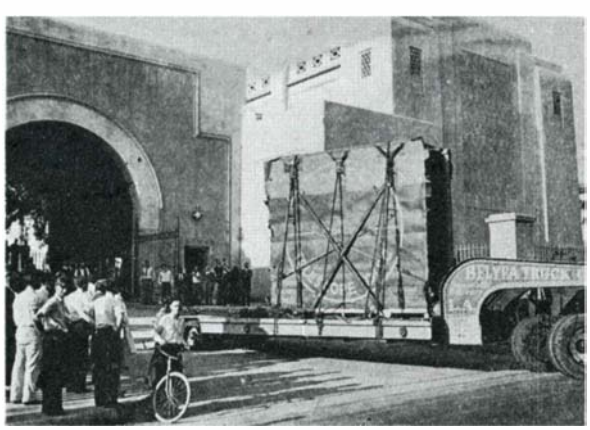
Conducted by ALBERT G. INGALLS

THIS month we publish several shorter items which have accumulated.

The first concerns a telescope made by a Benedictine nun, Sister Cornelia of Mount Saint Mary's Convent in Pittsburgh, whose photograph, kindly sent us at our request by her mentor in telescope making, Leo J. Scanlon of that city, is reproduced above. Sister Cornelia is an instructor in mathematics and physics at the high school in the Convent. "Before the bell sounds at 4:30 in the morning, summoning the nuns to chapel," says the Pittsburgh Press, whose photographer took this photograph, "Sister Cornelia trains her lens from her window to see Venus." The amateur telescope makers of Pittsburgh have elected Sister Cornelia an honorary member of their organization.

Sister Cornelia and her telescope

THE second picture shows the 120-inch Pyrex disk arriving at the optical shop of the California Institute of Technology. This disk is being figured as a flat for testing the 200-inch disk. The larger 200-inch disk cast last March at Corning was pre-cooled rapidly from 1800 to 120 degrees Fahrenheit, to permit an examination, which showed it to be crystal clear, free from cracks and bubbles. Whether the same disk will be repaired, annealed and used, or a new one cast has not been decided at present writing (July 20), newspaper reports to the contrary notwithstanding. The 200-inch mirror is to be aluminized, not silvered, and no doubt, when the time comes, that job will devolve on Dr. John Strong of the California Institute of Technology, the man who has mainly developed this process. In the meantime Dr. Strong keeps his hand in by aluminizing various smaller mirrors, from the 30-inch Crossley reflector at Lick to a three-inch mirror he gave to your scribe. A snapshot of Dr. Strong, taken by the same humble scribe, is reproduced on this page. An eight-page article by Dr. Strong, on evaporated aluminum mirrors, appeared in the February 1934 number of the *Publications of the Astronomical Society of the Pacific*. This article gives the best data thus far made available on this work.



The ten-foot disk of Pyrex at destination

SIX or eight years ago a very young lad named Evans besought our aid in building a telescope, and now his endeavors have finally led him to choose astronomy as a profession. Accordingly he has specialized in that science when in college, and has become just what he set out to be. Mr. Evans (see photograph, opposite page) did his undergraduate work at Swarthmore and has been an observer in the Flower Observatory of the University of Pennsylvania and a graduate student in astronomy for the past year or so. Next year he is to be at the Oak Ridge Station of the Harvard Observatory, with his principal duty as assistant to Dr. W. A. Calder in photo-electric photometry with the 61-inch reflector. Here is one amateur telescope maker who has already lost his amateur status—gone professional. Dr. Calder is another victim of A.T.M. who switched over from physics after making a telescope.

A DRAWING on the opposite page shows the mounting for the new 32-inch reflector at the Provence station of the Paris Observatory, as described in the *Journal of the British Astronomical Association* (Vol. 44, No. 5) by A. F. Bennett, F.R.A.S., who points out that in this design all esthetic considerations have been subordinated to simplicity and absolute rigidity. The polar axis is set definitely out of center to diminish the unbalanced effect of the tube. The leverage of the tube around the axis is thus reduced, while at the same time the heaviest part of the axis serves as a large part of the counterweight. The mounting is a combined Newt-Cass, and the diagonal is oddly set in order to reflect the rays out at a 125-degree angle. The 32-inch mirror is only 3 inches thick and, but for the lever supports, its flexures, which figure out 50 times the allowable limit, would be bad. Other things being equal, the deformations of mirrors due to their own weight, Mr. Bennett points out, are in the ratio of the fourth power of the diameter divided by the square of the thickness. An interesting piece of engineering design.

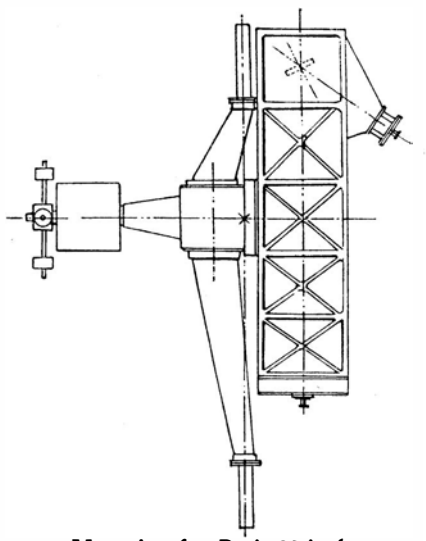
SOME workers take zone radius readings on mirrors by means of micrometers attached to the knife-edge, and express these in thousandths of an inch, which implies a high degree of accuracy. However, the question has arisen whether readings finer than hundredths of an inch do not represent fictitious accuracy. The worker may set the micrometer, and he may make the readings in thousandths of an inch, but can the eye estimate the opposite zones under comparison closely enough to justify these very precise readings? The ability of the eye to do this—its "contrast sensitivity" —varies with the amount of illumination (see, for example, Hardy and Perrin, "Principles of Optics," under "Fechner's fraction"); also with the distance of separation of the illuminated areas.

We submitted this question, with a sketch of the typical Foucault test set-up, to a noted physicist-illuminating engineer, and he answered as follows:

"You bring up the question of the photometric accuracy. This largely depends upon a perfect juxtaposition of the two brightnesses being compared. Under these conditions brightnesses can be compared to an accuracy of a fraction of a percent, providing a number of readings are averaged. However, ordinary photometric accuracy is commonly considered to be about 1 percent. Of course, as the brightness diminishes the accuracy decreases. As I understand your letter and drawing, the two fields are not perfectly juxtaposed but are perceptibly separated. This would diminish accuracy considerably. I do not believe I can estimate within

Dr. John Strong

a few percent the accuracy of a brightness comparison with the set-up you describe. However, I do not see how such comparisons of brightness could be accurate within several percent unless a very large number of readings were made and averaged. If your intensity of illumination is very low, I believe Fechner's constant would be of the



Mounting for Paris 32-inch

order of magnitude of 3 percent, even when the fields were perfectly juxtaposed.

"If I understand the set-up correctly, I would be inclined to estimate that, if you have very low brightnesses, the error of brightness match would be of the order of magnitude of 5 or 10 percent."

Perhaps it is not so bad as this. It would be interesting, however, if someone who understands the Foucault test would work out an answer to the question whether zonal readings expressed in thousandths of an inch mean something, or are largely illusory.

IN the June number we mentioned that Richard Perkin, 122 Chester Avenue, Garden City, New York, would act as a sort of informal "committeeman" to ascertain how many would buy 20-inch mirror

Evans, who turned "pro"

disks of Pyrex, if such combined purchasing would result in a lowered price. Mr. Perkin received many inquiries and has now obtained a quotation on Pyrex disks, 20½ by 3¾ inches in size, in lots of six, of 85 dollars—a reduction of nearly one half from the ordinary price. By the way, Mr. Perkin is not a dealer, but an amateur who undertook to do this little job as a kindness. Evidently some thought him a dealer. He received a total of about 50 inquiries, to which the above is his answer.

RECENTLY PATENTED INVENTIONS

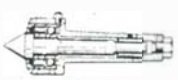
Conducted by A. P. PECK

Beach Chair

Patent Number 1963708, Samuel W. Marvin. Folding chairs which are light in weight yet sturdy in construction are greatly to be desired for the beach and other vacation resorts, and several different forms are provided for by the present invention. One type is shown in the accompanying drawing wherein a back and seat portion are so arranged as to be adjustable to the position considered most comfortable by the user. Since the chair has only two short legs and has no other bulky supporting means, it is obvious that it can be folded into a very small space and can readily be set up for use when needed. In the particular form shown, the back is supported from the seat by means of straps; in other forms, wooden or other rigid members are used.

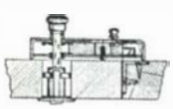
Lathe Center

Patent Number 1962499, Walter W. Gairing. The main object of this invention is to provide an improved lathe center in which the spindle is supported so that it will not chatter or vibrate, and so that it is capable of carrying heavy end and radial thrust loads. The center is also designed so that its structure is comparatively simple and only a few parts are used. As shown in the drawing, the spindle is provided with a reduced bearing part which is suitably mounted on combined radial and thrust bearings. A pair of these bearings is used, one being a ball-bearing unit and the other a roller-bearing unit. It is claimed that this particular lathe center is especially adapted for heavy work, and because of its sturdy and rigid construction can not be thrown out of adjustment by an unskilled workman.



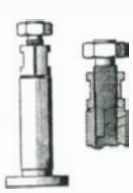
Lock

Patent Number 1959361, John Holtzman. A new type of lock shown in the accompanying illustration is said to be simple and durable, dependable in use, and efficient in operation. Essentially, the lock consists of a casing which, when applied to a door, overlaps the jamb and has a bottom plate with openings so constituted as to receive and hold hooks attached to the door jamb. A bolt rotatably mounted has a pair of members which are designed to engage and hold the hooks and thus provide a secure locking arrangement. The lock is so constructed as to be operated by means of a key from one side or by turning a handle on the other, and is provided with a latch which holds it in non-operating position. The patent specification shows several different forms which this simple lock may take.



Valve Tappet

Patent Number 1957784, Charles E. Johnson. In automobile engines and other machinery where adjustable valve tappets are employed, one of the problems of maintenance is keeping the valves accurately adjusted. The subject of the present invention is a valve tappet which is self-locking. When these are used there is no necessity of first adjusting the tappet and then locking it in place by means of the conventional lock nut. Instead, the adjustable portion of the valve tappet is provided with a slot. By means of this slot the shank of the adjustable portion is somewhat expanded and this, together with proper threading of the adjustable part and the sleeve in which it fits, provides a locking arrangement which will withstand any ordinary operation. This complete valve tappet arrangement has only two parts. The outer sleeve is provided with a flattened portion which can be gripped with a wrench, and the inner or adjustable part has a head which can be gripped with another wrench. Holding the two parts in this manner, a proper adjustment can readily be obtained.



Weed Gun

Patent Number 1960738, Charles L. Giezentanner. A simple method of applying weed-killing liquids is provided by this particular invention. Essentially, the device consists of a container or reservoir, a valve controlled spout, and a handle. The drawing at the left shows the construction of the device. It is so designed that it can be produced cheaply, the container for the liquid being detachable from the spout and handle so that it can be thrown away when empty and replaced by a full one. A rod, which has at one end a valve, is located in the spout, the other end of the rod projecting beyond the spout. When the outer end of this rod is pressed into the center of a weed, the valve is actuated, allowing a portion of the liquid in the reservoir to run down and enter the puncture which has been made in the weed by the rod. When the device is lifted, a spring presses the rod outward and closes the valve, thereby shutting off the flow of liquid. When this device is equipped with a long handle, it is possible for the user to kill weeds rapidly and effectively without bending over. Pressure on the upper end of the handle accomplishes the job efficiently when any one of several well-known types of weed-killing liquids is placed in the container.

Electric Safety Plug

Patent Number 1956018, Charles E. Gilbert. One of the objects of this invention is to produce an electric plug of cheap and rugged construction to which insulated electric wires may be easily and quickly connected without removal of the insulation, and which will hold such wires with great tenacity and less danger of rupture than is obtained with conventional plugs. The connection between the wires and the prongs of the plug is obtained by providing serrated jaws into which the wiring is slipped. When these jaws are pressed together they puncture the insulation and make a firm electrical and mechanical contact with the interior wire.

Extension Flash Light

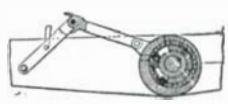
Patent Number 1959979, George G. Gunderson. An improved flash light having a removable head carrying a lamp which may be operated as an extension lamp is provided by this invention. As shown in the accompanying drawing, a standard type of flash light is so adapted that there is a space above the battery in which is stored a flexible cable connecting the battery to the flash light bulb. The part of the device which carries the bulb is also so arranged, with a clip or other device, that when it is removed from the flash light case it can be hung up or otherwise supported in any desired position. Means are also provided for enabling the lamp to be attached to the head of the user while the case containing the battery may be carried in the pocket. In one form of the invention disclosed in the patent specification, the lamp housing is provided with a spring clip and also a vacuum cup which makes it possible to attach the extended lamp to any smooth surface.

Cigarette Container

Patent Number 1960468, Eugene C. Wamelink. Cigarettes, when packed by the manufacturer for sale, are customarily wrapped and sealed in a moisture-proof package to preserve the freshness and flavor of the cigarettes. When such packages are opened by the user the wrapping is broken and partially destroyed. It is one of the objects of the present invention to provide means for cutting or tearing partly through an original package of cigarettes so that the package may be opened at the cut point by folding the other side, thus giving access to the cigarettes within. Another object is to provide a carrier or container for a package of cigarettes, in which is placed the package which has been cut partly through, as described. This container is provided with a hinged back so that when open cigarettes are exposed for ready removal.

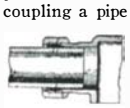
Reverse Lock

Patent Number 1957428, Ivo George Brenneman. One of the annoying features of driving a motor car is that if the vehicle is stopped when heading upgrade it will coast backward unless held by the brakes. The present invention provides for a mechanism which will prevent backing up under all ordinary conditions but will permit the operator intentionally to reverse the car when he so desires. The mechanical construction of this reverse lock is such that it will not in any way prevent the driving shaft of the vehicle from rotating when the car is driven in a forward direction. The result is achieved by mounting frictional rollers within a specially shaped housing in such a manner that the rollers will constitute an efficient and automatic frictional grip for locking the drive shaft against reverse rotation. Several modified forms of the invention are shown in the patent specification, one of them being reproduced herewith.



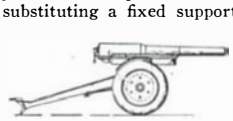
Threadless Pipe Coupling

Patent Number 1959607, Ernst G. K. Anderson. The object of the present invention is to provide a simple and novel construction for coupling a pipe to a surrounding tubular element which may or may not be a part of a connection box. By the means shown in the accompanying drawing, a secure mechanical connection is obtained and the joint between the pipe and the tubular element is effectively sealed. The object is attained by providing a coupling nut to be screwed on to the tubular element and to embrace the pipe. Placed over the pipe and between the coupling and the tubular element is a suitably shaped fillet which, when the nut is tightened, is compressed and thereby forced into place to form a tight seal.



Gun Carriage

Patent Number 1959357, Elmer C. Goebert. In wheeled gun carriages it is a common expedient to emplace the carriage for firing by substituting a fixed support for the wheels. The purpose of the present invention, illustrated in the drawing, is to provide a firing support which is associated in a novel manner with the wheels and the brake mechanism for the wheels. Mounted on the axles of the gun carriage are segments which, being longer than the radius of the wheels, can be lowered so as to raise the wheels off the ground, and when locked in position provide a rigid mounting for the gun. In emplacing the carriage for firing, the segments are unlatched and allowed to fall to the ground behind the wheels. The rear end of the carriage is then raised, the segments are locked to the brake drum, and when the rear end of the carriage is lowered to the ground the arc shaped segments will rotate into the proper position for firing.



THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 155)

conditions responsible for immunity from dental decay are prolonged breast-feeding with a supplementary diet often for three or even six years and a high intake of vitamin D (or exposure of the body to the sun) together with a sufficiency of calcium and phosphorus. A high carbohydrate diet (cereals or potatoes) is compatible with good teeth, provided the supply of vitamin D, calcium, and phosphorus is also sufficiently great. Caries is especially rampant where cereals form a large part of the diet; breast-feeding is short; the intake of milk, eggs, and animal fats is small; and sunshine is negligible or rendered ineffective by clothing.

"It has thus been shown that perfectly calcified and regularly arranged teeth can be produced by including in the maternal diet during pregnancy and lactation, and in the diet of the offspring at the time of dental development, substances containing much vitamin D, calcium and phosphorus, such as milk, eggs, fish and animal fats, and that cereals, especially those rich in embryo such as oatmeal, tend to produce hypolastic teeth and call for a correspondingly larger supply of calcifying foods for good development.

"It has further been established that the resistance to caries can be increased independently of the original structure by giving a diet containing much vitamin D, calcium and phosphorus, or decreased by a diet rich in cereals.

"If these general principles of feeding were widely adopted, there is little doubt that dental caries (and also pyorrhœa, to which a deficient intake of vitamin A predisposes) will cease to be the scourge they are at the present time.

"It may finally be pointed out that none of these conclusions conflicts with the generally accepted idea that the *exciting* cause of caries is the growth of micro-organisms in the mouth: the novelty is the proof that the tooth can resist the onslaught of the microbes by the absorption and assimilation into the body tissues of certain specific dietary factors."

Fireflies Flashing in Unison

FOR some unknown reason, fireflies flash in unison, thousands of them, almost as if led by an "orchestra" leader. An instance of this kind is described by one of the readers of this magazine, Earl Porter, Route 1, Cortland, Ohio, who writes:

"Tall trees lined the bank of the river for a distance of about 200 yards. I was watching the fireflies flitting among the trees. Then something began which held my attention. The myriad points of light, flashing at random against the black shadow of trees, began to assume a sort of regularity. Though still evenly distributed among the trees, the flashes occurred simultaneously, at intervals of a few seconds, with a short period of almost total blackness between flashes. This seemed peculiar. Then the flashes occurred only at the extremities of a stretch about 200 yards long, in front of the trees. The flashes began moving

toward each other, met at the middle, and traveled back to the ends, as when two pebbles are dropped simultaneously into the ends of a long, narrow tank of water and the waves roll toward each other, meet and return, several times until the motion subsides. This movement was repeated a number of times. Then the lights concentrated at one end of the stretch, and moved swiftly toward the other end—down and back, twice—then all at random again. I was amazed, but there was no doubt about it having happened. Does natural history record such a phenomenon?"

Similar phenomena have been reported to science in many instances, and scientists, particularly Dr. E. W. Gudger of the American Museum of Natural History, have collected and published many of these instances. There is no dearth of similar observations but a dearth of really plausible interpretations—that is, not guesses, but actual data. Probably nobody knows why fireflies flash in synchronism.

Football Bladder Keeps Paralyzed Man Breathing

A FOOTBALL bladder strapped to his chest has kept an almost completely paralyzed patient, S. Crosby Halahan, breathing continuously for months, it appears from a report by Dr. Phyllis Tookey Kerridge of the London School of Hygiene to the current issue of *The Lancet*, medical journal published in London. Dr. Tookey Kerridge has just designed a new apparatus to replace the football bladder.

Mr. Halahan is a man now 63 years old. He is suffering from a progressive wasting of the muscles which started in 1927. Although almost completely paralyzed he is still mentally alert and contented. By 1931 he began to have difficulty in breathing, as a result of the gradual paralysis of his muscles.

From June, 1932, until September, 1933, he was kept alive by manual artificial respiration maintained continuously by relays of relatives and nurses. Then his friend, Sir William Bragg, Fellow of the Royal Society, designed a hand-operated machine for inflating a football bladder bandaged to Mr. Halahan's chest. In October, 1933, he designed hydraulic bellows for inflating the football bladder, which have worked successfully ever since, except once when the water froze.

An old injury to the right side of Mr. Halahan's chest has made it extremely sensitive to pressure, so Dr. Tookey Kerridge designed a rubber bag which surrounds the left side of his chest only, and is now successfully taking the place of the football bladder apparatus.—*Science Service.*

Ethylene Gas Loosens Walnut Husks

CHEMISTRY has solved many a problem that was considered a "tough nut to crack" but it is only recently that chemists of the U. S. Department of Agriculture have discovered that ethylene gas will literally coax walnuts from their husks. This ethylene gas is the same that is used by orange growers to speed up the ripening of green fruit.

In the commercial harvesting of walnuts, the trees are shaken as soon as the outer husk of the nut begins to crack. On from 15 to 50 percent of the nuts the outer husk has not yet cracked. Those which have commenced to split can be husked in the field, washed, and taken to dehydrators. Those which have not split, and which are termed "stick-tights," must be subjected to a rather lengthy treatment, entailing additional expense and staining some of the shells, so that the nuts must be sold as culls.

The ethylene gas treatment has apparently solved the problem of "stick-tight" nuts. On account of the ease with which the new method can be applied, together with its low cost, estimated at six to eight cents a ton, and the higher grade of nuts so treated, leading walnut growers believe that a revolutionary change in walnut harvesting is at hand. However, nuts so treated will not be placed on the market until storage tests indicate that no adverse effect of any kind has been produced.—*A. E. B.*

"Doping" of Race Horses Detected by Mouse's Tail

A TEN-MINUTE test with a mouse will show whether or not a horse has been "doped" with morphine or heroin before a race, Dr. James C. Munch of Temple University and the Sharp and Dohme research laboratories has reported to the American Pharmaceutical Association.

A quarter of a teaspoonful of the horse's saliva is injected into the mouse. Within 10 minutes the mouse's tail curves up into a letter S, if the horse has been given morphine or heroin. In addition, the mouse humps up his back, his hair stands on end and his hindlegs become twittery. Other substances produce this effect on the mouse's tail, but the combination of tail curve and the other symptoms described are produced only by morphine, heroin, or other opiate, Dr. Munch said. He was the first person to work out these details and to apply them to the problem of detecting "doping" of race horses.—*Science Service.*

Solid Alcohol

SOLID alcohol, for use as a fuel, is made by combining ethyl alcohol with nitrocellulose (gun-cotton) in a manner that utilizes the fact that *cold* alcohol dissolves nitrocellulose better than warm. According to a recent patent, outlined in *Chemical Industries*, the nitrocellulose, insoluble in the absolute alcohol at ordinary temperatures, becomes soluble when the alcohol is chilled to low temperatures. In this process a mixture of nitrocellulose and absolute alcohol is chilled to approximately –20 degrees, Centigrade, and a similar amount of aqueous alcohol, chilled to approximately the same temperature, is added. The mixture solidifies when allowed to warm to atmospheric temperature.—*A. E. B.*

Milk is Source of Common Salt

ALTHOUGH milk is generally recognized as the best dietary source of the essential minerals, calcium and phosphorus, few persons realize that it is also an excellent source of sodium and chlorine which, together, comprise the necessary food substance known as common salt. A quart of milk contains the equivalent in sodium and

chlorine ions of three grams of salt, or slightly more than the minimum daily needs of the human body.

As pointed out by Dr. James A. Tobey in the *Milk Plant Monthly*, the function of common salt in the human body is to aid in maintaining an equilibrium of the bodily fluids, such as the blood, lymph, and gastric juice, and it also assists in the retention of water in the muscles and other tissues. According to Dr. Tobey, the liberal consumption of milk will not only provide the various important nutrients of this almost perfect food, but the consumer will be assured of an adequate amount of common salt in the diet, without danger from an excess if he also employs salt as a condiment and flavor for other foods.

Music by Telegraph

EACH night for the duration of the World's Fair in Chicago, a musician seats himself before a telegraph typewriter in a Western Union office in a different city in the United States, and plays the Deagan chimes in the tower of the Hall of Science on the Fair grounds. Hundreds or thousands of miles away from the chimes, the musician can still play them as easily as if he played the keyboard in Chicago.

Keyboard from which chimes may be played from a far distant point

To explain how this is possible, it is first necessary to describe the telegraph typewriter. Instead of transmitting dots and dashes, the modern telegraph typewriter transmits evenly timed electrical impulses during one or more of the five successive time intervals necessary to transmit the various combinations for each of the various characters used on the typewriter.

For example, if an electrical impulse is sent during the first time interval and none during the four successive intervals, this signal will select from the 32 keys of the telegraph typewriter the letter "E" and cause it to be printed on the typewriter platen. If the electrical impulse is sent during both the first and second time intervals the letter "A" will be selected and printed, and as a third example, if the first, third, and fifth intervals carry the current, the letter "Y" is produced. Thirty-two different selections may be made in this manner. It is possible to select the 26 letters of the alphabet and to shift to the upper case for the selection of figures and for the various mechanical functions required of the telegraph typewriter.

The same selecting device which operates the typewriter may be adapted to any other function requiring the use of 32 selections, and in this case the machine has been connected to the carillon at A Century of Progress. This instrument, however, has only 25 chimes and, therefore, requires only part of the total number of keys.

In order to make it easier for any musician to play the Telemusicon, as the selecting device is known, a small two-octave piano keyboard is attached to the telegraph typewriter, mechanical connections being made from the piano keys to the typewriter keys immediately above them. Some of the foremost chimers and musicians participate in the nightly programs of the cities taking part and their playing, transmitted by telegraph, is heard by the assembled thousands in Chicago.

Ancestor Seeds 325 Million Years Old

MORE evidence that some 325,000,000 years ago there existed a "missing link" in the plant world, a common ancestor type of plant from which both the modern seed bearing plants and the seedless plants evolved, was reported by Dr. C. A. Arnold, curator of fossil plants in the University of Michigan Museum of Paleontology, upon identification of several seeds found last summer in Pennsylvania.

Seeds as old as those found by Dr. Arnold have been discovered only twice before—once in the Catskill Mountains and once in Ireland. Dr. Arnold made his find in northern Pennsylvania rocks dating from the Devonian period, at least 325,000,000 years ago, and about 30,000,000 years before the Carboniferous period, when the great coal beds were deposited.

As in the case of the Catskill and Irish seeds, plants having fern-like foliage were found in intimate association with the seeds. Presumably the seeds belonged to this plant. This strengthens the supposition that at some ancient time in the earth's history there was one common type of land plant from which the seedless ferns and the present-day type of seed-bearing plants branched off, says Dr. Arnold.

The Country Is "Shining Up"

THE depression must be over, for America has begun to shine up the old "bus" and to polish the hardwood floors again, according to current statistics. Heavy imports of animal and vegetable waxes since the beginning of 1934 reflect increased activity in domestic production of polishes. During the first four months of the current year imports of such raw materials totalled 6,750,000 pounds valued at 1,150,000 dollars, compared with 3,872,000 pounds valued at 409,750 dollars for the corresponding period of 1933.

The bulk of wax imports consists of carnauba wax from Brazil, receipts for which amounted to 4,581,000 pounds valued at 794,300 dollars during the first four months of the year—more than double the amount imported during the corresponding period of 1933. Other wax imports include beeswax, chiefly crude unbleached, Japan wax, Chinese insect wax, and various vegetable waxes.—*A. E. B.*

CURRENT BULLETIN BRIEFS

SHORT CUTS TO POWER TRANSMISSION, is a 72-page booklet for belt users and contains all information needed in solving any ordinary belt transmission problems, as well as valuable material on good practice, and a mass of associated tables and data. *Write for Bulletin 9D to Scientific American, 24 West 40th Street, New York City.—Gratis.*

A REVIEW OF RAILWAY OPERATIONS IN 1933. (Reprinted from *Railway Age*, Special Series No. 62.) This study of railway operations is by Dr. Julius H. Parmelee, Director, Bureau of Railway Economics, and no one is better fitted than Dr. Parmelee to describe the upward trend of railway business in 1933. *Bureau of Railway Economics, Washington, D. C.—Gratis.*

MANUAL OF WELDING AND FABRICATING PROCEDURES FOR "INGACLAD" STAINLESS CLAD STEEL is a 16-page booklet which takes up step by step the various methods of welding, soldering, lock seaming, riveting, deep drawing, pickling, heat treating, and so on, encountered in fabricating products of stainless clad steel. *Write for Bulletin 9C to Scientific American, 24 West 40th Street, New York City.—Gratis.*

THE POST-WAR DEVELOPMENT OF INTERNATIONAL LAW AND SOME CONTRIBUTIONS BY THE UNITED STATES OF AMERICA—TROUBLES OF A NEUTRAL—SOVIET FOREIGN POLICY. (International Conciliation. June, 1934. No. 301.) The first author, Dr. Manley O. Hudson, describes the progress made in international law since the World War. The second article is by Charles Warren, who was charged with enforcing our neutrality laws; the third, by Michael T. Florinsky, describes the foreign policies of the Soviet Union during the past ten years. *Carnegie Endowment for International Peace, 45 Portland Street, Worcester, Mass.—five cents.*

LUBRICATION OF GRAIN HANDLING MACHINERY. Strange to say there is little literature on grain-handling machinery. The problems involved are not only lubrication but concern dust explosions which are very prevalent and destructive. This pamphlet gives an excellent idea of both the hazards and the proper forms of lubrication. *Write for Bulletin 9A, Scientific American, 24 West 40th Street, New York City.—Gratis.*

ON THE PRACTICAL IMPOSSIBILITY OF A COMMODITY DOLLAR, is a study by Benjamin M. Anderson, Jr., Ph.D., Economist of The Chase National Bank, New York, and gives an analysis of the main types of proposals for stabilizing commodity prices by currency manipulation. *Chase National Bank, New York City.—Gratis.*

BROWN RESISTANCE THERMOMETERS. This pamphlet deals with measuring devices for temperatures from −300 degrees to +1000 degrees, Fahrenheit. The principle involved in these resistance thermometers concerns the property which most electrical

conductors possess of changing their electrical resistance with variations in temperature. The pamphlet gives information as to the various uses to which the instruments can be put. *Write for Bulletin 9B to Scientific American, 24 West 40th Street, New York City.—Gratis.*

A PLAN FOR UNIFICATION OF THE EASTERN RAILROADS—ITS RELATION TO RAILROAD RECOVERY, by A. J. County, Vice-President in charge of Finance and Corporate Relations of the Pennsylvania Railroad Company. The pamphlet shows how a united eastern railroad system would eliminate wasteful competition and tells how England has faced and dealt with almost identically the same situation. *The Wharton Alumni Institute of Business, University of Pennsylvania, Philadelphia.—Gratis.*

BLASTING DITCHES WITH EXPLOSIVES. A blasted ditch may be described as a series of overlapping craters each made by the explosion of an individual charge of dynamite, but so arranged that all the charges explode at the same time. The pamphlet describes the technique in detail. *Write for Bulletin 9E to Scientific American, 24 West 40th Street, New York City.—Gratis.*

WHY THE BATTLESHIP?

(*Continued from page* 142)

the accepted belief among naval authorities that the battleship is the only type that is not extremely vulnerable to the many forms of attack to which surface craft may be subjected. It must be borne in mind that the development of the battleship has been progressive, and consummate skill has been shown by the designers in effectively weeding out any offensive weapon. The submarine and mine have developed the intricate compartmentation in a battleship that make her practically unsinkable. The advent of aerial bombs has brought about the development of the blister and protective decks to the point that they will successfully resist high-powered bombs. Effective means have been taken to protect the personnel from gas attacks. However, these changes in design have necessitated added weight, and added weight means greater displacement. To give adequate protection with less displacement would be at a sacrifice of offensive power, armament, and cruising radius—all vital characteristics of a battleship.

Practical experimentation has been made on the new and old types of ships and on specially constructed sections of hulls to show the effect of high explosives. Torpedoes, mines, explosive shells, and bombs have all been used in this connection. From data derived from these tests the constructor has designed special features in hull construction and compartmentation to resist the actions of high explosives.

Special steel decks have been designed that will explode bombs before penetration, thus localizing damage and protecting the vitals of a ship.

The British, during the World War, took the lead in the design of blisters which provided excellent underwater protection. The blister has been developed by the naval

architect in two forms: either an external protuberance, or an internal arrangement, both of which provide a multiplicity of tough, parallel, longitudinal, elastic bulkheads, between which, at short intervals, are short transverse bulkheads, all forming a honeycomb of compartments. Some of these parallel layers of compartments could carry oil or some other energy-absorbing medium, while others are merely void. The energy of the gases from an explosive is gradually absorbed by having to rupture the bulkheads and pass through the liquid, so that the inner bulkheads would remain intact and protect the vitals of the ship inboard. By intricate draining and flooding of these compartments, damage control may be exercised and a wounded ship maintained on an even keel, so that efficiency of gun fire is not impaired.

The more modern ships are built along these lines and the older types have been modernized by extensive reconstruction.

Gunnery has likewise made extensive strides since the World War and the anti-airplane batteries have been developed to a high degree. It is believed that the anti-aircraft batteries of the battle line could give a fine account of themselves in an air raid and further development is expected in the future.

While it is desirable to keep down size and cost of battleships and to limit their length in order to retain their maneuverability, the history of their development indicates that they have been forced to increase in size to provide guns and armor adequate against similar ships, to provide torpedo protection, and to provide sufficient deck thicknesses for modern gun ranges and aerial attack. In common with other types of fighting craft, also, battleships have had to devote much weight and displacement to efficient compartmentation.

Whether it is possible to obtain on the Washington Treaty limit all the offensive and defensive qualities desired from considerations of the power of modern guns, torpedoes, and bombs on the one hand, and the resistance of armor and bulkheads on the other, is a difficult problem, the successful solution of which will demand the application of the most modern developments of the shipbuilding art. Limitation of displacement, however, will sacrifice much that we now have and in addition give little leeway for those future developments which we have every reason to expect.

OF all combatant ships the battleship is the only one designed to stay and "take it." Nothing else is tough enough because nothing else has sufficient size. That is the main and outstanding reason why battleships are necessary in our first line of defense.

Our Navy will be strong offensively and defensively in direct proportion to the strength of our battle line, made up of capital ships. There is little difference between the tactics of a well handled fleet and of a well run football team. The same axioms apply in general. Neither can be successful without a strong and well trained line.

The Navy believes that if the practical demonstration—a war—ever comes, the battleship will prove its worth in every respect. In the meantime the case of the battleship is submitted and may be rested with much confidence on the following points:

1. The big gun ship is the hardest hitting and best protected type of vessel yet designed.
2. Ability to give and take punishment.
3. Tactical value in all weather, sea conditions, and for long periods of time.
4. Can best embody all weapons of sea offense and defense.
5. Affords better protection from air attacks than any other surface type.
6. The last word in ships and sustains the other types.
7. Most reliable defense against blockade and invasion from overseas.
8. The ship upon which will depend the final decision at sea.

When the torpedo has acquired the range and precision of a 16-inch gun, when a lighter ship is designed to give and take on equal terms, when the radius and carrying power of aircraft have increased tenfold, when aerial bombs are as accurate and effective as 16-inch high explosive shell, and other types are effective under all conditions of wind, fog, and sea, then, but not until then, will the supremacy of the battleship be endangered.

STARS ON PARALLEL TRACKS

(*Continued from page* 133)

should ultimately be disintegrated—provided, of course, that the general dimensions of the galaxy and the material universe remained the same during this enormously long time.

The principal interest of such calculations lies, however, not in the future but in the past. We find in the heavens clusters like the Pleiades, which have a life of ten billion or twenty billion years before them; others, like the Hyades, with only two billion or three billion years; while the Ursa Major group, and Kapteyn's enormous and widely scattered southern stream, appear to be already well on the way to disintegration.

If the universe of stars in anything like its present state had existed for hundreds of billions of years in the past, it would be very surprising that all star clusters had not already disintegrated. Bok's more detailed analysis shows that their actual presence in the galaxy indicates that this greater star system has not existed under conditions similar to the present for so much as twenty billions of years, and may have had a considerably shorter life.

This whole discussion is quite independent of the theory of the expanding universe, but supports strongly its most interesting conclusions—namely, that we can set definite limits to the age of our universe. Starting with ordinary unalterable space, and the simple Newtonian law of gravitation, it shows that scattered groups of stars with common motion cannot last forever. The maximum age which it gives is greater than that set either by the motions of the nebulae or by radioactive processes in the earth; but this is as it should be, since the first is a true upper limit and may be considerably too high, while the others have a smaller margin of doubt. The evidence, however, in favor of the "short" cosmical time scale of billions of years, rather than the "long" scale running into trillions, is apparently very strong.

Books SELECTED BY THE EDITORS

LEARNING TO SAIL

By H. A. Calahan

LEARNING TO RACE

By the same author

HERE are two books that will interest every landlubber who has ever had a hankering to sail, and every sailing craft owner or skipper whether he has sailed for a week or a generation. "Learning to Sail" was first published two years ago and is now available in a new edition which includes much valuable information not found in the original. The author has a knack of imparting his knowledge, gained through 35 years of sailing, so that the novice can soak it up and retain it. Throughout these two books explanatory phrases prevent confusion where terms unfamiliar to the layman are used. "Learning to Race" is written especially for those who have mastered the art of sailing small craft under ordinary conditions and who want to become familiar with racing technique, rules, and so on. Diagrams and photographs make everything clear as a bell. If you sail a small craft, you will want both of these books; if you have never sailed, but read these books, you won't rest easily until you get your hands on a tiller with a fair breeze speeding you along. Perusal of both of these books will add greatly to your enjoyment in following the press reports of the coming America's Cup Races, or in watching the races themselves. "Learning to Sail," $2.65 postpaid. "Learning to Race," $3.65 postpaid.—*A. P. P.*

HOW TO COLLECT MINERALS

By Peter Zodac

IN this 80-page book the editor of the mineral collectors' magazine, *Rocks and Minerals*, gives full and explicit instructions for starting a collection of minerals: How to begin; hints on collecting; what to collect (gems, geological specimens, fossils); collecting in the field; equipment; where to look for minerals; preparing the specimens; organizing a mineral collectors' club; and many other immediately practical aspects of the mineral hobby which has become quite widespread and popular within recent years. A list of books on mineralogy, gems, geology, and prospecting is included. When you have this book you can go right ahead with your hobby, since it gives definite details instead of vague generalities, as too many books do. Mineral collecting provides a fine introduction to earth science, to the great outdoors, and to some fine fun. It will work off some of your waist line. —$1.10 postpaid.—*A. G. I.*

THE SCIENCE OF WORK

By Morris S. Viteles

THE study and treatment of problems of human adaptation to work in the Machine Age are the chief functions of industrial psychology. A shorter, simpler volume than the author's "Industrial Psychology," free from technical and statistical terminology, covering the same ground. It tells how psychology is applied in making work a happier and more productive activity. It is designed to promote a better understanding of the mental aspects of efficiency and adjustment in modern industry. The orientation of this volume is practical. It will be useful to all who deal with human nature in industry.—$3.95 postpaid.

OCEAN WAVES AND KINDRED GEOPHYSICAL PHENOMENA

By Vaughan Cornish, D. Sc.

THIS is a popular and most readable special study of waves—mainly ocean waves—their height, length, velocity—but also waves in sand dunes and on the bottoms of bathing beaches and in drifted snow. It tells how to measure accurately the height of waves from the deck of a ship, and so much else of interest about waves that few of us have ever heard of, that its reader will possess a whole new science having an everlasting incidental interest. It also contains a more technical section about the physics of waves, by the noted geophysicist Harold Jeffreys. Dr. Jeffreys states that Dr. Cornish has obtained a larger quantity of observational material than any other worker on the subject.—$3.95 postpaid.—*A. G. I.*

THE NEW TYPOGRAPHY AND MODERN LAYOUTS

By Frederic Ehrlich

A COMPREHENSIVE reference book for students of typography and layout, which, as the author points out, is designed to accomplish two purposes: First, clarify the confusion, doubt, and uncertainty that exist regarding the precepts and history of the new typography in European countries and its inception in America, and second, to acquaint the reader with the basic balances that have resulted from the first efforts and experimentations of a group of foreign typographers and the effects of these on American typography. A beautiful book, 9½ by 12½ inches, with over 1000 specimen layouts for study by compositors, typographers, and layout men in advertising agencies, print shops, and classroom. $5.25 postpaid.—*A. P. P.*

THE BIRD KINGDOM

THIS book consists of 20 large plates, each showing several kinds of birds in three dimensions. This is made possible by the familiar device of printing slightly offset red and green pictures, and viewing them through celluloid "spectacles of red and green" (furnished with the book). The subjects are elaborate exhibition groups at the Field Museum of Natural History in Chicago. The different birds shown are keyed and identified. — $2.15 postpaid. — *A. G. I.*

OUTLINE OF CLINICAL PSYCHOANALYSIS

By Otto Fenichel, M.D.

THIS is a presentation of clinical data which psychoanalysis has collected in the course of its almost 40 years, and it presupposes some previous elementary knowledge of psychoanalysis. The language partakes of the elusive nature which is characteristic of most works on psychology, compounded in this case with the fact that the book is a translation from that ponderous tongue, the German. Hence this book is recommended mainly to heroes and gluttons for punishment, or to masochists. The translators themselves state that its author frankly sacrifices simplified clarity to systematic completeness and here they show real insight.—$5.20 postpaid. —*A. G. I.*

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Triplex Patent Valid and Infringed

IN a recent patent infringement suit brought by the Triplex Safety Glass Company of North America against the Duplate Corporation, the District Court of Pennsylvania held the Benedictus patent number 1182739 to be valid and infringed. This patent pertains to non-shatterable glass, a product made by both companies, the plaintiff operating under the patent.

The following is quoted from the findings of the District Court:

"This is a patent suit involving Benedictus patent, No. 1182739, issued May 9, 1916.

"Claim 12 in that patent is in suit:

"'12. As a new article of manufacture, a sheet of celluloid faced on both sides and in the order named by sheets of gelatin and glass, all rigidly and autogeneously united together, and the gelatin being substantially free from contained moisture, as described.'

"The patent relates to nonshatterable glass. In the prior art the strengthening of glass by inserting a sheet of celluloid between the sheets of glass was known, and the use of balsam for causing the sheets of glass and celluloid to adhere together was disclosed in the prior patent of Wood. The fact that gelatin might be used as an adhesive was also known to the prior art.

"The plaintiff contends that Benedictus brought to the art the use of gelatin substantially free from contained moisture as an adhesive element in causing the sheets of celluloid and glass to adhere together. . . .

"We have no hesitation in concluding that the patent is valid; that there was a real invention in bringing to the art the product made by adhesion of celluloid and glass with the use of gelatin that is substantially free from contained moisture. It was thoroughly demonstrated that using wet gelatin or sticky gelatin for the purpose of cementing together the sheets of glass and celluloid resulted in a product which was streaked and cloudy. . . .

"We need next to determine whether or not the defendant by its product has infringed the patent. We find from the evidence that the defendant in its product uses glass and celluloid cemented together by a thin film of gelatin in substantially the same manner as that disclosed by the Benedictus patent. . . .

". . . the main element is there—gelatin with the moisture sufficiently extracted so as to cause the sheets of celluloid and glass to adhere to one another with no impairment of transparency. That is the product of both processes used by the plaintiff and the defendant. . . .

"We therefore find on the whole case that the patent in suit is valid and has been infringed. . . ."

The decree of the District Court was affirmed by the Circuit Court of Appeals, Third Circuit, and the defendant has been ordered to pay over half a million dollars in damages and claims to the plaintiff.

Radio Advertising Censored

RADIO advertising is to be subjected to the scrutiny of the Federal Trade Commission, according to an announcement made by that Commission recently. This announcement means simply that the Federal Government will extend to radio advertising the same principle that for many years has been applied to newspaper, periodical, and other forms of advertising, under Section 5 of the Federal Trade Commission Act, which gives the Commission jurisdiction over unfair methods of competition in interstate commerce. This the courts have uniformly held to embrace false and misleading advertising. The Federal Trade Commission has handled thousands of such cases.

Anticipating complete harmony with the radio industry, as already manifested by some of the leading executives, the Commission is approaching the radio field in a spirit of friendly co-operation. Consequently, instead of adopting a plan of monitoring broadcasting programs, the Commission is asking for copies of advertising announcements to be furnished by the networks and broadcasting stations. Pursuant to that plan, the Commission has addressed letters to the broadcasting stations requesting them to mail weekly copy of commercial continuities, which will be checked to determine whether or not any of them are in violation of the Federal Trade Commission Act.

Whenever statements occur in commercial announcements which appear to be false and misleading, or otherwise constitute an unfair method of competition in commerce, notices will be sent both to the advertiser and the radio station broadcasting the advertising, with the view of effecting a stipulation under which the advertiser and the broadcaster agree to cease and desist from the practices complained of. Execution of such a stipulation would end the case. However, should such compliance not be effected, the case would then proceed through a public hearing, with argument before the Commission, decision by the Commission, and perhaps appeal to the Courts.

Beards on Trial

IN a recent case decided by Judge Woolsey in the District Court for the Southern District of New York, it was held that the cut of a man's beard was not susceptible to exclusive appropriation. The Israelite House of David, familiarly known as the House of David, brought suit to restrain unfair competition on the part of the defendant in the simulation of its baseball team. The defendant operated a bearded baseball team which wore uniforms bearing the words "House of David" across the front. Plaintiff further showed that defendant's team, posing as the "House of David" team, booked games a few days ahead of the date set for the plaintiff's team, thereby destroying in that neighborhood the interest in the plaintiff's team. The Court restrained the use by the defendant of the uniforms bearing the House of David inscription but refused to restrain the defendant from requiring his players to wear beards. In his opinion, Judge Woolsey stated:

"The plaintiff complains quite bitterly because the defendant's ball players are all required to wear beards like those of the plaintiff players.

"From time immemorial, however, beards have been in the public domain. In respect of matters within that domain all men have rights in common. Any man, therefore, if so minded, may—without being subject to any challenge, legal or equitable—not only grow such beard as he can, but purposely imitate another's facial shrubbery—even to the extent of following such topiary modification thereof as may have caught his fancy."

It follows that while the defendant's ball team may still maintain its beards as an added attraction, it may not hold itself out to be the House of David team or wear uniforms with that name appearing upon them.

"Ironized Yeast" Curbed

THE Federal Trade Commission recently announced it had ordered Ironized Yeast Company, of Atlanta, Georgia, to cease and desist from representing in newspaper, radio and other advertising that use of its product, "ironized yeast," can or will end or cause to vanish over night such ailments as indigestion, constipation or skin eruptions.

"There is no advantage in the combination of iron and yeast in one compound," the Commission reported in its findings, relying on expert opinion. "Such combination cannot and does not produce more effective or beneficial results than the administration of iron and yeast separately."

The respondent is directed to cease representing that indigestion, constipation, nervousness, and other diseases can and will be cured or relieved by use of this yeast, except when they result from or are produced by a deficiency of Vitamin B or of iron or both of them.

Also, it is not to be advertised "that skinny or scrawny persons or those deficient in shape or form can or will by use of Ironized Yeast develop well-rounded and curved limbs and otherwise become transformed into shapely persons, or that Ironized Yeast furnishes the means for attainment of beauty or attractiveness, except as far as the health of persons which has been impaired by deficiencies in Vitamin B or in iron or in both may be improved and appetite and weight gained, by the use of Ironized Yeast."

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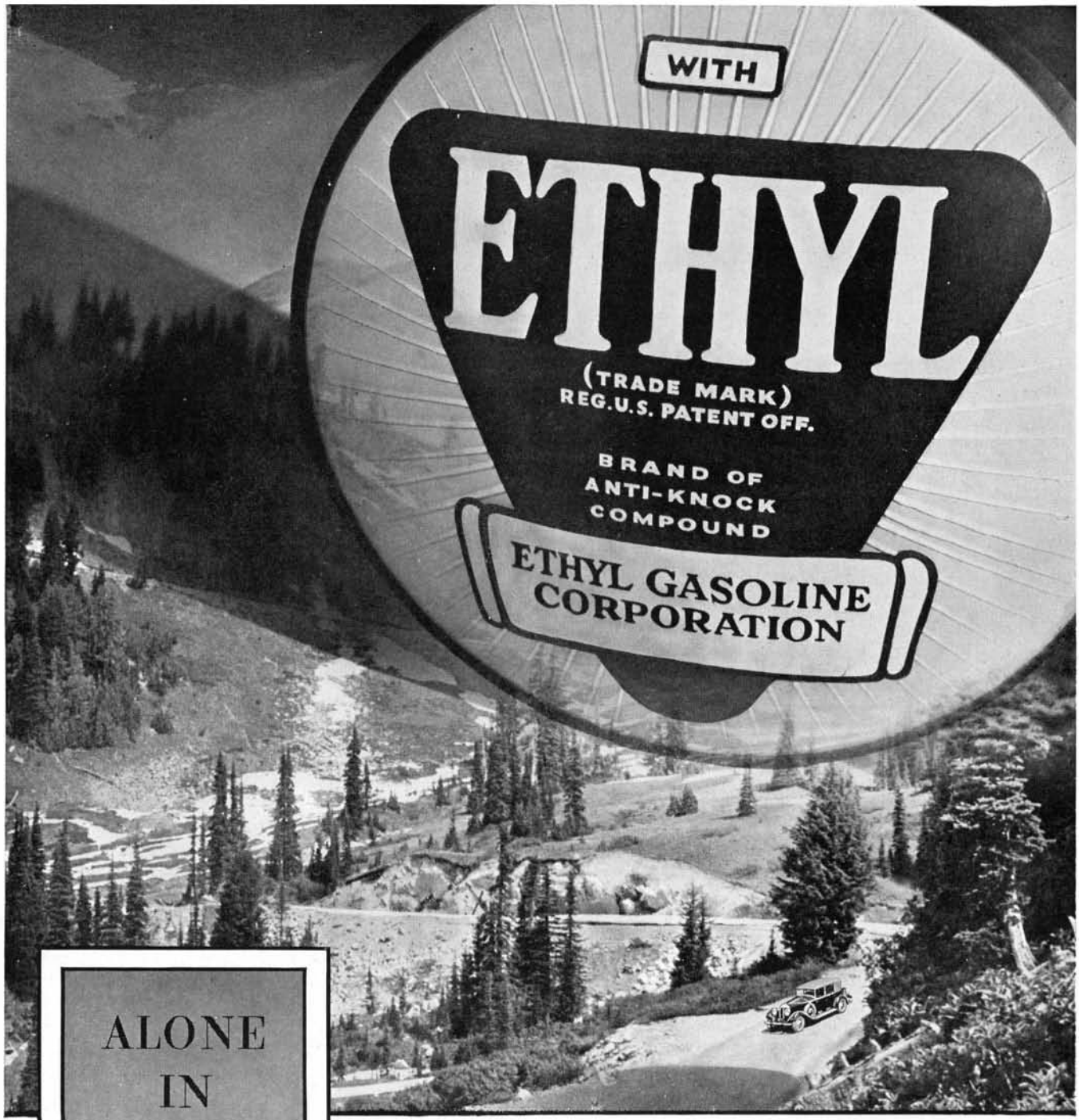
Two samples of the many such commendatory letters received by us yearly.

SCIENTIFIC AMERICAN



ALONE IN QUALITY

The Ethyl pump stands side by side with other pumps, but it stands alone in quality. The only way to get Ethyl performance out of your car is to put Ethyl Gasoline into the tank . . . **NEXT TIME GET ETHYL!**

ETHYL CONTAINS SUFFICIENT LEAD (TETRAETHYL) TO MAKE IT THE WORLD'S QUALITY MOTOR FUEL