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A LEAF FROM HISTORY


SCIENTIFIC AMERICAN.

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EIGHTY-EIGHTH YEAR • ORSON D. MUNN, Editor

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ACROSS THE EDITOR'S DESK

SO accustomed have people become to thinking of matter as made up of atoms, which in turn are composed of electrons and protons, that it is difficult to bring into the picture a new unit—another building block in the scheme of things. Electrons and protons have been regarded as the ultimate entities with which science has to deal, yet brilliant research at the Cavendish Laboratory in England has revealed the necessity for another concept in order to make the picture more complete. The result is the theory of the neutron which appears to be a self-satisfied and self-sufficient unit composed of one proton and one electron closely knit together and electrically neutral. We have been fortunate in obtaining an article on this development in atomic physics from J. G. Crowther, well-known science writer, who has had the entrée to the remarkable work being done at Cambridge and who tells the story in a highly illuminating manner. The article is scheduled for publication next month.

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Traffic between New York and New Jersey has always presented peculiar problems. Separating the two states is the Hudson River. On the New Jersey side, between Jersey City and Newark, are flat, swampy meadow lands and two smaller rivers. The Holland Tunnel solved the Hudson River problem, but created a demand for better traffic accommodations on the Jersey side. Here traffic now has to pass over two draw bridges which often hold up lines of vehicles for long periods of time. The situation is becoming more acute with the rapidly increasing use of New Jersey's fine super-highway system, particularly the one which gives more or less direct access to the Holland Tunnel. The New Jersey State Highway Commission has foreseen the necessity of attacking this problem on a large scale, and as a result there is under construction the world's longest high-level viaduct for vehicular traffic. It will connect Jersey City and the Holland Tunnel with the super-highway system of the state; will afford ample capacity for all vehicular traffic; and will eliminate the two river draw-bridges. We will present in our next issue an illustrated article detailing this project which will take its place as an outstanding engineering achievement.

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The first article in the present issue gives evidence which may be accepted as fairly conclusive that the continent of North America was discovered at least 20,000 years ago. Who were the people who first came to America; whence came they, and why? In seeking answers to these questions, archeologists are handicapped by the fact that there are no written records upon which to base their researches. Therefore, the author of an article to be published next month says, "we must fall back upon the next best and the only available—circumstantial evidence." This article, "How Was America First Peopled?" by Marius Barbeau, gives to the layman a more complete survey of the conditions under which America was first settled than has formerly been available.

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The bridge of an ocean liner is by many considered to be a place of mysteries, a sort of sanctum sanctorum where the ship's officers hold forth in their never-ending vigil so necessary to safety at sea. Glimpses of the various instruments—telephones, engine-room telegraphs, "metal Mike," and so on—serve only to whet the appetite for more knowledge of what it is all about. One of our editors recently went aboard the *Bremen* for the purpose of collecting material about this phase of ocean voyaging, and he returned with a fine set of photographs that will be used to illustrate the article which he will write. This article is scheduled for publication next month, and will answer many of the questions asked even by seasoned travelers.

●

"Serpent Worship in Africa" is the title of an article by Wilfrid D. Hambly, of the Field Museum of Natural History, to be published soon. It deals essentially with python worship and tells of some of the amazing practices of the savage inhabitants of Africa in connection with these huge reptiles. Whether you do or do not like snakes, you will be fascinated with the story Mr. Hambly has to tell.

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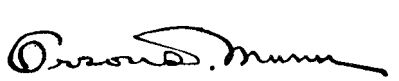
The eminent position which the United States holds in the field of night flying can be attributed directly to the work which has been done to render such aviation activities safe. A network of airlanes, marked at night by seldom-failing beacons, has made it possible to fly "around the clock," subject only to the restrictions of storms so severe that flight is impossible. How these lights are kept burning, and how the keepers of the intermediate landing fields are always on the job, safeguarding the airlanes, are the subjects of an article to be published next month.



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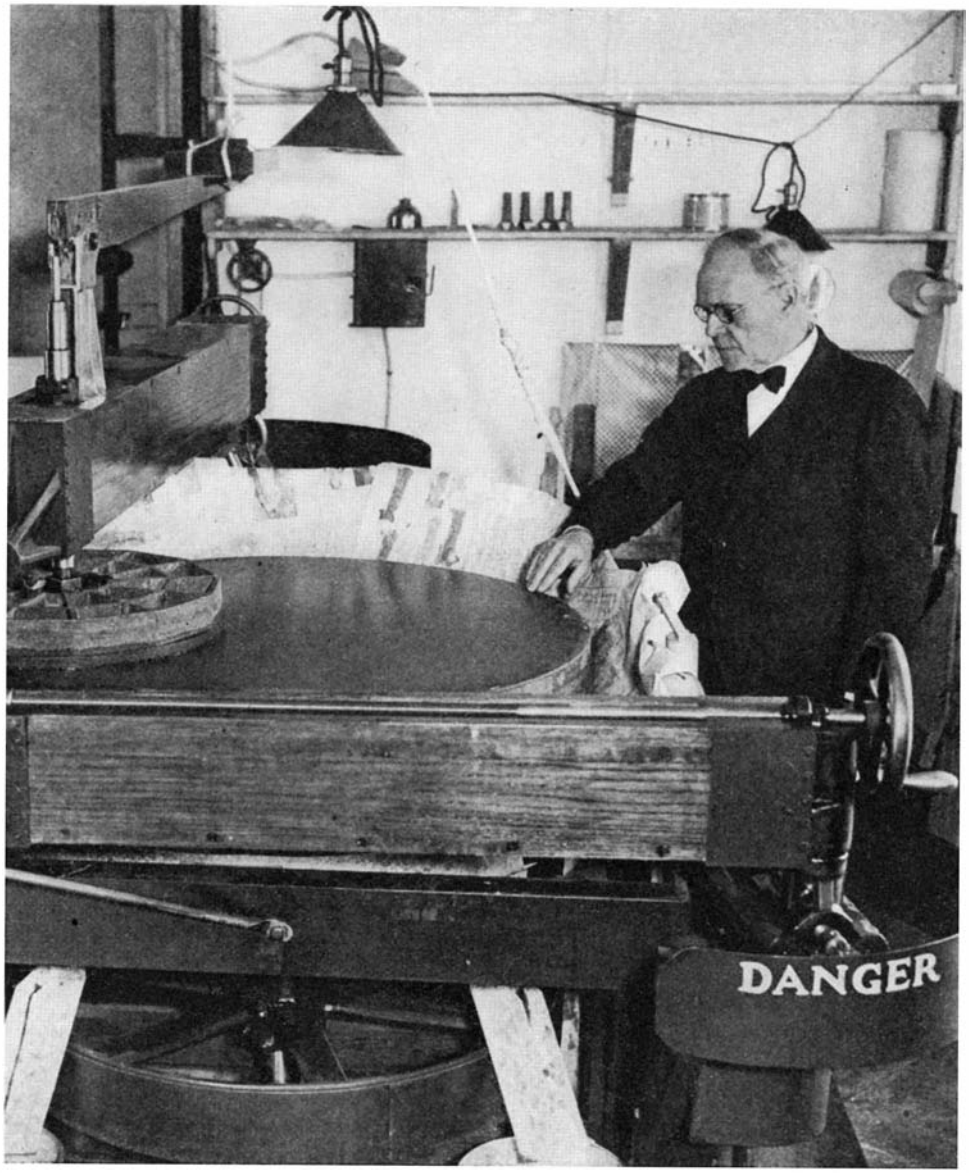
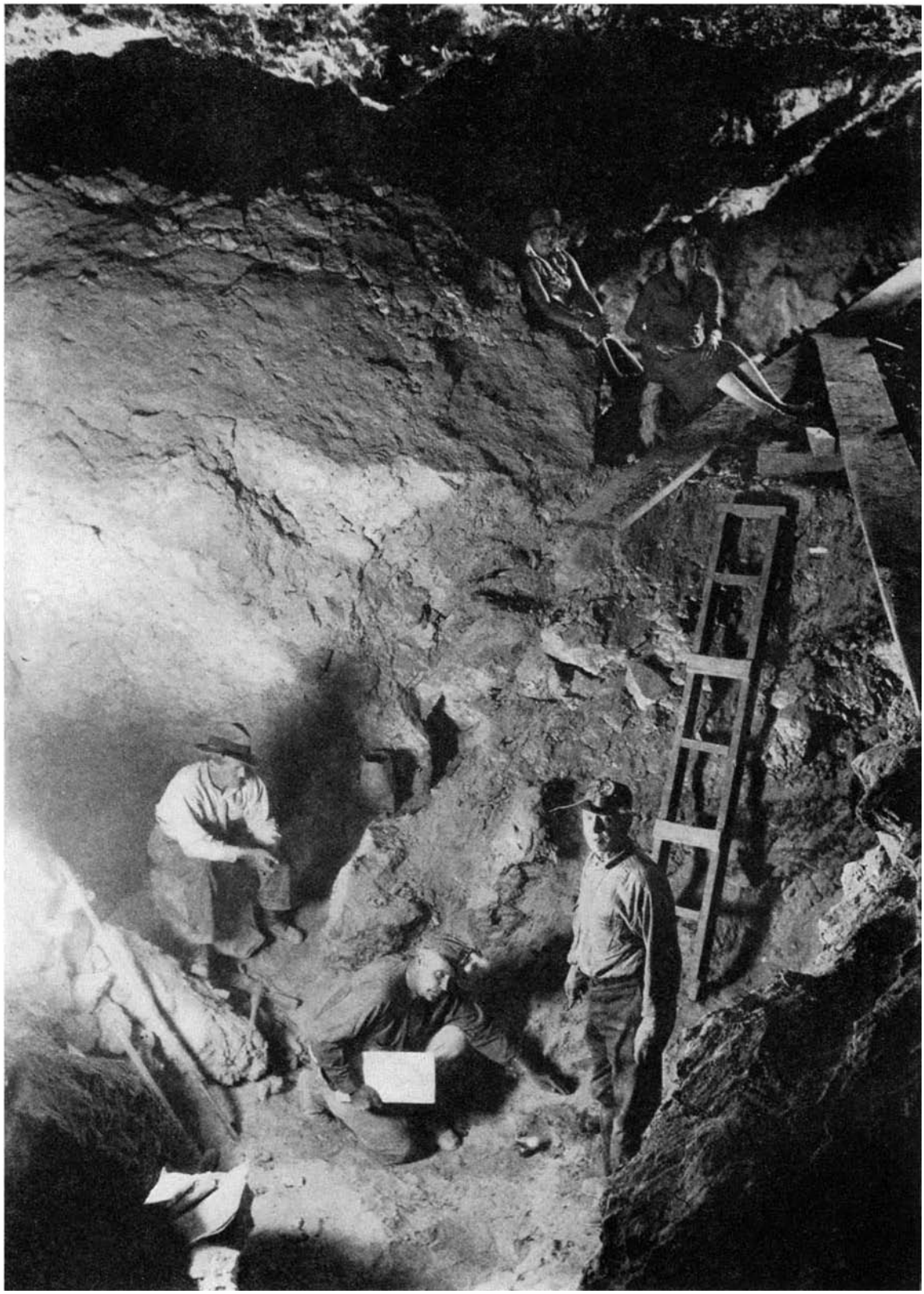


PROFESSOR GEORGE WILLIS RITCHEY

AN article on page 20 describes the basic, somewhat hidden, principles of a new kind of astronomical reflecting telescope, called the "Ritchey-Chrétien" type, which is much more highly refined in design than any telescope in use at present. This telescope is now being built at Washington by Professor Ritchey, who is shown above supervising the grinding of the concave curve of its main mirror. It was Dr. Ritchey who built the two great telescopes, with mirrors respectively 60 and 100 inches in diameter, at the Mount Wilson Observatory in California, and the machine shown is the same kind used for those large-scale pieces of optical work. The massive, thick disk of glass is attached horizontally to the top of a slowly rotating vertical shaft or turntable, coarse grains of abrasive with water are sprinkled on it, and a heavy grinding tool attached to a horizontally reciprocating arm is caused to move slowly across its face in different patterns or strokes whose length, shape, and distribution on the glass are controllable with refined nicety by means of various adjustments. When the curve has been ground out very closely to form it is polished with very much finer abrasive (optical rouge), and finally it is "figured" to exact geometrical form—within nearly a millionth of an inch—by means of carefully selected strokes of the same machine, optical tests indicating where the abrasion should come.



UNEARTHING EVIDENCES OF THE EARLY INDIAN

ARCHEOLOGISTS from the Southwest Museum excavating in "Room 1" of Gypsum Cave, mentioned in the article on the opposite page. In this cave, situated in southern Nevada, they found evidence proving that man dwelt in America contemporaneously with the ground sloth, which is extinct. Other evidences cited in the same article point to the arrival of man (the ancestor of the Indian) in the western hemisphere 15,000 to 20,000 years ago

E. G. Ward and M. R. Harrington, the author (right), examining a piece of charcoal taken from Gypsum Cave. The findings here are part of an array of evidence that man discovered America about 15,000 B. C.

WHEN WAS AMERICA DISCOVERED?

By M. R. HARRINGTON
Curator of the Southwest Museum, Los Angeles

IN trying to determine when America was really discovered we shall first of all be obliged to get rid of two handicaps that hamper us considerably. The first handicap is a pretty serious one—the "Caucasian superiority complex" embracing, among others, the funny notion that nobody but a white man ever discovered anything. If we can make up our minds at the start to forget all about Columbus and Leif Ericson and to look instead for the copper skinned gentleman with dark eyes and straight black hair, who undoubtedly was the first human being to set foot on American soil, we may get somewhere.

Having shed a superiority complex let us now get rid of our second handicap which, strange to say, is an inferiority complex. Gregory Mason calls it the "hemispherical inferiority complex," the idea of which is that nothing really old or truly interesting archeologically can possibly exist in our Western Hemisphere.

Of course we may not be able just yet, even without our complexes, to put our finger on the original sturdy discoverer of the Americas; but evidence has been piling up, especially within the last few years, that will enable us to come closer to him than we have ever been before.

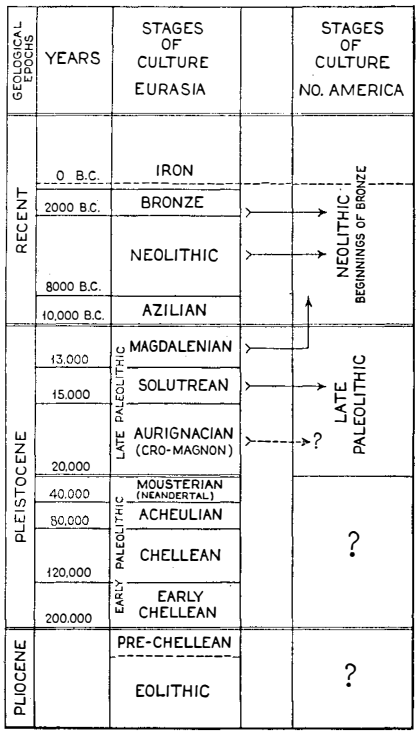
Such evidence was recently found in Gypsum Cave in Nevada (see map, page 8, at point marked 17), where the Southwest Museum of Los Angeles, working in collaboration with the California Institute of Technology, uncovered the remains of various species of animals now extinct—ground-sloth, camels, and horses—along with the weapons of ancient man and traces of campfires and torches. Thanks to a grant of money from the Carnegie Institution of Washington it was possible to complete the exploration of the cave and a full report will soon be published by the Southwest Museum. Many of the details were described in my article, "The Mystery of Gypsum Cave," published in the SCIENTIFIC AMERICAN for July, 1930.

ONE of the most important Gypsum Cave finds, however, was not described, because it came to light only after the article was in press. This was a fireplace, or rather a deposit of charcoal, charred dung, and ashes, found in Room 1 about eight feet from the surface. As may be seen in the section drawing (page 9) it lay below two distinct strata of well preserved ground-sloth dung, which formed part of what we called Layer 5.

In Layer 1, far above, which extended from the surface to a depth of about two feet, were found relics of the Early Pueblo culture and the still older Basket Makers, the latter supposed to have flourished 3500 years ago. Let us exclude the layer of broken limestone (Layer 3), some two feet thick, which seems to have fallen all at one time; and let us assume that the remainder of the deposit, composed mainly of dust, small stones, and mountain sheep dung, has been deposited at a reasonably uniform rate. Then if two feet of deposit represents 3500 years, six feet of deposit should represent three times 3500, or 10,500 years. Probably 10,000 years would not be far from the truth.

Later another fireplace where dung alone had been used as fuel was found a few feet distant, but slightly deeper, and many charcoal-bits of charred sticks were found below the lowest and also between the two dung strata. Layer 5 also yielded two artifacts—a flint scraper-knife and a worked stick —some distance, however, from the fireplaces.

The Gypsum Cave find is supported by another, made about the same time by the Los Angeles Museum of History, Science, and Art. In this case Conklin's Cave, in New Mexico not far from El Paso, Texas (see map, 16), was found to contain a deep lower portion cut off from the entrance by a layer of solidified stony material. Beneath this "septum" were unearthed the bones of a ground-sloth (Nothrotherium), near which in the same deposit was the upper part of a human skull. No report is



Geologic epochs and stages of human culture in Europe. See text

available on the skull, but there is nothing particularly primitive in its appearance.

This find is not the only one or even the latest of these discoveries. Last summer Professor Barnum Brown of the American Museum of Natural History and Edgar B. Howard of the University of Pennsylvania, during the exploration of a cave near Carlsbad, New Mexico (map, 15), found indications of Basket Maker culture, which flourished, as stated, perhaps 1500 years before the dawn of the Christian era, down to a depth of about three feet; and below that the bones of various species of animals, including extinct American horses and native camels. At the depth of seven feet seven inches from the surface lay a flint dart point of the same type as was, a few years ago, found intermingled with the fossilized bones of a herd of extinct bison near Folsom, New Mexico (map, 14). This latter, one of the outstanding discoveries in the history of American archeology, was described by Harold J. Cook in the SCIENTIFIC AMERICAN for July, 1928.

Last August another Folsom type dart point of somewhat cruder workmanship was found beneath the left scapula of a mammoth, by A. M. Brooking, Director of the Hastings Museum, Hastings, Nebraska. The find was made in Nuckolls County, Nebraska (map, 8), at a depth of about 16 feet from the present surface, according to Director J. D. Figgins of the Colorado Museum of Natural History, who studied the finds.

Somewhat similar points were secured with bones of extinct bison on Lone Wolf Creek, near Colorado, Texas (map, 12), by H. D. Boyes, in 1923 (SCIENTIFIC AMERICAN, November, 1926.—*Ed.*); but the first find of this class on record seems to have been H. T. Martin's discovery, reported by S. W. Williston on Twelve Mile Creek, in western Kansas (map, 9), in 1903. This case was a dart point, which, like the one found last summer with the mammoth, lay beneath a shoulder blade; this time, however, of an extinct bison. Interesting is the fact that bones of the Columbian mammoth lay near by in the same deposit.

We must not forget the numerous points, strongly suggesting Folsom culture workmanship, reported from Yuma County, northeastern Colorado (map, 13), in the SCIENTIFIC AMERICAN for February, 1931, by Mr. Cook. These were found in a deposit containing bones of the mammoth and of fossil bison, some bones apparently showing signs of use as implements. Bones and points seem to be contemporaneous.

THAT the east is keeping up with the procession is shown by the recent discovery of the tusks and some of the bones of a mastodon associated with charcoal and flint dart-points, in a bog near Cromwell, Indiana (map, 3), by Dr. John C. Stanford and E. R. Burmaster of the Buffalo Museum of Science, in the city of Buffalo, New York.

These are some of the finds which have been putting a new complexion on American archeology, much to the dismay of some of the "Old Guard." I have not mentioned a few of the most controversial, like the Vero, Florida (map, 5), finds and those at Frederick, Oklahoma (map, 10), (SCIENTIFIC AMERICAN, August, 1927.—*Ed.*).

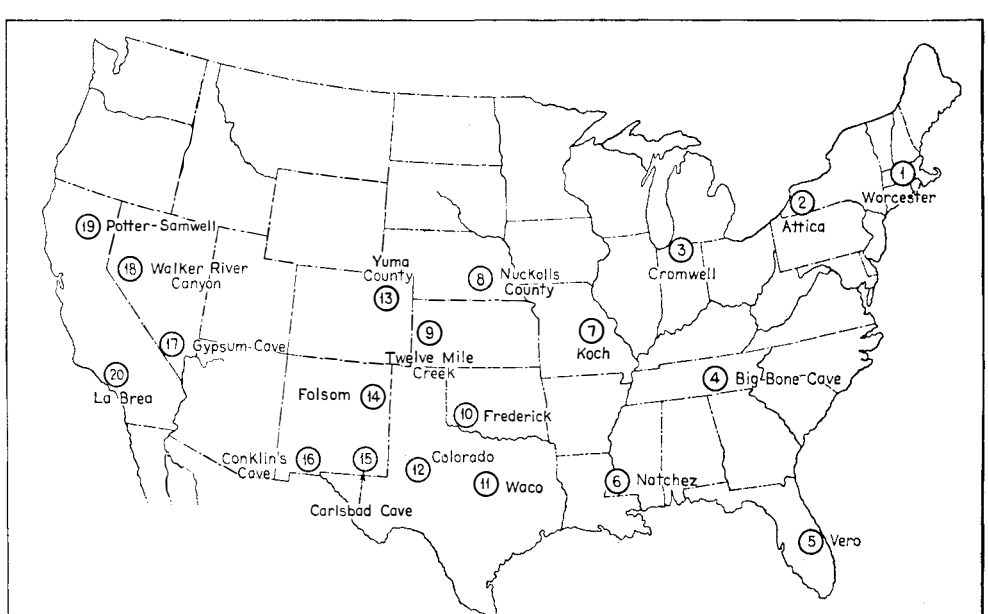
All this 20th Century evidence gives us courage to look at some of the earlier reports which we were formerly inclined to sniff at in spite of the great names behind some of them. Let us review a few.

As far back as 1839 Koch reported "arrow" points associated with mastodon remains in Missouri (map, 7), but this association was later thought to be accidental. Was it? We wonder.

IN 1846 a human bone was found, near Natchez, Mississippi (map, 6), with remains of the ground-sloth, Mylodon. To the suggestion that the bone might have worked down from some recent Indian grave, no less a person than Thomas Wilson showed it to be in a more advanced stage of fossilization than the Mylodon fragments, and consequently as old or older.

Professor F. W. Putnam of Harvard University was a great light in the archeological world and his words should carry some weight. In 1885 he reported an association of man and mastodon near Worcester, Massachusetts (map, 1).

In geology, Professor Israel C. Russell of the University of Michigan was fully as good an authority as Putnam in archeology. In the same year of 1885 he reported the discovery of a well made obsidian spear-point together with the bones of mammoth or masto-

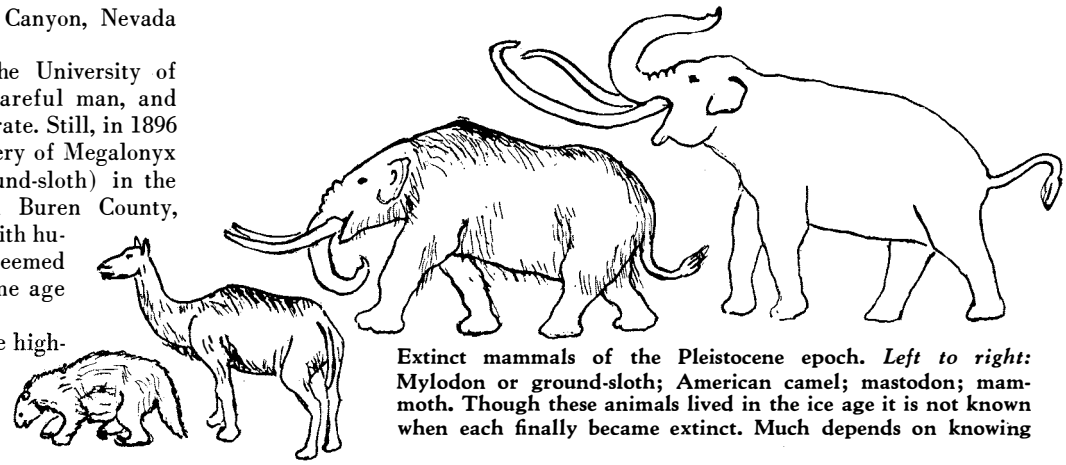


Location of finds mentioned in the text, proving or suggesting the association of man and extinct animals in North America. No. 2 (not cited in text) refers to Attica mastodon, 1903; No. 11 to a mammoth, 1931; No. 19 to several mammals described in 1902 by Sinclair

don in Walker River Canyon, Nevada (map, 18).

H. C. Mercer of the University of Pennsylvania was a careful man, and not inclined to exaggerate. Still, in 1896 he reported the discovery of Megalonyx bones (a type of ground-sloth) in the Big Bone Cave, Van Buren County, Tennessee (map, 4), with human remains which seemed to be of about the same age as the ground-sloth.

Such were some of the highlights of the finds made in the 19th Century. To my mind they are strictly in line with some of our latest, and add great weight to them.



Extinct mammals of the Pleistocene epoch. *Left to right:* Mylodon or ground-sloth; American camel; mastodon; mammoth. Though these animals lived in the ice age it is not known when each finally became extinct. Much depends on knowing

But even without considering the older evidence, we have plenty to prove that man existed on the American continent before various species of animals characteristic of the Pleistocene epoch had vanished. Scanning the various discoveries we find that among these creatures of the past are the elephant-like mastodon, and the true elephants or mammoths as well; at least two species of extinct bison much larger than and quite different from the surviving buffalo; at least two species of native horses; and two or three kinds of American camels. Even more strange to our modern eye are the ground-sloths of which at least three kinds—Nothrotherium, Mylodon, and Megalonyx—have been definitely found associated with human traces. Among birds we have the huge extinct vulture, Teratornis, the bones of which were imbedded with human bones in the La Brea tar pits near Los Angeles, California (map, 20), and reported by Dr. Chester Stock. All these creatures were characteristic of the Pleistocene or glacial epoch, and all are now extinct.

ALTHOUGH positive proof is lacking as yet, it is quite possible that the ferocious flesh-eaters of the Pleistocene found with the above mentioned animals at La Brea and elsewhere were also contemporary with the earliest American. I refer to the giant lion, the short-faced bear, the dire wolf, and the formidable saber-tooth tiger.

I think that no further evidence is needed to show that man was acquainted with many of the Pleistocene animals of America, and consequently if we use associated species as a criterion, we can call him Pleistocene or glacial age man. However, a study of the separate finds suggests that all or most of them are post-glacial; that is, they were found in deposits laid down when the great glaciers that once covered so large a part of North America were in retreat, but usually when the climates of our present desert or semi-arid regions were far wetter than they are today. Only in a few cases have there been indications even suggesting a period before the last advance of the ice.

The question then arises: At what period during the retreat of the ice did the Pleistocene epoch end and the Recent epoch begin? We must remember that the ice sheet still covers Greenland and there are still glaciers on our high mountains, also reflecting Pleistocene conditions. Unfortunately this point has not been determined exactly, but we can say definitely that the period represented by most of our finds is either late Pleistocene epoch or early Recent.

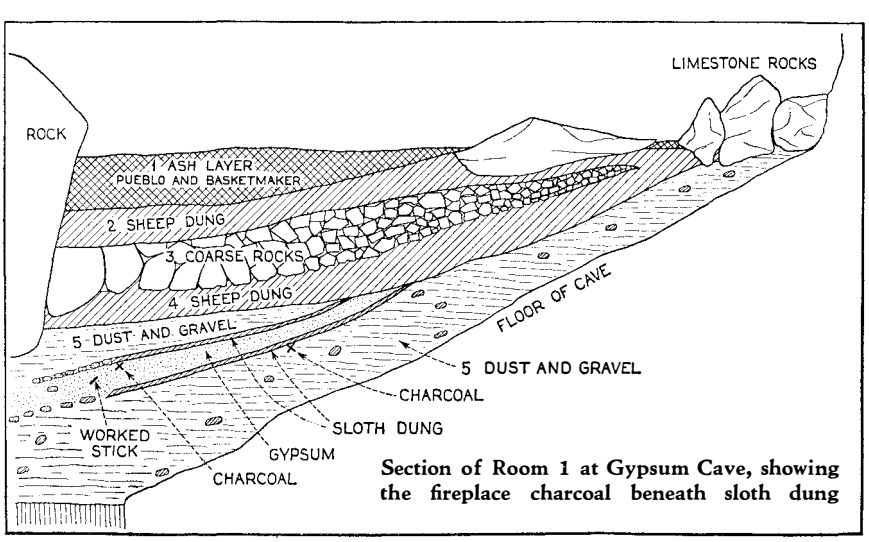
So much for geological time. Now let us consider the matter from the strictly archeological point of view.

In America we have worked out successions of pre-historic cultures for a number of regions, reaching back a thousand years or so before the Christian era; that is, to the days of the Basketmakers in the southwest. Before that we have not yet enough material to make any time sequence or to separate the periods represented. We shall therefore be obliged to apply the old-world system for our earliest finds until we have developed a system of our own. Besides, it is appropriate to use the old-world system in dealing with America's first immigrants, because we have every reason to believe they came from the old world. If we can determine how they fit in there we will have another key to the time of their arrival here.

I SAY the "old-world" system; I mean the European system, because only in Europe has early old-world archeology been worked out in full detail. Fortunately for our discussion, the early finds thus far made in Asia fit in pretty well with Europe where the successive stages of man's development are known, corresponding to periods of time.

What are these stages or periods? The first and oldest is called the Eolithic (see bottom of time-scale chart), when man was a very crude fellow indeed, but little advanced above the higher apes which he resembled in body much more than we do today (which is enough, goodness knows). For tools Eolithic man used only natural stones or very slightly worked ones, and knew many strange animals now vanished from the earth. He lived, in geological terms, in the late Pliocene and early Pleistocene, perhaps 350,000 to 200,000 years ago, according to Keith.

Now comes the Paleolithic or Old Stone Age, which is further divided into two sections, Early and Late. In the Early Old Stone Age, Paleolithic man, although still ape-like and bestial, as



Section of Room 1 at Gypsum Cave, showing the fireplace charcoal beneath sloth dung

shown by the skulls of the Neandertal race which was typical of the period, made various improvements in the manufacture of his flint implements, although they still remained crude enough. Chellean, Acheulian, and Mousterian are the names given to the three sub-stages of the Early Paleolithic, the last one marking the height of development of the Neandertal type of man. In geological language all this took place in the Pleistocene epoch, when man was still obliged to fight with many odd beasts now extinct. In terms of years the Early Paleolithic is thought by Keith to have extended from 200,000 to 20,000 B.C.

Now here is a point to bear in mind in connection with America. At the end of the Early Paleolithic our low-browed, ape-like man vanishes from Europe and our modern type of man, our ancestor, the man of Cro-Magnon, ushers in the Late Paleolithic. He belongs to our own species, which we in our modesty have named *Homo sapiens*—wise or reasoning man.

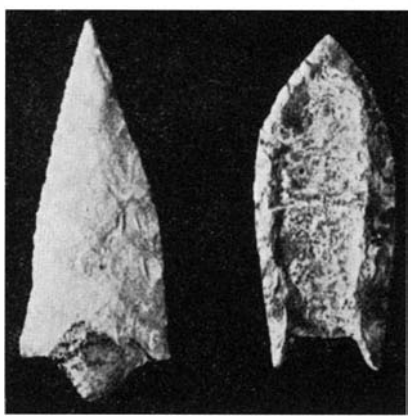
HOWEVER, in the first sub-stage of the Late Paleolithic, which is called the Aurignacian, 20,000 to 15,000 B.C., man made but little progress in his stone work over his low-browed predecessor, and still hunted the hairy mammoth and the woolly rhinoceros with crude spears. We are still in the Pleistocene, at this stage, although the last great advance of the ice is passing.

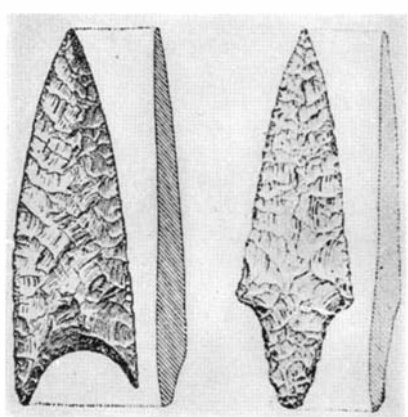
Our next sub-stage, the Solutrean, 15,000 to 13,000 B.C., is most important in connection with the present discussion, because at this time the modern-type Cro-Magnon man learned a new and superior method for making his flint implements which we now call the *pressure-method*, and which we find almost everywhere *in America*. The Solutrean flint knives and spear-heads were the finest that had ever been produced up to that time, and no better way of working flint has ever been invented. The period is still late Pleistocene, with strange beasts still roaming the country, and the ice has nearly finished its retreat in Europe.

We must be sure to remember this Solutrean combination, for later reference: Late Pleistocene epoch, glacial retreat nearly complete, modern-type man, fine flint work, extinct animals associated—these are the catch words.

Now we turn to the last sub-stage of the Late Paleolithic, called the Magdalenian, 13,000 to 10,000 B.C., and this marks the end of the Pleistocene geological epoch also. After the Magdalenian the typical animals of the Pleistocene—the mammoth and his contemporaries—disappear. Strange to say the fine flint work of the Solutrean does not continue into the Magdalenian; in fact flint work degenerates or flint is replaced by bone for making implements. Man is, of course, still of modern type physically.

The following periods have little importance for us at present; geologically, they all belong to the Recent, and the associated animals are about the same as we find today in Europe. These archeological periods are the Azilian, 10,000 to 8000 B.C., marking the transition from the Paleolithic, and the Neolithic, or New Stone Age, when the fine type of pressure flaking for flint which began in the Solutrean came back into favor, when many stone implements were polished, and when pottery was invented and agriculture discovered. The Neolithic is dated by Keith 8000 to 2000 B.C. Following comes the Age of Bronze, around 2000 B.C., and the Iron Age, beginning some time before the Christian era.





***Upper:* At left, a dart point from Gypsum Cave; at right, Folsom dart point. *Lower:* Solutrean points**

Now all this makes a neat time scale, which is also a culture-scale, into which almost any old-world prehistoric find can be fitted. Let us see if we can use it for our most ancient American discoveries.

Before taking up the evidence of artifacts let us see what we can do with bones. No remains of the more or less bestial and ape-like species of man, such as the Neandertal or Peking types, have as yet been found in America; on the contrary, all the skeletal remains thus far found here, even the oldest, have been of *Homo sapiens*, the modern type, which began in Europe with the famous Cro-Magnon.

This fact rules out Eolithic and Early Paleolithic man entirely; for, on our European scale, *Homo sapiens* did not appear until these periods had passed.

Yet extinct animals of Pleistocene types are associated with our oldest American finds. Using our European scale again, this rules out all periods later than the Magdalenian, for these later periods do not show extinct animals associated with man.

On our European scale our American finds are therefore Late Paleolithic archeologically, and Late Pleistocene geologically, these two being in chronological agreement. Now let us try to discover whether they are Aurignacian, Solutrean, or Magdalenian; for, if they fit into the European scale at all they may belong to one of these sub-stages.

WE examine the dart-points from Gypsum Cave, or better yet, the Folsom points. What style of flint work do they represent? Pressure flaking, of course—the style that originated in the Solutrean but disappeared in the Magdalenian. (See illustrations of Solutrean and Folsom points.) There is therefore only one Late Paleolithic sub-stage to which our oldest American finds can belong, and that is the Solutrean.

In other words there was only one stage in which Paleolithic man in Europe made flint implements similar to those from Gypsum Cave and Folsom—and that was in the Solutrean.

We can therefore say that according to most of the evidence at hand man came to America in the Solutrean stage of the Late Paleolithic, in the Upper Pleistocene period, about 15,000 to 18,000 years ago.

Possibly there was a center somewhere in Asia where Solutrean man developed his superior flint work, from which streams of migration carried it westward into Europe and eastward to America.

Our knowledge of the early archeology of America is in its infancy. Perhaps when we know it better we shall find that our copper-hued, straight-haired discoverer of America was Aurignacian and not Solutrean—that is, that immigration into America had already begun before the Solutrean stream started.

That other migrations occurred or continued on up into the Neolithic period can not be doubted. (See an article scheduled for next month.—*Ed.*)

But until somebody finds a genuine primitive, low-browed, bestial, ape-like Neandertal or Peking skull in America we can not claim anything older than Aurignacian. Yet 20,000 years for man's occupation of America gives us quite a respectable background!

OUR POINT OF VIEW

Haven't We Enough Already?

JUST what may happen if the physicists succeed in making available the incomparable energy within the atom —enough of it in a dime to drive a steamship across the Atlantic and back —is anybody's guess at present. Science is again playing around the edges of this intriguing problem—not, it is true, seeking this energy as its deliberate aim but primarily seeking new knowledge of the constitution of matter. In the famous Cavendish Laboratory at Cambridge University, Doctors Cockroft and Walton have split the atom, releasing on a minute scale, but nevertheless releasing, far more energy than was put into the process. This may be the beginning of something big in a practical way. Again, it may not.

The idea is not a new one. For a long time physicists believed access to "intra-atomic" energy was certain to come. Later, for a time, they believed it would not come; now there are grounds for thinking it may, after all.

One thing that is again evident from the experiments at Cambridge is that the energy released when the atom is split will not touch off the similar energies of other atoms and "blow up the world." Physicists have never worried about such a débâcle. Radium constantly releases intra-atomic energy, yet nothing has been "touched off" by it yet. This touching off business has been and probably will continue to be a pet scare-you-all of the sensational Sunday feature writer.

While science cherishes and treasures every fragment of new knowledge of nature it can gain, in the present case there unfortunately is a possible by-product which might prove to be a doubtful asset to humanity. It is a commonplace that every man, woman, and child in this America has 30 mechanical slaves working for his well-being and comfort, for this is the machine age and coal feeds these "slaves." Suppose now we should actually gain control of intra-atomic energy and thus provide everybody with a million slaves instead of 30. Sir Oliver Lodge thinks the young human race is still too primitive for this dangerous Christmas present. Perhaps humanity would not handle it judiciously. The control of such stupendous forces might also fall into the ruthless hands of the soldier-minded —some future Attila—and what fun it would provide for him while the human race and civilization lasted!

May it not be better for man to consolidate his recently gained control over the 30 slaves of coal and oil and be sure he is using them more fully than at present to his own real well-being, before he undertakes to pull the strings that manipulate the million slaves of atomic energy? Isn't the world sufficiently maddening already without a newer madness pitched on a higher scale? We hope that no inventor will discover in the Cambridge experiments a menacing by-product which its performers have probably never thought of seeking.

Vox Populi

ALREADY, our June issue having just reached our readers as this is being written, letters are beginning to arrive, commenting on our stand regarding the federal deficit and means of meeting it. As was to be expected, both sides of all the questions discussed by the editor are represented, but most of the letters commend our stand for repeal of prohibition and acceptance by the nation of the revenue that might be obtained from legalized liquor. The letters seem to come from all types of people but principally from industrial men.

Thus we are furnished with further proof that the country is tired of misgovernment, of political foot-balling, of federal extravagance, of the Congressional Do-Nothings. In short, the country is tired of the paternalism that pats us on the back, tells us what is best for us, and goes on its reckless course.

So far, at this writing, Congress has done nothing definite regarding the deficit, prohibition, or, indeed, any vital problem of the day. So ridiculous, in fact, has been the recent attitude of Congress and so futile its efforts, that Mr. Hoover has lost patience and soundly rebuked both Houses. In so doing, he proved himself, for the moment, the type of leader so eagerly awaited by the country. If the President will only continue this leadership, he will get the budget balanced—before this is published perhaps—and will redeem the country by restoring world confidence in the United States and in our credit. We urge him to put aside all personal political considerations and continue talking directly to the people. He'll never regret it, for—

The mute majority, usually content with an apathetic rôle, is finding its voice. It begins to cry out, this time with such concerted vehemence that it will not be smothered with sophistries, for a consideration of its desires and its welfare. A note, ominous to the politician's ear, sounds through this cry of the multitudes as an undertone which, should present conditions not be corrected, will surely rise to a crescendo of political revolution at the next balloting.

Public Projects

ENGINEERS have recently been more insistent than ever that the way back to economic stability and to a period of sane progress—without the hysteria that characterized the 1929 period—lies in the inauguration of construction on vast public projects. Coupled with the fact that this idea seems to be taking stronger hold, it must be noted that a realization of the necessity for hard work by all is rapidly becoming more general.

While no one will subscribe offhand to this construction plan, without qualifications, it has a great deal of merit. There are thousands of miles of roads here and there that need improvement or that could be made into important highways to alleviate traffic conditions or shorten routes. With the normal increase of automobiles that is expected after the upturn, every mile of these roads will be needed. Then there are bridges, tunnels, parks, public buildings, and schools by the score on which construction has too long been deferred or which need renovation, modernization, or replacement. Public money could also be spent at this time in the erection of monuments, museums, art galleries, and other such projects conducive to the nation's cultural advancement.

Some communities have sired construction programs on a more or less ambitious scale but, unfortunately, a few of these have illogically turned to the pick and shovel, hand labor—in order to give a longer period of work to a larger group of laborers—whereas they could have accomplished a great deal more, to the lasting benefit of all, by using every modern means of construction.

Despite rumors to the contrary, funds for such purposes are available. They are available in amounts limited only by the degree of faith communities, the states, and the nation have in their future. If we have confidence in the future, well-balanced programs of construction can not fail to help us upward.

RESEARCH IN THE FUTURE

By L. W. CHUBB
Director, Research Laboratories,
Westinghouse Electric and Manufacturing Company

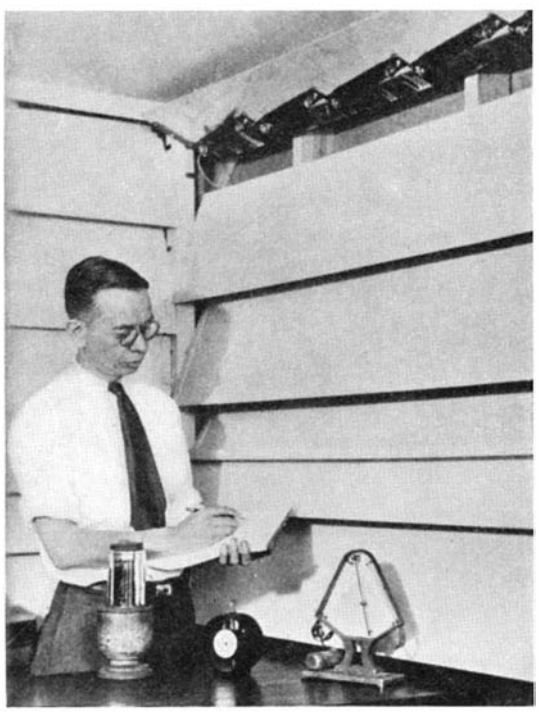
Unique Developments in Science and Industry Lie Just Over the Horizon

As it appears now, the electrical and other industries are going to be profoundly influenced during the next few years by the development and application of new vacuum and gaseous discharge devices for the control and conversion of power. The essential elements of these controls are:

(1) The vacuum tube amplifier and power tubes with which everyone who owns a radio set is familiar; (2) The grid-glow tube, which is a relay or trigger with no moving parts and which makes possible the control or release of considerable quantities of energy by the application of infinitesimal amounts; (3) The photo-glow tube, which suddenly passes comparatively large amounts of electric current when illuminated by definite amounts of light; and (4) The photo tube, which passes current in proportion to the amount of illumination.

By means of these and suitable auxiliary devices and electrical circuits it is possible to perform automatically many functions which now require human action, and to accomplish them much more rapidly and with greater certainty. For the human ear, eye, and sense of touch, we can substitute these new devices in industry in many cases to very great advantage.

THE "electric eye" can, for example, be used for automatically assorting articles of various colors or shades; it can be used for counting; it may form the essential element of new automatic traffic control devices, thus speeding up automobiles very considerably at busy intersections; it can be used for the indication and control of smoke, for turning on signs automatically, and for controlling illumination generally. When the paper breaks in a large paper machine, an enormous amount of loose paper may be spread over the machine room before the operator can bring the machine to rest. The electric eye can detect such a break in the paper the moment it happens and almost instantaneously shut down the machine, thus preventing loss of time and material. The essential element of the electric eye is the phototube. The change in electric current is very small for an appreciable change in illumination. However, in conjunction with the grid-glow tube as an amplifier, a very effective control results.



Study of heating and humidity problems: L. W. Schad in his perpetual spring laboratory

The grid-glow tube itself can automatically see to it that, if the pilot flame in furnaces and ovens is extinguished, no gas can be turned on and therefore the possibility of explosions due to such causes is prevented. The grid-glow tube is the essential element in the latest type of theater light dimming equipment in which many lighting circuits can be controlled without moving parts from a small conveniently located keyboard. The grid-glow tube can function very effectively for controlling motors and other electrical equipment without the use of contactors or other moving parts.

FACSIMILE picture transmission by wire or wireless is now used quite extensively by the newspapers for the rapid distribution of pictures of important events. With rapid improvements in facsimile devices, it is now possible to place them on airplanes and in time of war an aviator will be able to fly over the enemy lines, draw sketches, and transmit them instantly to headquarters. An extension of this system may be made to the home, whereby tabloid newspapers will be printed almost immediately after the events which are described. This of course can be done now by radio, but often the listener is busy with other tasks when important announcements are made, and does not hear them. With the tabloid newspaper it will be possible to pick it up at leisure and read the latest events without waiting for the several hours' delay which now takes place in newspaper reports.

Thermionic light organ for obtaining unusual lighting effects in a hall in Cleveland, Ohio

For many important electro-chemical and electro-metallurgical processes and for direct current electrifications of railways it is necessary to convert alternating to direct current. At the present time this is generally done with expensive and bulky rotating apparatus. It is probable that with improvements in mer-

cury rectifiers these rotating converters will be done away with.

There are in commercial use for broadcasting purposes, vacuum tubes of 200-kilowatt rating. If these tubes can be sufficiently decreased in cost it may be economical to use them to supply intermediate frequency power to induction furnaces and similar devices which are used in the manufacture and treatment of steel and other alloys. High frequency generators are very large and expensive and the power tubes are a very attractive alternative if they can be made cheap enough. Large size grid-glow tubes can also be used for similar purposes for frequencies up to several hundred cycles.

Electric refrigerators for the home are now becoming so reliable, quiet, and inexpensive that there seems to be no question that the old fashioned ice box is doomed. Whether the ultimate refrigerator will use rotating parts or will work on other principles requiring no motors is not yet known, but it is certain that even the present type of reasonably satisfactory refrigerator will undergo considerable modification and improvement.

THERE has been, during the past generation or two, gradual transition from single heaters in each room to central heating plants for homes. It is now possible that by the use of electricity we shall once more change back to individual heaters for each room. It may be that these will have very large area and low temperatures and that they will work, to a large extent, on the radiation rather than on the convection principle. Also the time may not be very distant when not only office buildings, but also homes will have simple air conditioning equipment, thus keeping the humidity at the proper level all the year 'round.

There will undoubtedly soon be offered for commercial use simple sun lamps to take the place of the ordinary incandescent lamps which will supply ultra-violet radiation of the proper amount for the best health conditions. During the winter we shall no longer feel the lack of sunlight as we do now with our indoor life in smoky cities.

Chemists are very active on the development of new chemical materials such as varnishes, resins, and the like, and as a result of their work there are appearing new types of insulation for electrical apparatus. These will make it possible for electrical machines to operate at higher temperatures and with greater reliability. These higher temperatures will result in smaller apparatus with the same output, therefore less cost.

Circuit breakers of the oil type have in the past been used almost exclusively for the interruption of moderate and large amounts of electrical energy. By recent developments, as a result of fundamental research, it is now possible to do away with the oil and, by the use of the de-ion principle, interrupt high power circuits in air, thus eliminating the danger of explosive and inflammable oils.

Recent developments in the art of electric welding have made possible buildings of skyscraper size without the use of rivets. This will ultimately result in less expensive construction and in the elimination of noise in connection with structural work.

Much research effort is now being expended on the analyses and causes of noise and vibration. Various types of noise analyzers, which have been developed, can be used to separate the various components of noise and measure their amplitude.

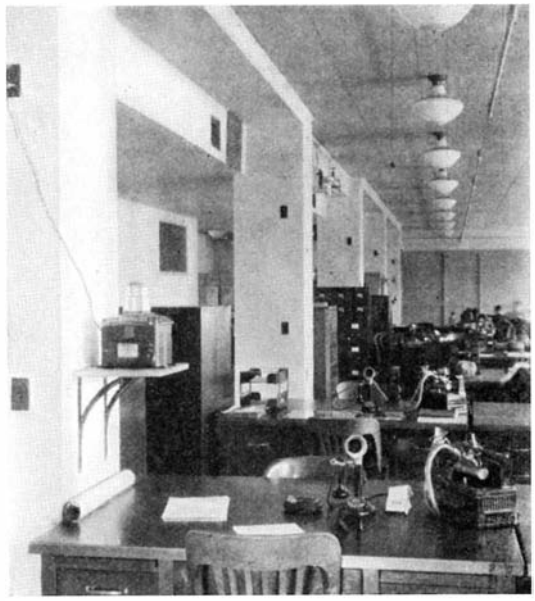
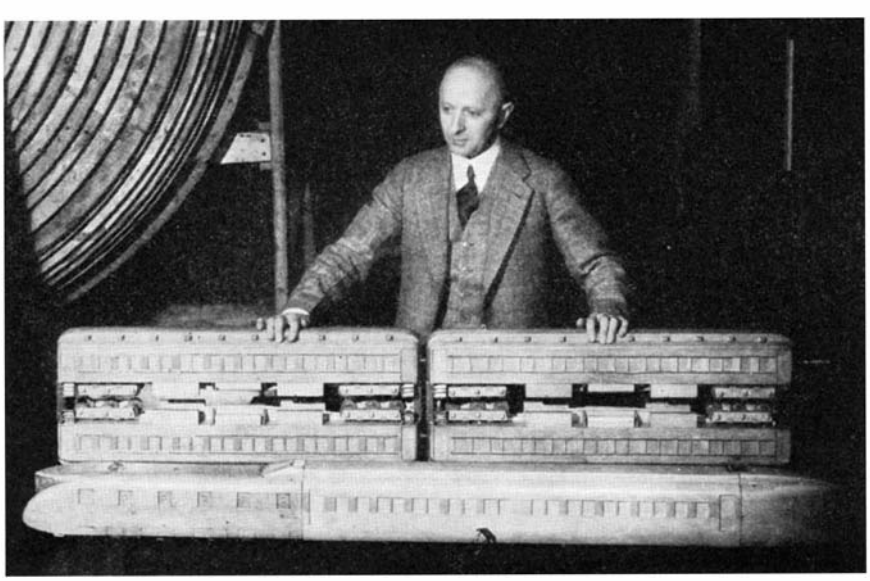


Photo-electric automatic light control, on the shelf at left, turns on lights in this office

THE present generation has seen the rise and fall of the interurban trolley line and has seen very little improvement in the speed of steam railway traffic. The interurban trolleys are disappearing rapidly due to the competition of the motor bus and automobile. The airplane, for certain classes of service, such as mail, valuable express, and passengers, threatens the railroads. Researches on the effect of streamlining, rail stresses, and the use of light aluminum alloys for rolling stock, should make it possible for the rail lines and perhaps the interurban lines to increase their speeds to about a hundred miles an hour with safety. If this were done the major threat of the autobus and airplane could be reduced.

By the application of advanced principles of physics and physical technique to physiological studies, namely the science of biophysics, it is possible that we may obtain a very much better conception of the nature of nerve action and allied physiological processes, possibly with great benefit to mankind. Studies of the effect of X rays and high frequencies on germ cells are undoubtedly going to be of very great importance to medical science. The application of high frequency for the production of fever and the cure of certain diseases already shows great promise.

These are a few of the things which we see ahead and which have promise of accomplishment within the next 10 years. Developments at present unthought of may be just over the horizon, and 10 years from now the picture may be entirely different.



Models of four old style coaches, base to base, and, in foreground, a model of streamlined electric locomotive, tested in wind tunnel by Dr. O. G. Tietjens

THE MYSTERY OF THE UNKNOWN LINES

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

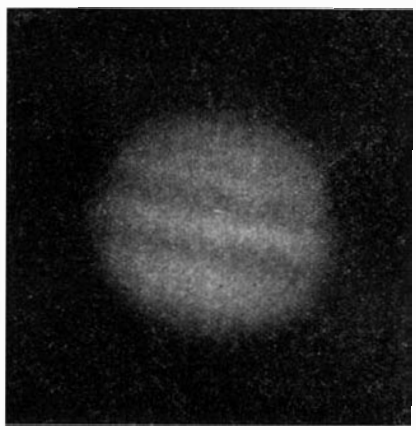
ONE by one the riddles of astrophysics are yielding to the increased powers of solution which come with growing physical knowledge. A few years ago the list of "unknown lines" in the spectra of heavenly bodies of one sort or another was long. The hotter stars, the nebulae, the aurora borealis, the solar corona, the outer planets, and the tails of comets, all showed important unexplained features.

At the beginning of the century this did not seem very surprising. There was still the hope of finding new elements—atoms of entirely unknown sorts—which might account for the problematical spectral lines or bands. The then recent discovery of helium had accounted for the most prominent of all the lines then unknown. Might not this success be repeated?

The work of the intervening generation has disposed once for all of any such possibility. Atomic structure is well enough understood to make it quite certain that no gaps remain in the series of possible atoms up to No. 60. The three heavier elements not yet decisively identified, Nos. 61, 85, and 87, must all be excessively rare, and there is practically no chance that, even when they are isolated and their spectra studied, their lines will be strong enough to show, even in the sun. The unanimous findings of all investigators indicate that the relative abundance of atoms of different kinds is very much the same wherever we can make our tests—in the earth's crust, the sun, or the stars.

ELEMENTS which are fairly abundant on earth often fail to show up, but only when their stronger lines are in the inaccessible "far" ultra-violet regions, their weaker ones certain to be very faint at best. There is not a single case where an element rare on earth is spectroscopically prominent in the heavens, except for helium. Here it is very probable that the earth's attraction is insufficient to keep so light a gas from diffusing away gradually into interplanetary space. Hydrogen, too, would be lost to us if it was not tied down by combining with the heavy atoms of oxygen to form water.

In this connection an interesting observation has recently been made by Professor Menzel (whose work on the sun's atmosphere we described last month). The new isotope of hydrogen recently reported by Urey and his colleagues has atoms twice as heavy as usual. Its spectral lines all lie a little to the violet of the lines of hydrogen of the more familiar kind. Ordinary terrestrial hydrogen shows them faintly, indicating that they are about 1/4000 as abundant as the others. But in the spectra obtained at solar eclipses there is no trace of them, though the familiar hydrogen lines are extremely strong. Menzel concludes from this that in the sun's atmosphere not more than one hydrogen atom in half a million is of the heavier sort. This discrepancy can



A photograph of Jupiter taken with a 12-inch Cassegrainian telescope made by Harold Lower, San Diego, amateur telescope maker

be explained if the earth, shortly after its ejection from the sun, lost most of its hydrogen by escape into space. The heavier atoms, moving more slowly, would be much less likely to fly away, and would be concentrated relatively to the others as the loss progressed. With no hope left of finding new elements of astrophysical importance we must turn to the familiar ones, convinced that the unfamiliar lines in our spectrum come from "old friends with new faces," and arise from familiar substances shining under unfamiliar conditions.

This prediction has been verified time after time. The "comet-tail bands" in the blue and violet can be produced in vacuum tubes containing carbon monoxide at very low pressure, and are due to ionized molecules of the gas. The lines in the spectra of the hottest stars, some dark, others bright, turn out to be due to such old acquaintances as carbon, nitrogen, and oxygen, with their atoms very highly ionized. The Swedish physicist Edlén only a few weeks ago identified lines of trebly-ionized carbon, four-times ionized nitrogen, and five-times ionized oxygen, as well as of the lower stages. Familiar elements again, nitrogen, sulfur and, above all, oxygen, account for the hypothetical "nebulium." Here the lines are given out only by atoms which have been undisturbed by collisions with others, and hence are produced only in an exceedingly tenuous gas. The green and red lines in the spectrum of the aurora are of the same sort, but produced by neutral (instead of ionized) oxygen.

This leaves only two outstanding problems, the corona and the major planets. In a recent preliminary note, de Bruin, a very competent young Dutch spectroscopist, announces that he has evidence that some of the strongest of the coronal lines may be due to oxygen. Fuller details of this important work are eagerly awaited, but are not yet at hand. Meanwhile a communication from Wildt of Göttingen makes the first attack on the other puzzle.

THE spectra of the four outer planets show broad and diffuse bands in the orange and red. Most of these increase in intensity from Jupiter to Neptune; but a few, notably one in the red at wavelength 6470, is strongest in Jupiter, faint in Saturn, and absent in the other two, according to the classic observations of Slipher at the Lowell Observatory. Wildt, working with the new plates sensitive to the deep red, has found several more beyond the limit of previous work. The strongest band of all is in the infra-red and extends from 8800 to 9100.

Band spectra come from compounds, and such wide and hazy bands as these suggest that they arise in a considerable thickness of thoroughly dense gas.

Now the surfaces of the outer planets are cold. Radiometric measures show very little "planetary" heat, and Menzel calculates the temperature of –130 degrees Centigrade for Jupiter and below –170 degrees for Uranus.

There is good reason, therefore, to suppose that the substance or substances which produce these bands are compounds of familiar elements which

remain gaseous, or at least condense only partially at these very low temperatures. Hydrogen compounds afford the "best bet," for the low density of the greater planets suggest that, unlike the earth, they may have retained a great deal of the original solar hydrogen. Such compounds as H_2O, H_2S, NH_3, CH_4 suggest themselves. Water vapor must be stricken from the list because the bands do not agree; and this is natural, for the extreme cold would freeze out the water most completely. Ammonia and sulphuretted hydrogen freeze out at about −80 degrees Centigrade, methane at about 100 degrees lower.

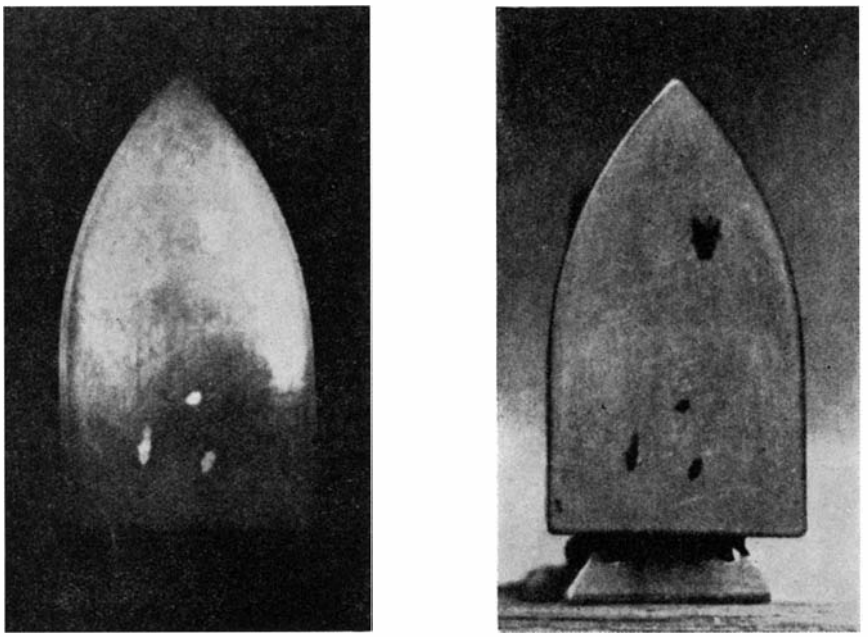
All these gases (like others) have strong absorption bands in the infra-red (due to changes in the rotation of the molecules and the oscillation of the various atoms without "jumping" of the electrons), followed by a series of bands at nearly one half, one third, and so forth, of the wavelength—each fainter than the last. The higher "harmonics" should lie in the observed region but, to observe them in the laboratory, light must be passed through a thickness of many yards of the gas and this has been done in but a few instances. Ammonia gas shows three bands at 8800, 7920, and 6474. The first two fall within the wide bands newly discovered in the infra-red, while the third agrees excellently with the band observed by Slipher.

IN this case so many of the details observable under high dispersion agree, that Wildt has no hesitation in stating that the presence of ammonia in Jupiter's atmosphere is proved. At Jupiter's temperature most of the ammonia should be precipitated as a strange sort of snow which may help to produce the clouds which form the visible atmosphere. Saturn is cooler and still more of the ammonia vapor should be frozen out. This accords well with the observed fact that the band near 6470 is weaker here and absent in Uranus and Neptune. The other bands which are strongest in Neptune must be due to a gas of low boiling point. Wildt notes that the one observed absorption of methane (CH_4) falls in the wide, strong infra-red band observed in Jupiter. The actual formula predicts three bands in the red, orange, and green, which agree excellently with observed planetary bands. Some of the other bands may be partly due to acetylene.

These conclusions are as yet unconfirmed, but they suggest that it might be very repaying to fill a pipe a hundred yards or so long with natural gas, which is rich in methane, pass light through it, and study this with a spectroscope.

The idea of an atmosphere full of such an active substance as ammonia is startling; but because we live in it we never start at the idea of an atmosphere containing free oxygen, which is also very active. The idea of lakes of liquid ammonia, with waves breaking on rock-like shores of ice, is picturesque—though it is unlikely that such things actually exist on Jupiter. Life as we know it certainly could not exist in such an atmosphere, any more than at so low a temperature.

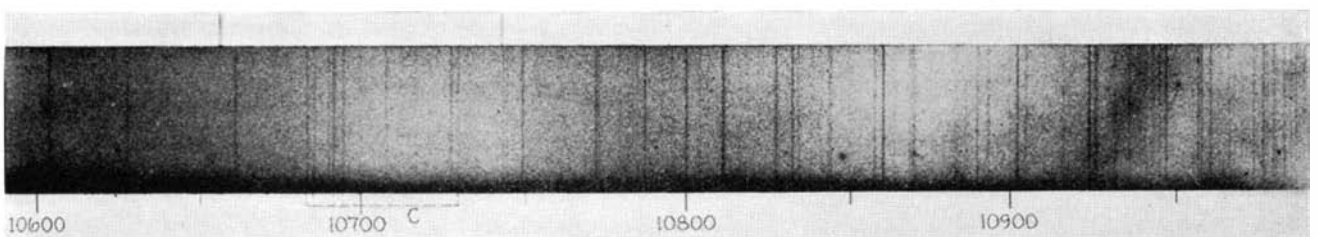
We may speculate wildly for a moment, recalling that liquid ammonia is the most powerful known solvent, next to water, and that all sorts of curious chemical reactions go on in ammonia solutions. It is just imaginable, though not seriously to be suggested, that forms of living matter might exist in whose cells liquid ammonia took the place of water. To such imaginary beings water might be a corrosive substance, while ammonia vapor would be what a famous schoolboy, cramming for a chemistry text without thinking, once said it was: a colorless and odorless gas!



Two photographs of the same flat-iron, the one on the right made by means of wavelengths of light which also affect the sense of sight (in other words, a common photograph), and the other by means of waves of greater length (infra-red) which are invisible to the eye but which have the same chemical effect on the plate as the others. The advantage of the plate over the eye has been obtained by the use of Neocyanine and, more recently, Zenocyanine, both having been discovered at the laboratories of the Eastman Kodak Company. The photographic plate now "sees" about twice as great a total range of wavelengths as the eye.

It is common to call the infra-red wavelengths "heat" waves, and so they are. But this statement, while true, is not the whole truth and has misled many, as it seems to exclude the visible wavelengths as heat waves. The visible lengths are both heat *and* light; or, more clearly stated, all these wavelengths are heat waves, while the sense of sight is based on a limited range of them.

The photograph on the left shows an interesting though not a surprising thing: it is brighter at the top where the iron was hotter. Dr. Harold D. Babcock of the Mount Wilson Observatory, who took the photographs, calls attention to another phenomenon: The ink spots on the cool flat-iron show brightest on the other, because things which absorb rays best (black) radiate them best.—*Ed.*



A spectrogram made by Babcock with the invisible light from the sun (not Jupiter; as in the text), using the new plates sensitive to the infra-red waves. Spectroscopists derived a big thrill when first they saw such a record of invisible waves

CABLES THAT REDUCE YOUR TELEPHONE BILL

By J. R. SHEA
Assistant Engineer of Manufacture, Western Electric Company

THE average person is inclined to think of a telephone system in terms of instruments, wires, exchanges, and operators. It is an interesting fact, however, that telephone cable constitutes approximately 25 percent of the investment in the Bell System telephone plants. In normal years the cost of new cable each year, including installation, averages 100,000,000 dollars. It is the development of new manufacturing processes that has been a large factor in the establishment of a high standard of service in the long distance communication field. Cables supplementing and often replacing the present overhead wire system probably will in time extend across the continent. At this time, Omaha is the farthest western point reached entirely by cable from the Atlantic seaboard, the last section of cable having been completed in May, 1931.

Paper insulating machine applies narrow strips of paper to the copper wire in spiral form

Suppose you are a subscriber residing in Yonkers, New York, and you wish to reach a party in Pittsburgh. You call "Long Distance" and are switched to the toll center in Walker Street, New York, from which point the call connections are completed. It is perhaps well-known to many of our readers that the speech currents traveling along circuits like this diminish in intensity. Therefore loading coils are placed along the cable circuit at regular intervals to eliminate distortion of the speech to a considerable degree but even with those it is necessary to supply amplifiers (repeaters) at intervals of approximately 50 miles to boost the energy level. This boosting would be done at Morristown, Allentown, Reading, Harrisburg, Shippensburg, Bedford, Ligonier and Pittsburgh, all except Morristown being in Pennsylvania. These enormously expensive facilities are available for a three minute "person to person" talk over about 500 miles of cable for $1.90. It is the multiple circuit cable that makes this low cost possible.

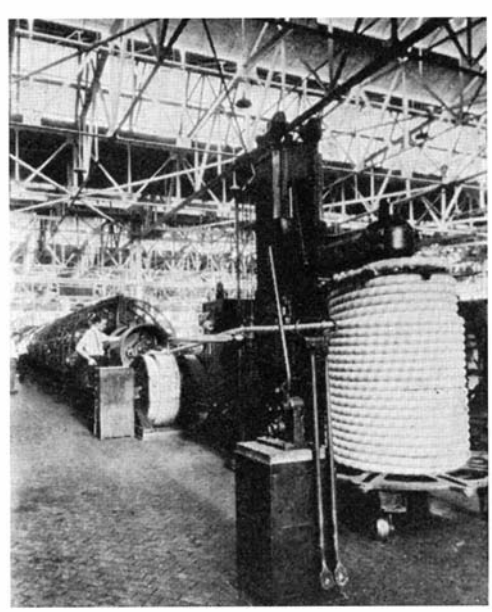
THE time was when all telephone wires were stretched on poles. The system expanded to such an extent that it became necessary in many instances to mass the wires in cables which might be suspended aerially or placed in the ground, usually in conduits, in cities. The wires from the subscriber's instrument to the exchange are often carried aerially for short distances until the cable can be reached where the two wires come together with many others and the connection is extended to the telephone exchange. Such cables containing the paired wires necessary for a conversation are referred to as "subscriber cables" (exchange cables).

Toll cable is used on most long-distance work. It is made up of "quads," that is, four wire units, each carrying three conversations on four wires instead of one conversation for every two wires as in the subscriber cable. One of the principal reasons for this difference is that the length of the toll cable warrants the more expensive terminal equipment necessary for placing three conversations on four wires. There are, however, many engineering considerations involved in the established uses of these two types of cable.

Of course the basis of any cable is the wire. It is a marvelous sight to witness the rolling of red hot copper ingots in powerful mills as they are passed and repassed through sturdy grooved rolls which rapidly reduce the bars in cross section until they are quarter-inch rods each over 1200 feet in length. These rods are then drawn to the proper size wire by means of alloy steel and diamond dies which still further elongate the material until it is reduced to the desired cross section. This wire is drawn at finishing speeds of over 4000 feet per minute.

Having made the wire, the next step is to insulate it, for naturally for communication purposes each wire must be kept from electrical contact with any other.

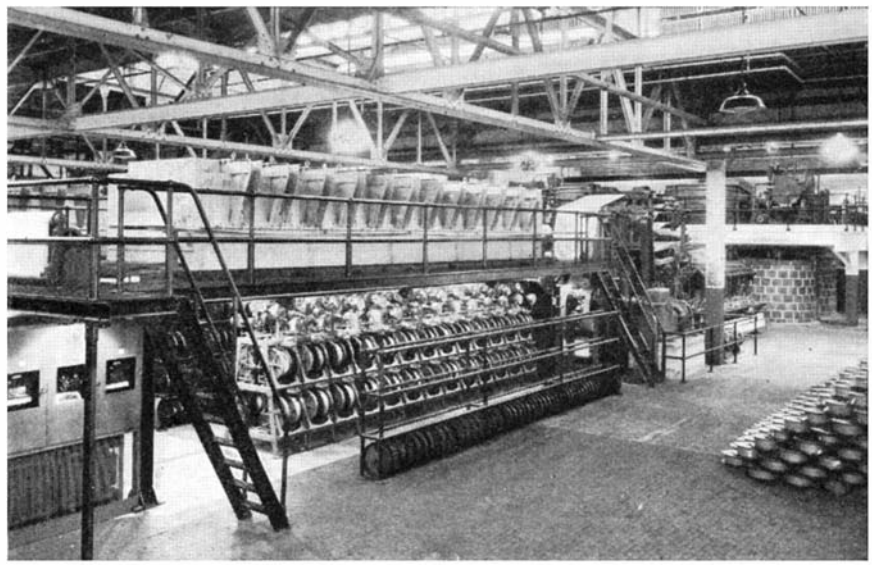
Two methods of insulating wire are in use. In one of these the first step is to take large rolls of thin manila-rope wood-pulp paper and slit them into disk-shaped pads from 8 to 12 inches in diameter. An insulating machine carries these pads of paper and the paper is wound around the copper wire in spiral form at a head speed of from 1470 to 3300 revolutions per minute. If the wire breaks the operator clamps the two ends and brazes them with the aid of a brazing transformer.



The insulated wires are twisted into pairs and twisted "quads" are made into a cable

Splices in the insulating paper are made by the application of a thin strip of gummed paper.

The second and recently developed insulating process is one which combines the operation of paper making and insulating in one operation, giving a continuous sleeve of pulp paper around the wire. The process consists essentially of making on a modified paper machine 60 narrow continuous sheets of paper, with a single strand of wire enclosed in each sheet; pressing the excess moisture from the sheets; turning them down by means of a rapidly rotating polishing device, so as to form a uniform cylindrical coating; and then driving off the excess moisture in the pulp by electric drying. The material used is "Kraft" pulp which is reduced to plastic form in an ordinary paper beater and fed to the paper machine in a somewhat diluted form. A continuous supply of wire must be furnished; therefore, means are provided for brazing the end of the wire from one spool to the next.

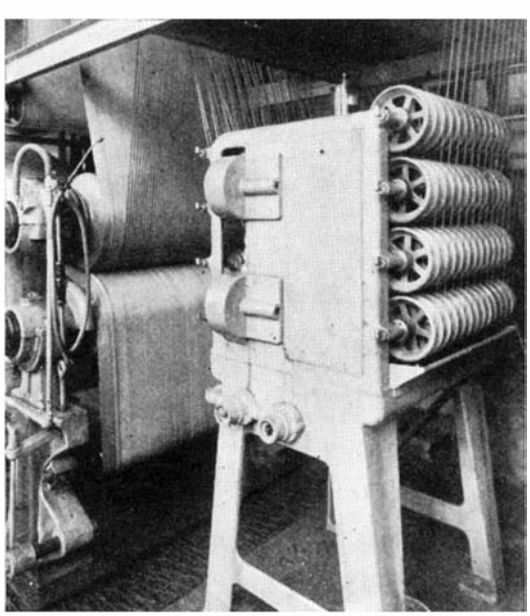


Wood pulp is applied directly to individual wires 60 at a time, forming a continuous sleeve of pulp paper around the wire; the sleeve is polished and dried

A NARROW sheet is formed on each conductor in an ordinary single-cylinder paper machine, the mold of which has been divided into 60 parts by means of celluloid strips and so arranged that a part of the sheet of paper is formed before the wire comes in contact with it. The remainder of the sheet is then laid down on top of the wire without any break in the formation, and the resulting narrow ribbon of paper carries the wire imbedded in it. Two sets of press rolls take the excess moisture from the sheet and leave it ready for the polishing operation. Various types of polishers have been developed and the one now in use consists of two short, specially shaped blocks, with a third block located about centrally to the other two. These polishers are rotated very rapidly around the wire. Their construction is such that if an occasional lump or break occurs in the sheet it does not cause clogging of the polisher.

Polished wet insulation carries about 70 percent water by weight, which has to be driven off by heat. The drier consists of a 25-foot long electric box-type furnace, with heating elements extending the full length of the top.

Two spooling positions are furnished at the take-up for each wire, so that as soon as one spool is full, the wire can be shifted to an empty spool, and the full spool removed. In this way no shutdowns for changing take-up spools are necessary. The normal speed is approximately 130 feet a minute and the weekly output is about 55,000,000 conductor feet.

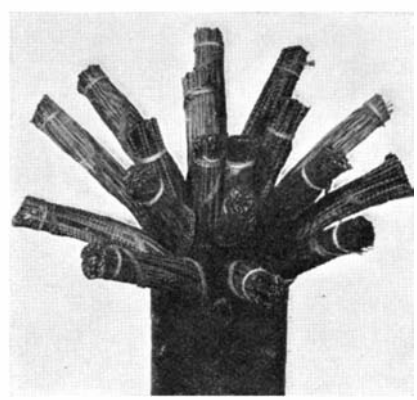


Machine for polishing pulp insulation after its application to the wire. The pulp is then dried

Depending on the type of cable being made, the insulated wires are twisted in pairs for loop cable or two pairs are twisted together, "quadded," for use in toll cables. The spools containing the paired or the quadded wires are put in a stranding machine which places them in alternate layers. Step by step the cable is thus built up until the full complement of wires is obtained, after which an outer wrapping of paper is applied to retain the insulated wires in place and also to serve as an additional insulation from the lead sheath.

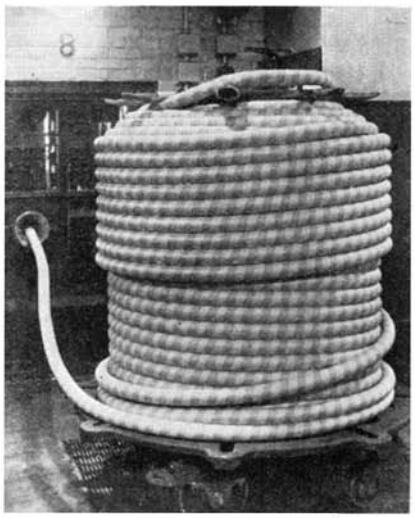
Recently a new and revolutionary method of cable manufacture has been introduced for local subscriber cable. A machine called a "flier strander" builds up pairs into individual color groups known as "units" which usually consist of 50, 51 or 101 pairs. A cabling machine assembles a definite number of these units into a round cross section which is wrapped with paper. No matter whether the cable is of the "layer" or "unit" type the subsequent treatment is the same.

Paper is a fine insulator for the conductors in a telephone cable, but it must be "bone dry." A vacuum drying operation is applied to the paper-covered stranded cable before the lead sheathing is applied. Horizontal driers 40 feet long and 7½ feet in diameter are used. The cable is subjected to this treatment at 270 degrees, Fahrenheit, for a period of from 12 to 42 hours, depending on the size of the cable.



An 1818-pair unit telephone cable showing how the assembly is made

The drying ovens are loaded in the cable room but are unloaded from the opposite end which projects into a dehumidified cable storage room. This storage room acts as a reservoir for the fluctuating deliveries of large quantities of various size vacuum dried cables. When needed for further use, the cable is payed out directly from this room to the lead sheathing press through air-tight cable tubes. After many experi-

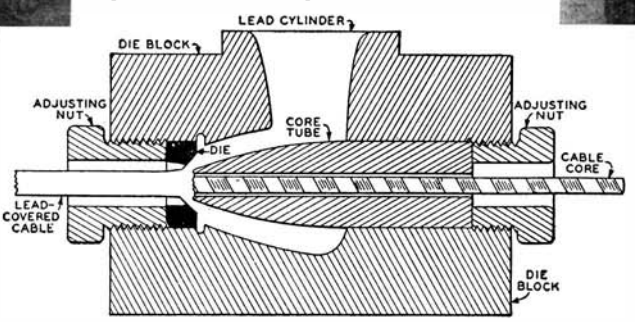


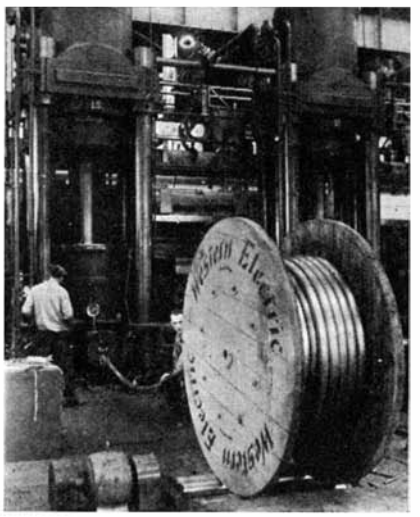
The cable after manufacture is wound with paper and is given a thorough drying in vacuum driers that discharge the "bone dry" cable into a low humidity storage room when it goes directly to the lead sheathing presses as it is needed. The protective covering of lead is the last process in cable manufacture

ments to secure a relative humidity of .5 to .8 percent at a temperature of 100 degrees, Fahrenheit, a silica gel system has been employed as the mechanism for dehumidifying the air.

Silica gel is a white granular substance, full of microscopic pores which give the material its remarkable powers of adsorption. When moist air is passed over silica gel, the moisture is adsorbed and heat is given off. After the gel has adsorbed its quota of moisture, it is heated and the water is driven off. This method of removing moisture from air is very effective at such low ranges of relative humidity. The temperature of this room is kept at approximately 100 degrees, Fahrenheit, a "comfortable working range" when the relative humidity is held at this extremely low value. This observation substantiates the statement so often quoted in oppressive summer weather—"it's not the heat, it's the humidity."

Now comes the last stage in the fabrication of the cable—the lead sheathing. The diagram shows the construction of the die-block. By means of enormous hydraulic pressure, the lead or lead alloy is forced around the core tube and through the die in this die block, thus pulling the cable core along with it. As the lead covered cable leaves the press, it is wound upon reels. The latest type of press can extrude 5680 pounds of metal per hour. The steel





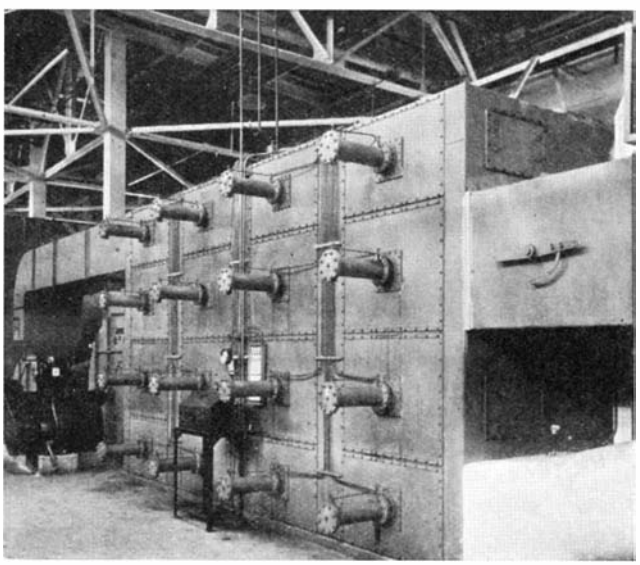
Left: Diagram showing how the molten lead and antimony alloy covers the paper-wrapped cable by extrusion in the inverted hydraulic presses. The die limits the thickness of the coating. *Above:* One of the hydraulic lead sheathing presses in action. The finished sheathed cable is wound on wooden or iron reels

ram exerts, during extrusion, a pressure of 59,000 pounds per square inch on the lead. A battery of huge hydraulic pumps furnishes the power.

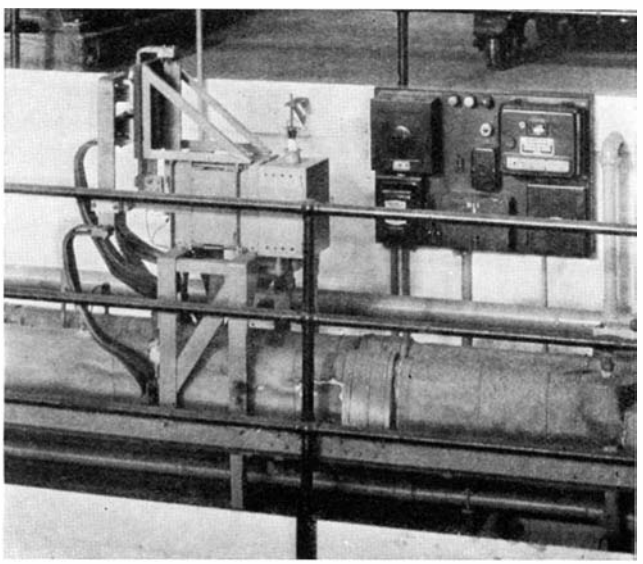
A new central melting and distributing system is now used in our Baltimore plant for handling lead. The new arrangement consists of melting all of the lead alloy in a large furnace at a central location and distributing this molten lead through a long loop pipe line running back of the presses. This line is heated electrically and the lead is in constant circulation. In order to take full advantage of such a system, the presses were placed close together, thus saving the space formerly occupied by the small individual melting kettles.

The lines are heated initially by a series of transformers which supply a low-tension, high-amperage current directly into the pipe by forming a loop of the supply and return line. Once circulation of the lead has been established in the piping system the main line requires little additional energy from the transformers.

Many scientists, engineers, and designers are constantly engaged in this kind of process and machine development work, drawing from all possible fields of knowledge, discovering new fundamental laws of nature, and inventing new devices and processes which result in a constant betterment in the manufacture of telephone cable.



Silica gel adsorbers are used in the cable storage room to remove any excess moisture from huge volumes of air



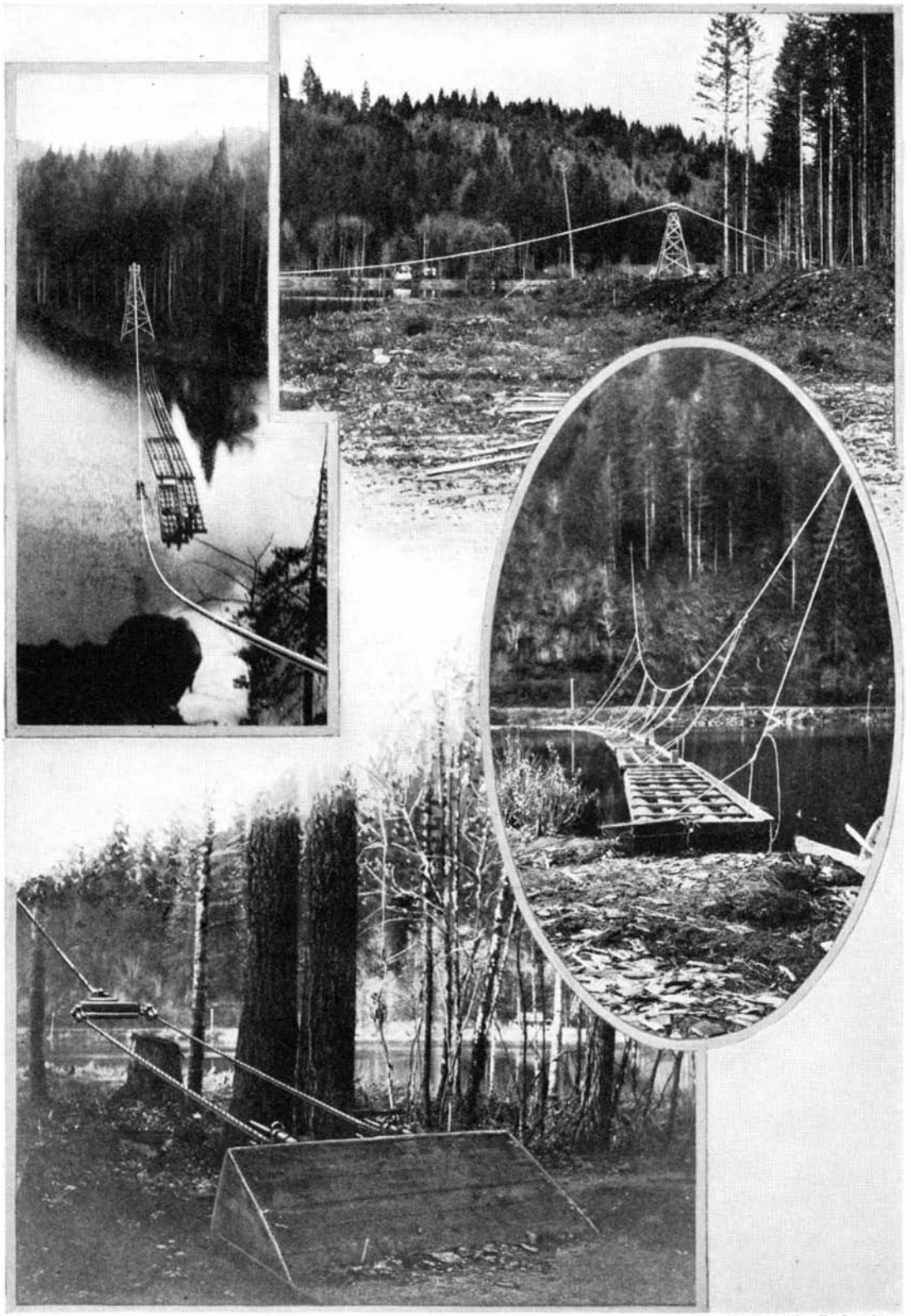
The lead sheathing presses are all connected by a supply line, on which transformers keep the lead alloy molten

Extreme right: On the east shore of the river, the cable passes over a 50-foot tower to the anchorage

Right: Resembling a small suspension bridge with but a single cable. The floating boom as seen from the west

Oval: The high point in the hill on the west shore where the cable terminates, as seen from a point in front of the tower

The east anchorage of the main cable, with the one-inch wire ropes which anchor the main cable



Courtesy *Wire Engineering*

FLOATING "SUSPENSION BRIDGE" PROTECTS DAMS

SPRINGTIME freshets and flood waters from the snow-topped Cascade Mountains, pouring into the McKenzie River in Oregon, bring down logs and other debris so that dams on the river are endangered. To eliminate this hazard, engineers have constructed a suspended cable log boom that rises and falls with the water but always floats and catches the debris. A shore tower 50 feet high was built on the east shore and the main two-inch plow-steel cable was passed over this to an anchorage beyond. On the opposite side, the cable was anchored in the hillside 135 feet above the water line and 720 feet from the distant tower. Seven boom sections, each containing 4000 board feet of timber and having three by twelve timbers extending three feet below the water surface, were then attached to the main two-inch cable by means of short lengths of 5/8-inch plow-steel cables. Cables and cable fittings were of Roebling manufacture.

WHAT PROFESSOR RITCHEY IS DOING

Why the New Ritchey-Chrétien Telescope Now Under Construction Will Be Far in Advance of Existing Types

By ALBERT G. INGALLS

"I EXPECT to increase the photographic efficiency of the reflecting telescope from 10 percent to 90 percent."

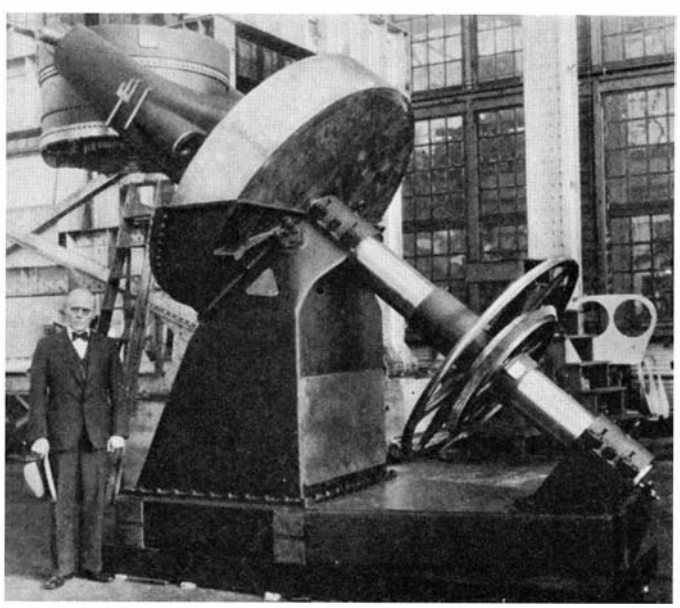
This is what Professor G. W. Ritchey, the noted designer and builder of large astronomical telescopes, writes from the United States Naval Observatory at Washington, where he is working day and night on a new kind of telescope which it is expected will first be put into use on the skies next May.

An increase from 10 percent to 90 percent!

That would be nine times—a 900 percent increase in the efficiency of the telescope.

How will Professor Ritchey accomplish this; and are the world's best and largest photographic telescopes today only 10 percent efficient?

Thus far the principles which Professor Ritchey is embodying in his revolutionary new type of telescope—the Ritchey-Chrétien type—have scarcely been more than hinted at, except in purely astronomical journals. Perhaps writers who have tried to describe them have given up the job, thereby showing more wisdom or less necessity than the present one. However, fools rush in where angels fear to tread, and it is therefore being attempted.



Dr. Ritchey and the heavier parts of the new telescope, at the Baldwin-Southwark Corporation plant near Philadelphia

THERE are two kinds of proposals for improving the results obtained from astronomical telescopes. The more obvious way is to build larger and larger instruments. Thus we hear frequent proposals to build telescopes of the existing type and several hundred feet in diameter. Such an approach to the problem would, however, be essentially an attack by sheer brute force in mass, the "mass" factor being represented by a lot of money. The less obvious way is an attack by stratagem—that is, to refine the telescope in its present size range to the very utmost possible before reaching toward radically larger sizes. This is what Professor Ritchey is trying to do. He contends that the best telescopes now in use, however refined they may be, actually are crude instruments when compared with what they could be—like the motor car in 1890 or the airplane in 1910. He has worked out a long list of separate improvements and these, when compounded, are expected to give the overall multiplication of efficiency he claims. Thus a 100-inch telescope, if made in the Ritchey-Chrétien form, would be nine times as efficient photographically as it is now. After the 40-inch size he is making has made good, Ritchey-Chrétien telescopes of a much greater size may and unquestionably will be built. This would indeed be compounding the return—double-compounding it, in fact. It is true, the telescope now being built by Professor Ritchey is relatively small. But so was Napoleon. What may come of the present experiment of modest size no scientist knows, but astronomers are watching the secluded laboratory at the U. S. Naval Observatory in Washington, as closely as a cat watches a mouse hole, for there the genius Ritchey is working on something which may prove to be epochal.

As a glance at the illustrations will reveal, there is little tangible evidence in sight to show that the Ritchey-Chrétien telescope is unusual. It will have the familiar large concave silvered mirror to catch and focus the light rays from the heavens, and a smaller one to redirect these rays to the point where the eye or the photographic plate is placed. Thus it will be essentially a Cassegrainian telescope. Even those who are familiar with the details of reflecting telescopes will look almost in vain for anything radical on it. But let us step up closer and study first the curves of its Ritchey-Chrétien mirrors.

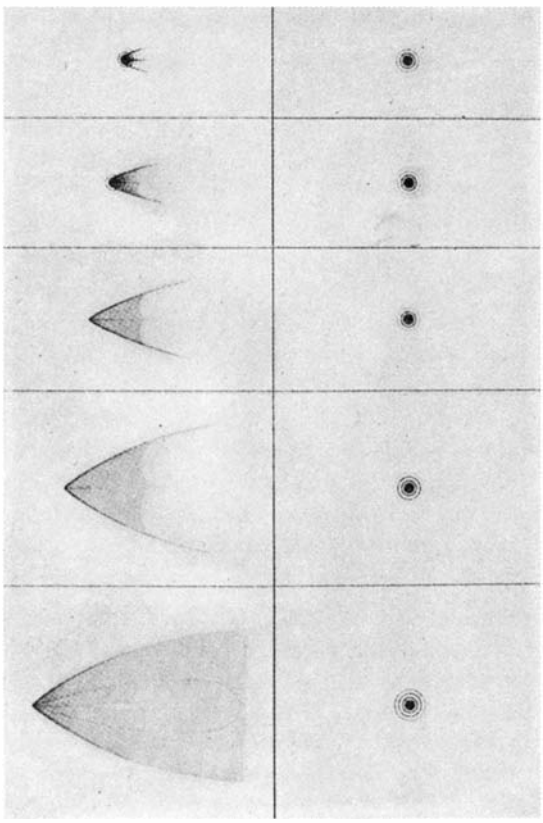
The most essential part of any reflecting telescope—the very heart and soul of it—is the large concave mirror. The glass disk from which this is made is first ground to the approximate depth of concavity required, and then it is polished to a spherical curve—that is, a large sphere would fit this concavity. In practically all reflecting telescopes of standard type this spherical concavity is finally altered very slightly into the form of a paraboloid. A paraboloidal curve has the peculiarity that parallel rays reaching it are all reflected and converged to a point focus at an equal distance in front of it. These rays form there a perfect point image of the object. Now this statement—that a paraboloidal curve gives a perfect image with parallel rays—is entirely correct, but it has been repeated so often that many have unconsciously been led to believe that a paraboloidal mirror gives a perfect image of the stars, and this it does not do. The "catch" here is simply that most of the rays which reach a telescope from the stars come obliquely to the mirror and therefore in effect they are not parallel rays. It is with these unavoidable "out-of-axis" rays that the trouble with all existing telescopes begins and, incidentally, this is where this same trouble is expected to end with the Ritchey-Chrétien telescope.

The reason the out-of-axis rays—which comprise most of the rays received—do not give a perfect image of a field of stars

is that they do not come to a focus at the same distance in front of the mirror. As a result, when the astronomer attempts to insert a photographic plate where they are supposed to focus and form an image he finds he can make only an approximation of that ideal position. In actual everyday practice this means that when a plate is exposed on an area of the heavens, only the center of the plate registers star images which are true, accurate, round and small (smallness, not largeness, is a most desirable quality in star images), because only the central stars send their rays centrally down the telescope. All the stars beyond and around the center of the plate are drawn out into elongated flares resembling arrowheads, all pointing inward. It is true, when we look at a picture showing a field of stars they do not often seem to be thus distorted. One might not at first notice this distortion, even on the original plate. What happens is that all the dots that represent stars are enlarged to some extent, and the flares due to aberrations of out-of-axis rays are not very obvious at first because they seem small. But to the astronomer, who has a much more exacting criterion, they are more than obvious. One of the illustrations gives a "close-up" or magnified view of some of these flares. The same picture shows round images such as astronomers would like to obtain. If a star image on a plate is a minute, round dot, even under a microscope (see illustration on page 23), so that the crosshairs of this microscope can be centered precisely over it, the separation between the dots can be measured with accuracy. If on the other hand the star's image is an indefinite blur, how is the astronomer to decide which part of it to measure from? For purposes of exact measurement an area only one inch in diameter in the center of a typical plate is the maximum that is usable to advantage, owing to the blurring of out-of-axis images.

THE second important reason for dissatisfaction with existing telescopes due to the elongation of "out-of-axis" images is the fact that, because of that very elongation, the little available light from faint stars is spread over so much territory on the plate that many more hours of exposure may be required to register it. Indeed if the stars happen, as billions of stars do, to be close to a given low limit of faintness they will never register at all, no matter how many hours of exposure is given. This is because photographic plates have what is called a threshold value—there must be a certain minimum of light before any effect whatever is registered, regardless of the length of the exposure.

Considerations such as these are very real to the astronomer. He deals with them every day—or rather every night. Professor Ritchey, who for years made the finest astronomical photographs with the large telescopes (built by himself) at the Mount Wilson Observatory, speaks feelingly and knowingly of the disabilities of the orthodox types of telescopes, the "Newtonian" type with a single curved mirror and the ordinary Cassegrainian type with a combination of two curved mirrors, when he says:[1] "The great importance of the last-named difficulty, and of all the others just described, becomes so marked in very large and refined instruments that I have made an intensive study with the object of finding methods by which these difficulties could be decreased or eliminated. . . . Could we expect to find," he continues, "by any possible good fortune, a type of reflector in which *all* of the difficulties just described would be eliminated or greatly decreased?" He tells how he suggested this problem to Professor Henri Chrétien, mathematician-astronomer at the Observatory of Nice, and how together they investigated the possibilities of a type having two mirrors with curves of a new shape. These are the mysterious "Ritchey-Chrétien curves" which have aroused the intense interest of every astronomer, professional and amateur, and this is the kind of telescope—one having these curves—which Professor Ritchey is building at the present moment at Washington, D. C.[2]



On the right are star images of the kind given by the Ritchey-Chrétien mirrors. Those on the left are the kind existing telescopes produce. The series, made respectively at 2½, 5, 10, 15 and 20 minutes of arc from the center of the field, shows how the out-of-axis stars are distorted

These curves are of such a peculiar shape that they automatically balance out, annul and compensate all the blurring effects caused by oblique rays of light coming from stars. They are about as complicated as the combination on a bank vault would seem if you did not know the numbers. For the omission of their specifications here there are two good reasons: One is that they are extremely mathematical, while this is a popular magazine. The other is that their precise numerical specifications are not now available—further than the fact that the one on the large primary mirror is "slightly more accentuated" as Professor Ritchey puts it, than the paraboloid and the one on the small convex secondary mirror is "slightly accentuated" in comparison with a paraboloid. As there are in geometry an infinite number of curves having shapes which would answer to these incomplete descriptions, the exact Ritchey-Chrétien curves seem at present to be out of reach of most of us. They have been described in very sketchy fashion in the *Revue d'Optique* (Paris 1922), that description being mainly mathematical. Even

[1] *Journal of the Royal Astronomical Society of Canada*, Volume 22, No. 6.

[2] To that fraction of the readers who are amateur telescope makers the following notes may prove illuminating: Primary mirror is made of Saint Gobain (Paris) glass similar in expansion characteristics to Pyrex. Diameter 40 inches. Curve is hyperboloidal. Focal ratio 4 to 1. Secondary is made of same glass. Curve is on hyperboloidal side of the paraboloid but is irregular and has no name. (See illustration, page 22.) Is produced by zonal figuring from zonal specifications. Curves differ for every focal ratio. Magnification due to secondary, 1.7 times. Distance between mirrors 96 inches. E.f.l. of combination 272 inches. E.f. ratio 6.8—short, for photography of faint objects. Field of best image is spherical, concave toward incident light. Mirror is supported on three fixed and 15 floating plates, the latter with counterpoises and levers. There are 12 edge supports. Tube length 10½ feet. Polar axis and parts carried by it weigh 10,000 pounds and are entirely floated in mercury. Tube fabricated of chrome molybdenum aircraft steel tubing, 1/32 inch walls. Parts of tube are to be insulated with felt. Dome 21 feet diameter. Tube extension (see illustration page 23) is a part of dome and does not actually touch telescope; is moved automatically in two directions and its purpose is to cut out sky light, wind, and heat radiation. Is collapsible, permitting dome to be closed. Surface intensity of images given by this telescope should be increased 16 fold. Photographically it will be 100 to 200 times more effective than a 40 inch refractor and will show stars that much fainter. This is not the first R-C telescope made; Professor Ritchey made a 20-inch R-C of 136 inches e.f.l. and tested it on the stars at Miami. Previous to this he made refined laboratory tests using a pinhole only about 1/25,000-inch diameter. See above illustration.

it is inadequate, as several advanced amateur telescope makers have found to their sorrow after wrestling valiantly with it.[3]

The actual production of these curves on the glass, once their mathematical characteristics are derived, is as easy as that of the old ones, Professor Ritchey says.

In sum, the new Ritchey-Chrétien curves are expected to clear up the best existing star images much as a pair of eyeglasses clears up the leaves of a tree to one who has always supposed it forever necessary to see a tree only as a blur.

A refinement which will contribute to the accuracy of the telescope Professor Ritchey is building is the use of low-expansion glass for the mirrors. While a telescope is in use the temperature of the air surrounding its mirrors is always changing, generally becoming cooler. Cooling contracts the glass but, since glass is a notoriously slow conductor of heat, the effect is not felt all through the disk at the same time—there is a lag of several hours. This differential contraction temporarily warps the mirror a few hundred thousandths of an inch and injures the integrity of the optical image produced by it. For this reason it actually is necessary on some nights to diaphragm out the outside parts of a large mirror. Thus the 100-inch telescope may be reduced at times to 70 inches in diameter. Since there is no practical way to obviate the changes of temperature of the atmosphere the next best thing is to use for a telescope mirror a kind of glass which expands and contracts less for a given amount of change, and this is being done on the new telescope.

SOME years ago Professor Ritchey originated a cellular type of mirror built up of thin plates of glass, and he was recently asked why he had abandoned this when making the present telescope, since it was designed to minimize temperature effects in large telescopes. "I have not abandoned it," he replied with decisiveness, "but since the present mirror is only 40 inches in diameter it does not need it." Unquestionably, if the present telescope is a success, much larger sizes will be built and the cellular type of mirror will then be used. Professor Ritchey sets almost no limit to the size.

Refinements of this kind would be of little avail if other refinements were not made, so that full advantage could be taken of them. The precision with which the rays of light should now be reflected to the exact points desired will make it possible to employ photographic plates in the Ritchey-Chrétien telescope which are far more accurate than those at present in regular use. The fact that the plates now used, like all photographic plates, are often as much as several hundredths of an inch from flat can make little real difference in connection with existing telescopes, because these errors are masked by still larger ones. But in the Ritchey-Chrétien telescope the rays are brought far more closely to a true geometrical shape—within 1/10,000 of an inch. As this shape happens to be slightly concave the plates will be ground equally concave.

When it is realized, as it too seldom is, that a large astronomical telescope is a huge, ponderous piece of heavy machinery, not a small desk instrument like most other precision instruments; that it is not even permanently fixed in position but must be swung in all directions from vertical to horizontal and is therefore subject to a variety of flexures due to its own great weight; that it must be used not indoors under ideal conditions but virtually out of doors in constantly changing temperatures which continually expand and contract, warp and distort, lengthen and shorten its component parts with the arrival of every puff of air throughout the night—then it will be recognized as a truly remarkable fact that such an instrument, working under such adverse conditions, can take an infinitude of delicate beams of light coming to it from an infinite number of points in its field of view and successfully bring them to the precise destination required in order to form a fine, sharp optical image of as nearly ideal a nature as modern astronomical research exacts. A telescope is an instrument having the size of a box car yet all the precision of a microscope. And now Professor Ritchey proposes to make this marvel of accuracy many times more accurate. If he can do this the world of science will build a monument to him. He has one trait which conduces toward that end; he is willing to take the extreme pains that some call fussiness. When fussiness succeeds humanity renames it genius.

Still another Ritchey refinement, and a big one, is the short telescope tube—only half the customary length. Let us see how many blessings can be made to flow from this apparently unpromising kind of specification. The first blessing works out something like this: Because the previously described blurring of star images due to the spherical aberration (coma) of out-of-axis rays would be greatly exaggerated if the ordinary paraboloidal mirrors heretofore used were to be given a deeper curve of short focal ratio which would in turn afford a short tube, designers have wished they might instead use a long tube. But this wish too has been vain, because a long tube, due to its own weight, bends much more than a short one; with the tube in a nearly horizontal position this bending would amount to large fractions of an inch—enough to corrupt so vulnerable a thing as a fine optical image, for the optical axes of the two mirrors must coincide absolutely in all positions of the telescope. In this predicament telescope designers have been forced to compromise on both a medium focal ratio and a tube of medium length, accepting some of the flexure and some

solution complète du problème, en suivant une voie à peine différente de celle de SCHWARZSCHILD.

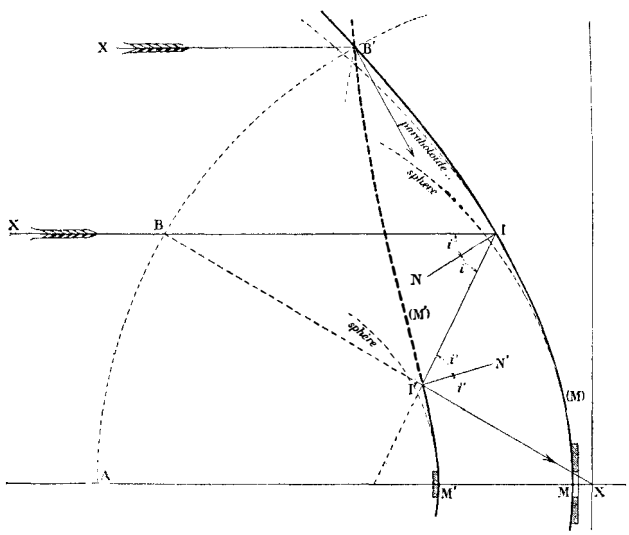


Fig. 6. — Théorie du télescope aplanétique.

Représentons (fig. 6) la section méridienne d'un télescope à deux miroirs (M) et (M'). L'instrument représenté sur la figure est du type de

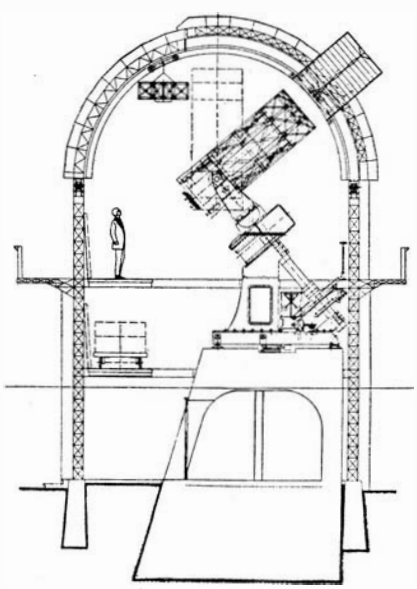
Part of a page reproduced from Chrétien's paper in *La Revue d'Optique*, showing the Ritchey-Chrétien curves. The curve on the secondary, M', is not a conic section

[3] In an informal private communication a mathematician who has been working on these curves says, "The curves on the Ritchey-Chrétien type of reflector are certainly a hard nut to crack and the development of the equations by Chrétien is a masterpiece. However, his publication in the *Revue d'Optique* is merely an index. He lightly says, 'In this equation we substitute the value of that from a former equation—and *this* is what we get.' Yes, but try to do it! This simple step will require several pages of transformations. I worked day and night on the stuff for over three months, just to get the right figures and be sure of what I got. Only this morning I heaved a sigh and 'Eureka' after having proved a coefficient. Just to get over a single step, and end up with an expression which I could write down on about one quarter of a square inch, fills two sheets of 16 by 21-inch paper with abbreviated forms of calculus, to say nothing of the extra sheets used for rough calculations. And then to use the stuff will take several weeks of algebra to get the necessary data for the optician—several years if you haven't a calculating machine to help out."

And yet there are amateurs who are eager to make a Ritchey-Chrétien telescope!

of the aberration. This compromise has always been uncomfortable. But Ritchey's telescope, with its new Chrétien mirror curves, eliminates the aberration, hence a long tube is not even desired; while the half-length tube reduces the flexure to one eighth. This is the second blessing. But there is a third blessing: The short tube is cheaper to make and the observatory to house the short, compact telescope costs only about one third as much as it otherwise would cost. If the Ritchey-Chrétien telescope appears at first glance to be a small, comparatively unimpressive affair, it may be pertinent to recall that a dime is smaller than a nickel.

Even these gains do not satisfy Professor Ritchey. In the photograph of the half-finished mounting a round hole may be seen at the base of one of the arms of the big fork which carries the tube. This—and there is a corresponding hole in the other arm—relates to a counterpoise lever with universal joint in the interior of the fork arm. These counterpoises will decrease practically to zero the flexures of the fork arms under the 3000-pound weight they are to carry. As the fork of a large telescope is one especially vulnerable point where flexures may occur, this is an important refinement. A further refinement is a system of counterpoise levers



Courtesy *Journal of the Royal Astronomical Society of Canada*

As the new telescope will look in its observatory dome, showing the collapsible bellows tube extension and, hanging out of the way, a constant temperature chamber of felt for day insulation of the mirror

connected with the tube, which will reduce its flexures 99 percent. Together these expedients will reduce mechanical flexure to only 1/800 part.

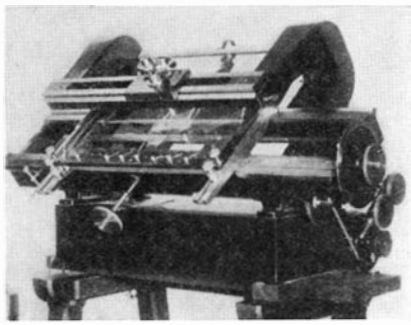
Still another of Professor Ritchey's refinements, his guiding mechanism, relates to the human factor, the observer. A large telescope consists of a machine *plus a man*, for that man is fully as much a part of the instrument as its metal and glass parts. It is not possible merely to insert a photographic plate in a telescope, set the driving mechanism going, and walk off until the time exposure, usually lasting several hours, is completed. No matter how precise the telescope were—no matter if it were perfect—outside factors would shift the images on the plate. The atmosphere—miles of it—through which all the light from the stars must pass is ever in motion at some higher level. The changes in density this produces continually bend the rays back and forth like a wagging finger, so that in time they would cover a large area on the plate. If a plate were left unassisted the result of this would be much the same as if someone in a group picture were to do tap dancing during a time exposure.

The observer therefore must glue his eye to an auxiliary visual eyepiece all through the time exposure, perhaps lasting a total of 12 hours, and by means of two handscrews continually move the plate in such a way as to keep a chosen point (star) under the crosshairs. This is strenuous business.

The observer, while thus "guiding," may make two of these corrections each second, and during moments of very bad definition he may occult the plate altogether. He may have to remove the plate holder and refocus every half hour because changing temperature alters the length of the telescope tube (ordinary type) and changes the focal length of the mirror (more if it is made of ordinary expansible glass). These are standard methods of guiding and control which have been in use for decades.

TO "go them one better" Professor Ritchey has thrown out the clumsy conventional pair of handscrews and substituted a lightweight, much more sensitive guiding mechanism operated electrically from two keys, one for either hand, and a shutter operated instantly with the lips, which occults the plate. After six months of systematic practice with this machine he found that guiding became as automatic as driving a car or riding a bicycle, and was much more rapid and flexible than guiding with the conventional mechanism. An average of four corrections each second with either hand and two occultations of the shutter have proved possible. A time exposure built up of several hours of this kind of thing should exhibit very superior results. Indeed, due to these advantages Professor Ritchey hopes to be able to make detailed photographs of some of the planets.

Astronomers seldom see a planet—Mars, for example—as it is shown in picture books. In the first place it never has proved practicable to photograph more than the largest general details on Mars. Photographs of the moon taken with the 100-inch reflector show no finer detail than it is possible to see, visually, with a 10-inch reflector. The



How the positions of star images are accurately measured on plates. A microscope with precise crosshairs and micrometer movements is centered exactly over each image

pretty drawings of Martian features with which all are familiar represent the patient integration of thousands of momentary glimpses—sometimes mere flickers—between longer periods of fuzziness and agitation. Rarely can one catch Mars in what the unaccustomed amateur would call a satisfactorily quiescent state. The reason for this is the antics of our atmosphere. Professor Ritchey hopes his improved methods of guiding will offset these antics so much more than the present methods of guiding do, that he will be able to make far better photographs of the planets—equal, he says, to visual seeing.

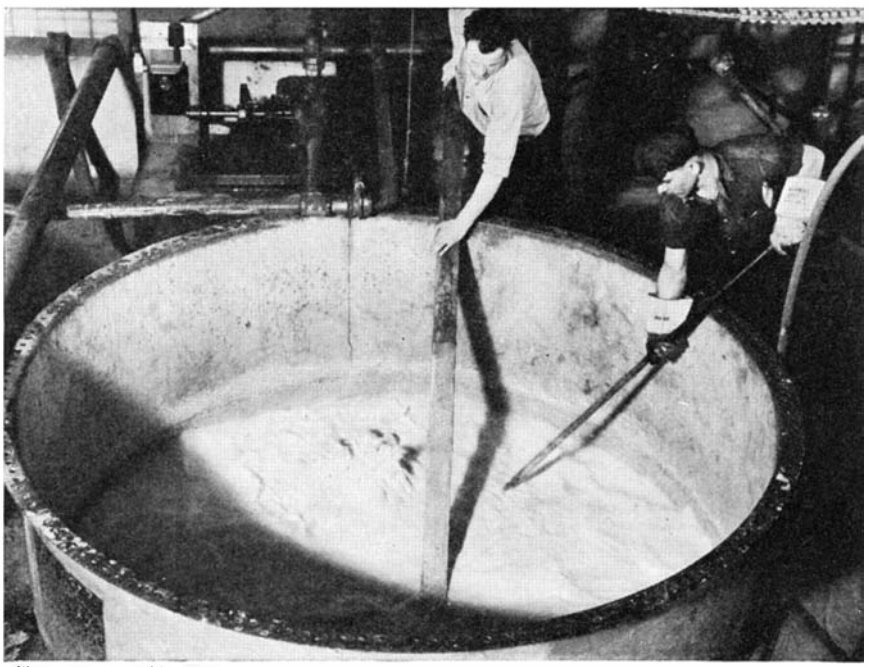
THESE, then, are the main reasons Professor Ritchey has for his great expectations. The scientist, professional and amateur, is awaiting his results with eagerness. Next year when Professor Ritchey begins taking some of the superb photographs of the stars for which he became famous several decades ago, even while using existing equipment, and when they show the increment in quality due to the Ritchey-Chrétien curves of the mirrors, the freedom from mechanical flexure in the telescope mounting, and the effects of the improved method of guiding, will a new epoch be opened in the science of astrophysics? "I shall show," he says, "why this modern 40-inch reflector, so compact and economical that it will be within the reach of scores or hundreds of observatories with moderate means (instead of only a few great observatories), will enable us to make photographs of fields of stars, of star clusters, of spiral nebulae, and so on, which for all purposes of highly accurate measurement of star positions will surpass the most perfect photographs which can be made with any telescope in use at present."

'RUBBER' FROM A CHEMICAL LABORATORY

By F. D. McHUGH

IF you happen to own one of a certain line of cars for which the manufacturer has developed a revolutionary engine mounting, and have had occasion to examine the gasoline feed line to the carbureter, you have probably been nonplussed, for that feed line is apparently of rubber! The reason for utilizing the tough resiliency of rubber at this point is obvious to you, for the feed line is subject to a rapid bending vibration which it must be able to withstand and remain leak-proof. You can not, however, reconcile your knowledge that rubber swells and loses its resiliency under the action of gasoline, with the simple fact that this feed line has done neither although it is constantly in contact with that rubber-solvent liquid.

If you were sufficiently interested to investigate further, you have learned that this feed line is not rubber, either natural or synthetic. You have learned that it is composed of a substitute for rubber, a product of the chemical laboratory; that this product is called Thiokol; that it has unusual resistance to absorption of any liquid, and a practically perfect resistance to the deteriorating effect of gases, oils, and acids; and that it is weather-proof, sun-proof, and apparently age-proof. You have found, further, that the process of preparing the crude Thiokol is extremely simple; and above all that, for many particular uses in industry, this new rubber substitute is superior to the vegetable product because of the characteristics noted. Its use as the material for making a gasoline-carrying pipe is, therefore, no longer puzzling.



Photographs by Aiklee Studio

The chemicals composing the new rubber substitute are mixed in a large vat and washed with many changes of water until all foreign matter is removed

Industry has for many years felt the need for a "synthetic rubber" or a superior rubber substitute, and many scientists have worked diligently to develop such a laboratory product. The layman is mainly interested in the rubber in his tires and so long as these may be purchased anywhere, he is not particularly concerned. With industry, the story is different, for rubber has proved indispensable in many industrial processes, for use in bumpers, engine suspensions, abrasion- and corrosion-resistant coverings or linings, shock absorbers, gaskets, packing, and many other such items of daily convenience or comfort or efficiency. The extent to which it has been used, however, is of small consequence beside the possibilities that can be seen for it if only the deficiencies of natural rubber could be overcome. Some success has been achieved in this direction but it is doubtful whether full success will ever attend the scientists' efforts. If so, that desirable result is still possibly years away.

It is common knowledge that the United States uses more natural rubber than all the rest of the world combined. Furthermore, it is no secret that, except for a negligible quantity, this rubber must all be imported from plantations under the flags of other nations. Because of this fact and because, in the event we should be drawn into a war,

After each washing, a yellow powder settles to the bottom of the vat. A pipe section is then lowered into the vat and the surface liquid is siphoned off

our supply of rubber would be vital to the continued operation of the nation's industries and to our movement of troops, supplies, and our mechanized army, attempts have been made to provide the country with a home supply of both natural and so-called synthetic rubber. It is our hope to become independent of foreign rubber both in war and peace time.

The late Thomas A. Edison experimented for years in the attempt to obtain natural rubber from the goldenrod and succeeded to some extent before his death. Before finally concentrating his efforts on this "hay fever" weed, Edison canvassed practically the entire list of indigenous plants and found rubber in many of them but not to the extent that he found it in goldenrod. In our southwest, the guayule plant has for years supplied a small quantity of rubber and more intensive cultivation of the plant recently has shown that this production can be appreciably increased. It has been found that, fortunately for us, guayule does not have to be harvested regularly but the plant itself will act as a warehouse for its latex which may be drawn on in an emergency. Though this supply is relatively small, it would help greatly should occasion demand an additional supply.

INDUSTRY desires, however, not so much a home source of natural rubber as a synthetic variety or a substitute—a laboratory product—that will have the unique attributes of hevea rubber and yet be superior to it in respect to corrosion, oxidation, and the like. Of the few partially successful attempts to satisfy this demand, Thiokol is one of the two which have, according to our observation, any real commercial significance. (See also page 42, January 1932 SCIENTIFIC AMERICAN.)

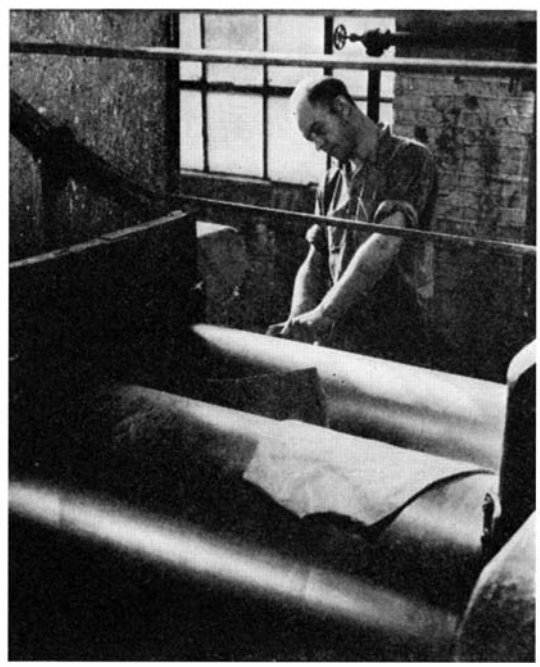
Eight years of intensive laboratory work have gone into the development of Thiokol, and already it has been used in some industries for two years. In this time it has proved its superiority as a tough and resilient substitute for natural rubber, and many new applications are daily being found for it. When the automobile manufacturer, mentioned above, developed his new engine mounting, he used Thiokol for his gasoline feed line, and in this service it has been eminently satisfactory. In mechanical goods of this sort, Thiokol is superior and its manufacturers are concentrating on that field.

Thiokol is produced and delivered to rubber goods manufacturers in the crude form, to be processed by them. In this form it is a yellow gum and is sold by the pound or the ton. The "curing" and processing by the rubber manufacturer involves practically no change in the equipment now used with ordinary rubber. Hence a manufacturer does not have to add either special equipment or specially trained labor.

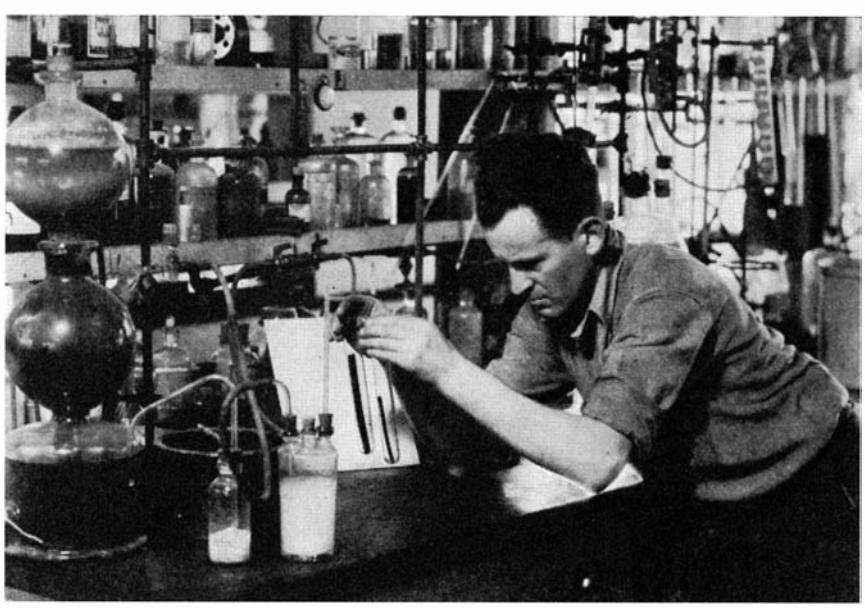
Crude Thiokol can be made from the ingredients in a few hours if necessary, the interaction of the olefin and the polysulfides, of which it is composed, being very rapid and simple. All the ingredients are common, and are of domestic manufacture.

The polysulfide is made in a large vat by mixing caustic soda and sulfur. After this first mixing, the polysulfide is run into another mixing vat which has a beater attachment, and ethylene dichloride is added. The proportions of these chemicals and the duration of the interaction are, of course, the basis of the Thiokol patents. The resultant fluid is then drawn into a third vat and allowed to stand until a yellow powder settles to the bottom. The surface liquid is then siphoned off and more water is added. This process is repeated a number of times until all the impurities have been removed. Commercial hydrochloric acid is added until a methyl orange solution, previously added, changes from orange to pink. The solution coagulates almost instantly into a yellow gum which is then rolled until all the water has been squeezed out. The Thiokol is then ready to ship.

There is at present one limitation to the use of Thiokol. It has a characteristic, somewhat unpleasant odor which makes it at present impractical for use in many of the intimate things of daily home life.

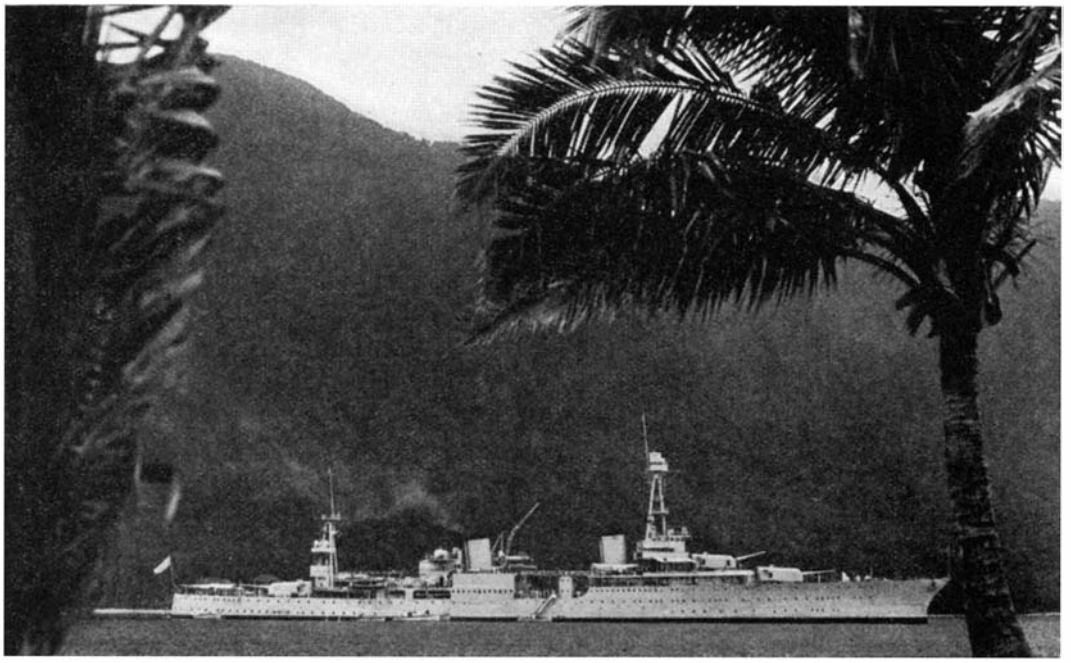


After the final washing, the Thiokol is run through heated rolls to remove surplus water



When a piece of rubber and a piece of Thiokol, identical in size, are placed in test tubes filled with gasoline, the rubber absorbs gasoline and swells

Rubber has been made having a maximum tensile strength of 4500 pounds. Thiokol's maximum strength at present is about 1300 pounds. However, when rubber is soaked in gasoline, oil, or similar substances for a day or two, its tensile strength drops to less than 500 pounds, while under the same or even more extreme conditions of soaking, Thiokol is unaffected. Rubber also soaks up such liquids and swells, so that serious manufacturing problems are created especially where oils and chemicals are used. Thiokol, furthermore, will adhere to practically anything and therefore it solves a problem that has prevented the use of rubber in many cases where manufacturers would like to take advantage of its unique qualities but can not.



One of our 10,000-ton cruisers, the U. S. S. *Chicago* at the Naval Station, Tutuila, American Samoa

WHY BUILD UP OUR NAVY NOW?

HAVING been granted complete naval parity with Great Britain at the Washington and London conferences for the limitation of naval armaments, we have, since the London Treaty was signed in 1930, endeavored time and again to pass legislation enabling us to build a "treaty navy"; that is, one which fulfills in all respects the conditions of both treaties. Yet, despite widespread agitation for the adoption of a plan for building our navy, the first definite step toward attainment of the tonnage allowed us was taken in May when the Senate passed the Hale bill for necessary construction, replacement, and modernization. This bill, however, is purely an authorization measure and should the House of Representatives, to which it must now be referred, also pass it, the appropriations necessary to put it into effect will have to be voted later.

The Naval Affairs Committee of the House has in its charge at present the Vinson bill under which construction of a parity navy would be spread out over a period of 10 years. Proclaimed widely as the most economical plan, it authorizes construction of three aircraft carriers, nine six-inch gun cruisers, 85 destroyers, and 23 submarines —a total tonnage, largely replacement, of 303,200 tons. The annual cost of this program would be about 62,000,000 dollars.

In addition to these two bills, the General Board of the Navy has also prepared a program. This plan or either one of the other two would accomplish the same result. All three take a long view of the problem and outline plans for a continuous building program instead of the haphazard year-by-year scheme we have recently followed.

UNDER any one of the three, we would do much toward regaining our naval status during the next few years; instead of hazarding our national rank as a world power and slipping to a position of fifth in naval strength by 1936, as it has seemed that we were about to do, we would take our natural place on an equal footing with Great Britain. If, then, we desire further disarmament, we will have a bargaining tonnage that will speak stronger than all the lip diplomacy in the world, a tonnage that will help the cause of disarmament more than all the arguments we could possibly advance.

As pointed out in our May issue, our Navy has a distinct value during peace time because of the tremendous benefits it confers upon industry, but its primary cause for existence is to protect our shores, our overseas possessions, our seaborne commerce, and our citizens abroad in backward countries. This is the controlling reason for a fleet, and the experience of Germany during the World War indicated that the second best fleet in the world may be as helpless as the smallest. So we *need* a fleet second to none.

The cost of such a navy will never be small, particularly in our country where we boast of our well-paid labor. It will, however, be worth all it costs by preventing possible wars and enabling us to carry the war to any bellicose nation that deliberately forces us into war as Germany did in 1917. Furthermore, much of the cost of a navy can be properly discounted because shipbuilding, of all of our industries, returns most of the dollar in wages to the small taxpayers who, in the end, support our Navy. Shipbuilding was the first American industry. It has had its golden eras and some very bad ones. Today it is at a low ebb, and not the least of the benefits of a proper naval program

	United States	Great Britain	Japan
	Tons	*Tons*	*Tons*
Capital ships	525,000	525,000	315,000
Aircraft Carriers	135,000	135,000	81,000
Cruisers A	180,000	146,800	108,400
Cruisers B	143,500	192,200	100,450
Destroyers	150,000	150,000	105,500
Submarines	52,700	52,700	52,700
Total	1,186,200	1,201,700	763,050

Table I: **Treaty allowances in standard tons for the three naval leaders**

would be the impetus it would give to a truly indigenous American enterprise —shipbuilding—that, in turn, would assist practically every industry in our country.

While on first thought the present might not seem a good time to start a building program because of the Treasury deficit, certainly no government expenditures such as for roads, public buildings, or harbor improvement could benefit as many industries as would a proper naval program.

In this connection it may be worth noting that although the World Peace Foundation reports that the United States spends considerably more for its navy than does Great Britain, the Foundation's figures do not take into account the many differences resulting from the relative purchasing power of the dollar, such as cost of labor, cost of material, pay of personnel, and other factors, all of which reflect unfairly against the United States in comparisons of total expenditures between this country and foreign powers. Examining naval budgets for the fiscal year 1931, that of the United States is found to be 382,424,000 dollars while that of Great Britain was 273,000,000 dollars. From this it will be seen that the ratio of naval budget to national income is by far greater in the United Kingdom than in the United States; the per capita cost of the navies during 1930 amounted to $3.24 for the United States and $6.21 for Great Britain.

Of the expenditure under any plan for building the navy, practically every nickel would be spent within the United States, and about 80 percent of it would be spent on labor. To build a 10,000-ton cruiser requires at the laying of the keel about 300 men, and this force would build up to some 900 men at the time of launching 24 months later. A destroyer or submarine would be begun with about 150 men and this force would increase to a maximum of 500. A 20,000-ton aircraft carrier would require at its maximum some 2000 men.

The material that goes into a ship divides roughly into three classes. Class A is steel or iron that has had little conversion work, such as plates, shapes, sheets, castings, forgings, pipes, rivets, bolts, wire rope, anchors, chains, and boilers. Class B is steel or iron on which large conversion work has been done, such as main and auxiliary machinery, refrigerating apparatus, valves, and pipe fittings. Class C includes items with little steel or iron, such as various optical instruments.

THE cost of a modern ship may be divided approximately as follows: 40 percent within the shipyard on actual construction, all of which goes to labor; 50 percent expended for the purchase of the material and equipment used in the construction; and 10 percent required for transportation, taxes, and insurance.

The 50 percent expended for materials is directly distributed among more than 200 industries, and indirectly, practically every industry in our country shares in the building of a modern ship. It is almost as though each individual engaged in industry contributed of his labor to one of our ships, for 88 percent of the population of the United States lives in the states that are engaged in the shipbuilding industry.

To see exactly where our Navy stands at present, consider the accompanying tables and diagrams (all drawn approximately to the same scale). Consider also what we have done toward disarmament as contrasted to what other naval treaty signatory nations have not done; how we have neglected to build up to treaty allowances while others have built steadily; and how Japan, in particular, has been able to improve its naval ratios by having an actual fleet instead of simply prior treaty allowances.

Table I gives the treaty allowance in standard tons for six categories of combatant ships. The object of this self-imposed limitation is to avoid naval competition and reduce naval armament. It is the cornerstone of the naval agreement now existing between the three leading naval powers. It requires some amplification.

The capital ship tonnage represents a replacement value of 15 ships of 35,000 tons each for the United States and Great Britain, and 9 ships of 35,000 tons for Japan—a ratio of 5:5:3. Likewise the aircraft carrier ratio of 135,000-135,000-81,000 is in the 5:5:3 ratio.

In the cruiser categories, Class A carries eight-inch guns, and Class B six-inch guns; the settlement of the cruiser ratios was a complicated process and the United States may increase its total cruiser tonnage 15,500 tons if it will build only 15 eight-inch cruisers in-

TYPE	UNDERAGE						OVERAGE					
	UNITED STATES		GREAT BRITAIN		JAPAN		UNITED STATES		GREAT BRITAIN		JAPAN	
	NO.	TONS	NO.	TONS	NO.	TONS	NO.	TONS	NO.	TONS	NO.	TONS
CAPITAL SHIPS	15	455,500	15	473,650	9	269,070						
AIRCRAFT CARRIERS	3	77,500	6	115,350	3	61,270						
CRUISERS CATEGORY A	8	72,900	19	183,686	8	68,400	1	7,350			2	15,720
CRUISERS CATEGORY B	10	70,500	30	139,140	17	81,455			6	23,445	3	11,920
DESTROYERS	69	81,450	33	42,211	79	95,685	186	190,620	127	133,170	18	16,000
SUBMARINES	65	38,220	48	49,919	67	70,973	16	8,030	11	6,610		
TOTAL	170	815,970	151	1,006,856	183	646,853	203	206,000	144	163,225	23	43,640

Table II: **The three navies as they actually stand today. Japan's fleet is the most modern**

TYPE	UNITED STATES		GREAT BRITAIN		JAPAN	
	NO.	TONS	NO.	TONS	NO	TONS
CAPITAL SHIPS			2	67,400		
AIRCRAFT CARRIERS	1	13,800			1	7,600
CRUISERS CATEGORY A	18	172,900	15	144,260	12	108,400
CRUISERS CATEGORY B			7	47,000	8	52,475
DESTROYERS	11	16,500	45	61,441	63	89,016
SUBMARINES	6	11,970	27	34,814	42	59,871
TOTAL	36	215,170	96	354,915	126	317,362

Table III: **Ships built, building, or appropriated for since the Washington Treaty in February, 1922. The United States has lagged behind considerably**

stead of its original program of 18.

At the London Conference, Japan obtained a slight increase in her total cruiser tonnage and a considerable increase in the Class A category. In addition Japan obtained an increase from the 5 to 3, to a 10 to 7 ratio in destroyers, and was allowed a complete 5 to 5 ratio in submarines, an increase of 40 percent—a great diplomatic victory for that country. While Great Britain and the United States wrangled over the advantages and disadvantages of eight-inch and six-inch gun cruisers, Japan gained in cruisers, destroyers, and submarines. Japan obtained these concessions by entering the conference with ships in these categories, already built or building, and simply refusing to scrap them. Rather than wreck the conference, the British and American delegations were obliged to meet Japanese demands.

TABLE II shows the three navies as they actually are today, divided into underage and overage ships—that is, into ships fit for the first line and those less fit but still serviceable. This table indicates the result of our 10-year naval holiday; only in capital ships are we up to our ratio and three of these are undergoing modernization made necessary because we scrapped our latest and best capital ships in 1922, instead of scrapping our *Delawares* and *Utahs*. It is to be noted that since 1922, the comparatively little scrapping that has been done by Great Britain and Japan was applied to old ships.

This table indicates that Japan has less than 44,000 tons of overage ships. It also reveals the rapid passing of the war-time destroyer strength of Great Britain and the United States; and finally it makes very plain our deficiency in aircraft carriers. We are about four to three to Japan, while Great Britain has an advantage of three to two over us.

Table III gives the tonnage of ships built, building, or appropriated for since the first limitation treaty in 1922. This table shows clearly why the United States is so far behind her position. After 1922 the Administration assumed that naval competition had ceased in all categories. Actually it was only suspended in capital ships, and the building programs in Japan and Great Britain in cruisers, destroyers, and submarines proceeded at a rapid pace.

Our first effort to lead the naval powers to disarmament by example failed. President Coolidge recognized this fact and towards the end of his administration laid down a program of 10,000-ton cruisers with eight-inch guns. But meanwhile, as shown by the table, Great Britain had undertaken 96 ships, and Japan 126, while we had undertaken only 36.

This table also explains why the other delegates at London conceded parity to Japan in submarines and increased her ratios in cruisers and destroyers. In 1922 our program of capital ships was nearing completion, and our war-time destroyers were still modern so that we were actually superior to Great Britain and had a two to one superiority over Japan. In London the situation was reversed: Japan had relatively outbuilt Great Britain, they both had outbuilt the United States, and Japan used her advantageous position to increase her ratios.

It should be emphasized that Great Britain and Japan were entitled to build as many cruisers, destroyers, and submarines as they pleased, for the Washington Conference did not apply to those categories. Our government realized that, but in the hope that our example would influence the other two states, delayed our program for several years, with the result already indicated.

Table IV is the table that should interest us most, for it shows the remedy for our present naval inferiority. We need, by 1936, 118 vessels of almost 300,000 tons, while Japan has practically completed her program already and has less than 22,000 tons to build. Great Britain has a large cruiser and destroyer tonnage to replace and needs one more aircraft carrier.

OBVIOUSLY it would have been more advantageous to have built currently with Japan and Great Britain but a large section of our people sincerely believed that we could lead the world to naval disarmament by example. It is now plain that the world is not yet ready for naval disarmament. It is of no avail to blame any person or organization. The remedy lies in our own hands. We can speedily regain our position and easily maintain it, simply by a rational continuous building program.

Such a program will cost money but it is worth all it costs. If, however, we are unwilling to spend the money, we should frankly say so and stop attending conferences when we do not intend to build our ratio, and only make use of the conference to endeavor futilely to retard the building programs of two countries who are wise enough to realize the value of sea-power and patriotic enough to pay the bill.

TYPE	UNITED STATES		GREAT BRITAIN		JAPAN	
	NO. (APPROX.)	TONS	NO. (APPROX)	TONS	NO. (APPROX)	TONS
CAPITAL SHIPS	NO PROVISION IN TREATIES					
AIRCRAFT CARRIERS	3	33,200	1	19,650	1	12,130
CRUISERS CATEGORY A	NONE		NONE		NONE	
CRUISERS CATEGORY B	7	73,000	10 TO 15	106,220	NONE	
DESTROYERS	85	133,500	57	85,699	6	9,209
SUBMARINES	23	25,650	11	11,491	NONE	
TOTAL	118	287,330	79 TO 84	223,060	7	21,339

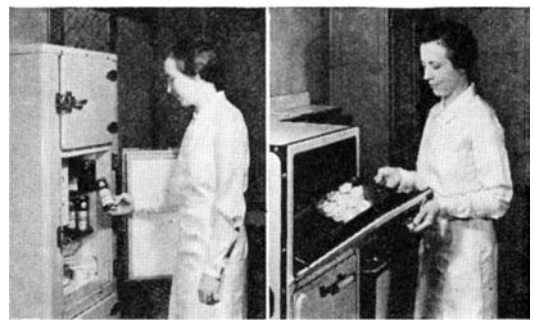
Table IV: **The tonnage that has yet to be built to bring all three navies up to full treaty allowances before the final expiration of the naval treaties in 1936**

THE BIG BUSINESS OF BISCUITS

Delivered to the Home Ready for the Oven

HOW modern refrigeration and motor trucks are bringing canned biscuits, ready for baking, to tables everywhere in America, is one of the latest economic developments of our day. There may not be a pound of flour in the house, the wife may not even know how to cook, she may be a timid bride, but she need have no fear for her biscuits.

The story goes back to Bowling Green, Kentucky, where L. B. Willoughby, a master baker, had won local fame because of his wholesome biscuits —buttermilk biscuits made from an old recipe which had been in the family for years. Pleased customers kept Mr. Willoughby busy, but, unknown to them, he was mixing a great idea with the flour and other ingredients which went into his wares. After years of experimenting, he was successful in preparing a dough which would keep its original flavor and wholesomeness under proper refrigeration, and could be marketed, cut into biscuit form, ready for baking.

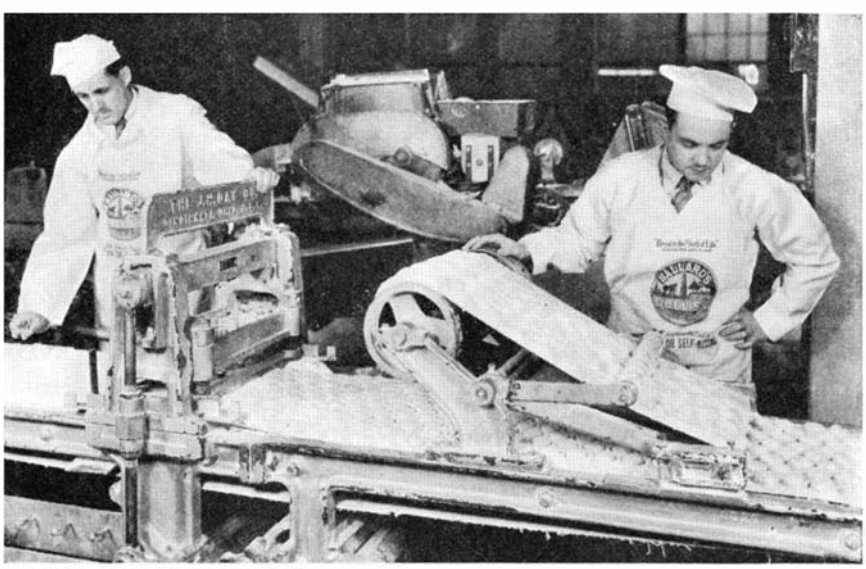


These biscuits come in cartons and are kept in the refrigerator until ready for the hot oven

The essential secret of the biscuits is that they must be kept constantly at a temperature of from 55 to 60 degrees from the time they leave the mixing rooms until they are ready for the oven. Under former conditions, without refrigerated trucks, this temperature requirement would have confined the distribution of the ready-mixed biscuit dough to a limited area.

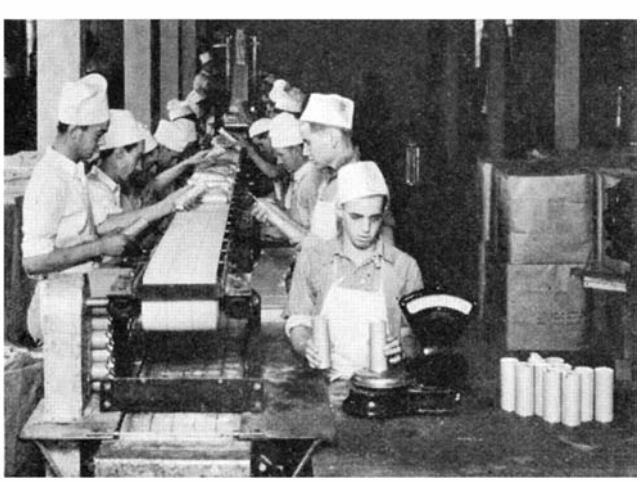
The composition of the biscuits is not available for publication but buttermilk is an active constituent. The dough is mixed in the ordinary way and is made in sheet form in a machine called a "sheeter" which consists of a pair of rolls that do the duty of the old-fashioned rolling pin. The sheet of dough is then dusted with flour and passes under the cutter. From this unit comes biscuits and scrap. The cut pieces pass on to a carrier belt while the scrap is removed in one piece and is reworked. The biscuits are wrapped in impervious paper and foil and are inserted in fiber cartons.

At this point refrigeration enters the picture. The cartons are kept in a huge refrigerator until wanted for shipment; then they are placed in boxes, sealed, and sent on their way to grocers in refrigerated trucks. The grocer should keep the biscuits in a refrigerator until sold and the biscuits should be used within a reasonable time. Both plain and whole-wheat biscuits are obtainable. One and one half million biscuits are shipped out daily from the Louisville plant and it is believed that the business is only in its infancy.

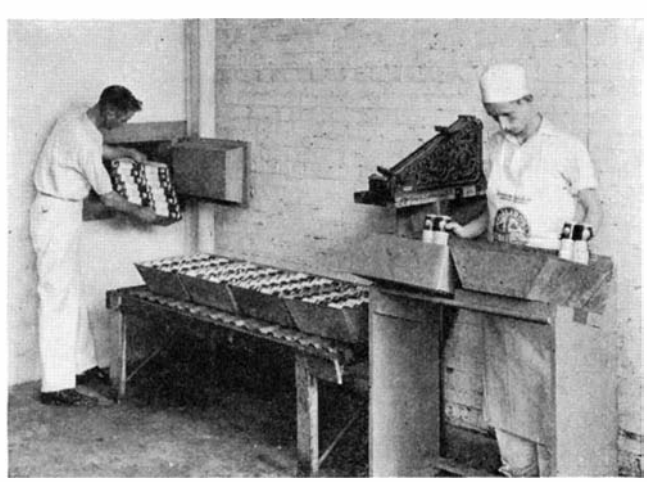


All photos courtesy Ballard and Ballard

The "sheeter" forms the sheet which passes under the cutter; the biscuits are carried along automatically on the belt while the scrap is removed in one piece



Putting the wrapped biscuits in the fiber cartons as they come down the carrier belt. Weight is constantly checked



The biscuits are taken out of the large refrigerator, packed, and then shipped by refrigerated motor truck

IN the sense that it deals largely with the more philosophical aspects of cosmology, the present article has much in common with articles by Hiram Percy Maxim ("What Is It All About?") and Sir James Jeans ("Watching the Creation of the Stars") published in the last three numbers of the SCIENTIFIC AMERICAN. In a sense cosmology is a super-science because it deals with entities of greater vastness and grandeur than any of the other sciences, not even omitting astronomy. Astronomy and astrophysics deal mainly, in fact only, with practical, immediate research problems in that relatively limited part of the universe which existing telescopes can reach, while cosmology far transcends even this, dealing largely with entities and concepts of the very greatest magnitude. The great cosmologists, Einstein, de Sitter, Lemaître, Jeans, Tolman and others, are working on these immense problems and it is believed that the principal reason their work interests most readers is certain of the more philosophical, rather than the purely physical, implications of it. For example, what intelligent man does not ask himself what started so vast a world, how it is kept running, whether it is eternal, and especially whether it has any definite meaning or purpose? Only the most matter of fact (or others who have not yet looked above their feet) have failed to discover the import of modern cosmological science. By plugging away at these problems man may some day be able to answer some of these questions—scientifically.

The author of the accompanying article is a clergyman, yet his article is one of the eight contributions made to the recent British Association for the Advancement of Science Discussion on the Evolution of the Universe. Why was a bishop chosen by men of science to sum up and conclude the oral arguments of leaders like Jeans, Lemaître, de Sitter, Eddington, Millikan, Milne, and Smuts? The Bishop of Birmingham was educated at Cambridge as a mathematician, in which science he took honors, and being himself a scientist as well as a clergyman he is well able to take care of himself among scientific men of that very high rank. Would that there were others in larger numbers with this same breadth of view.—*The Editor.*

THE EVOLUTION OF THE UNIVERSE*

By THE RIGHT REVEREND E. W. BARNES, Sc. D., D. D., LL. D., F. R. S., F. R. A. S.
Bishop of Birmingham

I WILL begin by briefly recapitulating the theory of the evolution of the universe in the form in which, as I understand, it at present exists.

In the beginning, a large unbounded finite three-dimensional universe with space of very small positive curvature was filled with highly diffused matter of very small density. The matter began to aggregate into masses of approximately equal size, spread fairly uniformly throughout the space; and the whole space began, at some epoch or another, to expand. The masses attracted neighboring matter and somehow acquired velocities of rotation which increased as the matter in them condensed. Finally, incredibly vast bun-shaped aggregates, spinning too quickly for the stability of their outer edges, began to throw off drops, as it were. The drops congealed into suns, and ultimately the aggregates became the spiral nebulae which now exist. Each of them, apart from possible central regions of diffuse matter, consists of thousands of millions of stars. Our sun is a star of no particular importance, belonging to a spiral nebula or group of nebulae called the galactic universe. That universe came into existence some five million million years ago.

Since they first existed, stars in the various universes have moved aimlessly under the influence of their initial velocities and mutual attractions. Periodically, but rarely, at intervals of tens or hundreds of millions of years, collisions between suns in the various universes have taken place and planetary systems have been born. So the earth came into existence some two or four thousand million years ago. Thus ours is quite possibly one of the youngest planetary systems in *our* universe. On the cooling earth primitive forms of life appeared at least a thousand million years ago; and gradually, by a slow evolution, more highly developed living organisms arose. Finally, about a million years ago, sub-men emerged from a group of anthropoid apes.

IF I personally am critical of this picture, I plead that we must not confuse speculative possibility with satisfactory demonstration. I am concerned that we do not give arguments to obscurantists, who claim that the scientific theories of one generation are usually repudiated by the next. So I would begin by emphasizing that in the group of possibilities and probabilities just outlined there is much less certainty than, say, in the facts upon which Darwin rested his conclusions when the "Origin of Species" was published 73 years ago.

I need not refer to the prejudiced opposition by which Darwin was assailed. Of course, his triumph has been signally complete. But others before him had put forward theories of the evolution of terrestrial animals. What Darwin did was so to accumulate and arrange biological facts, that experts were convinced that evolution by the mechanism of natural selection had produced from primal organisms the vast range of living things upon the earth, including man himself. Since Darwin wrote, further investigation and discovery have confirmed his insight. Some of his subordinate opinions were erroneous; but his main scheme stands intact because his facts were correct. All fresh geological and embryological investigation confirms the conclusions on which he rested. The scanty remains of primitive man that are discovered from time to time accord with expectation; and such statistical investigations as those in R. A. Fisher's recent volume are a triumphant vindication of the potency of natural selection.

It is worth while recalling these facts when we consider the picture of the evolution of the universe which has emerged from recent work. I personally doubt whether the time has yet come for an astrophysicist of genius to write a book which shall in its own sphere rival the "Origin of Species." We can point to a few new facts and to considerably more new (and occasionally discordant) theories. Out of them there has emerged the present picture, immensely exciting, but by no means certain.

What of it can we regard as certain? First of all, there is no reason to doubt the existence of island universes. Such form that vast, fairly regular distribution of spiral nebulae through the depths of space which is revealed by photographs taken in the great telescopes. We can say with fair certainty that our own galactic universe is either a single spiral system or an aggregate

*Courtesy of *Nature* (London)

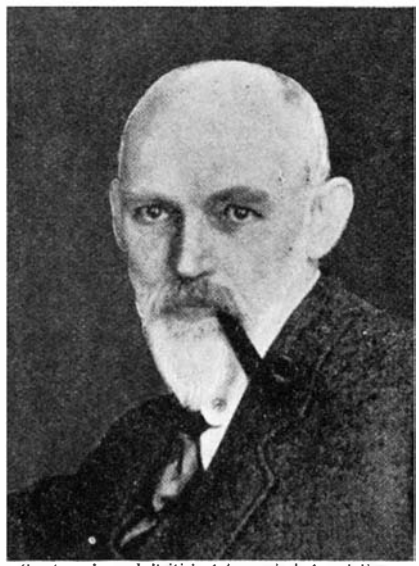
of several such, each analogous to millions of others with which space is strewn.

Secondly, I would say that it is fairly certain that our space is finite, though unbounded. Infinite space is simply a scandal to human thought; and, though we must not assume that the universe was made that man might understand it, the alternatives to finite space are incredible. We cannot accept the idea of island universes succeeding one another indefinitely as we pass in imagination through the depths of space. Such a distribution does not accord with a Euclidean-Newtonian gravitational scheme, for it would lead to infinite gravitational potentials. Neither can we with equanimity think of a vast finite group of universes forming a sort of island in empty space. Ultimately such a group ought, one would surmise, to aggregate into a single mass. But in Riemannian spherical space we can have a finite and uniform distribution of universes, inasmuch as such space is unbounded so that every point is related to the whole as is every other point. Finally, there is no fact of observation to set against the belief that space has a very small positive curvature.

THIRDLY, I think we must accept as highly probable Jeans's hypothesis that in the stars matter is actually destroyed as protons and electrons unite to form radiation. To this conclusion, however, we are driven by failure to find any satisfactory alternative explanation of the vast output of energy by the stars. If, however, their lives were not to be measured by so long a period of time as millions of millions of years, the necessity for assuming the actual destruction of matter would not be so great.

Consider now some of the uncertainties and difficulties which belong to the present scheme. First of all, of course, there is the insoluble difficulty of infinite time. No man of science will postulate a supernatural intervention, a stirring of the uniformly distributed matter filling space with which in imagination the present scheme begins. Yet in default of such a beginning, we must imagine an infinite regress, a never-ending sequence of alternate periods of world-building and world-destruction, the rise and fall of universes without end. In comparison with such a past the future is perhaps less perplexing, though it is not very satisfying, because the second law of thermodynamics seems to necessitate an end when all energy will have so run down that nothing happens anywhere to break a deadly uniformity.

Of course, we can escape from the difficulties caused by infinite time if we accept the opinion entertained by some philosophers that time is not real. With them we may hold that the notion of time is due to the nature of our perception. If we accept such an idea, we can assert that consciousness in its passage through the space-time continuum meets but does not cause events. It then follows, however, that all our fancied activities are an illusion. Against any such belief we must put what surely is our constant and invariable experience. We *have* a measure of freedom of will. Labor and struggle *are* real. We *can* get nearer truth and overcome evil as we strive for goodness. Thus I am forced to conclude that the time-process must be real. Yet, unless time is an illusion, or unless alternatively the cosmos had a beginning in time, any picture of the evolution of the universe must fail to satisfy.

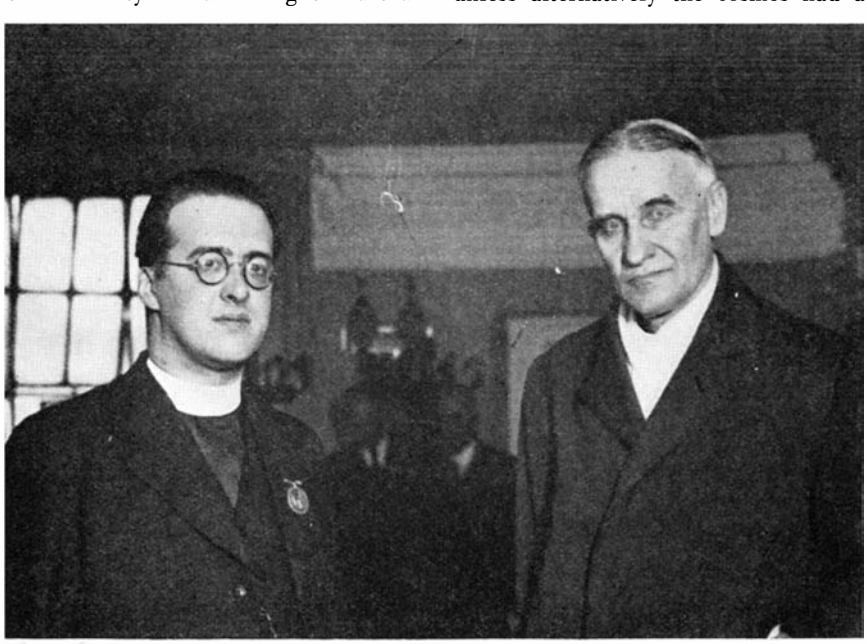


Courtesy *Journal British Astronomical Association*

Willem de Sitter, the Dutch cosmologist whose views with regard to "curved space" Einstein has adopted

Let us take it, however, that the primal mist that filled all space in the beginning aggregated into masses of roughly equal size in a finite universe and that these masses slowly began to condense and revolve. Whence came their rotation? To this question I can find no satisfying answer. Let us ignore the difficulty. Out of condensation and rotation came the spiral nebulæ, the universes of thousands of millions of stars with which space is strewn. Obviously, with relatively few exceptions, the great nebulæ are built to a common pattern. They are results of rotation, and the picture of vast rotating lenticular masses throwing off stars, like drops at the edge of a fly-wheel, satisfies the imagination. But why are the arms of the spirals so short? We should expect arms which curl repeatedly around the central nucleus. None such exist; and yet there is apparently no ejection into space of early-born stars to account for the disappearance of the coils of stars that ought to be visible.

THE different chains of reasoning by which Jeans has been led to assign a period of millions of millions of years for the age of our universe seem to me to demand respect. I doubt whether they are conclusive. But I wish that there were certain knowledge of the development and decay of typical stars. Theories abound. Some are magnificent in the ingenuity and in the intellectual power which have gone to their making. But the final theory of stellar evolution has not emerged. I confess, moreover, that I am by no means happy with regard to the expanding universe; and I doubt whether Doppler's principle is rightly applied to measure the velocities



Science Service

Two clerics as scientists, the Abbé G. Lemaître (left) of Louvain, Belgium, exponent of an unstable (expanding) universe before its astronomical proof was available, with the Bishop of Birmingham, at the recent London symposium

of recession of the great nebulæ. It is not improbable that the reddening of their light is due to other causes. If the great nebulæ are moving away as fast as is suggested, we are lucky to be living at an epoch when we are able with our telescopes to see them at all. Moreover, the Friedman-Lemaître equations give contraction as an equally possible alternative to expansion. May it not be that a velocity of approach is masked by some other effect? A universe that was continuously contracting would have a snug end. Steady and continued inflation, either of a currency or of a universe, is disquieting.

It is, however, when we come to the formation of planetary systems that I feel especially uneasy. The current theory is, as I have said, that the earth and its associated planets arose from the encounter of our sun with a wanderer which came so near as to disrupt it some few thousand million years ago. If the theory be true, planetary systems must be rare and therefore consciousness, as men know and possess it, is rare. In fact, the existence of consciousness, when it occurs, will be the by-product of an accident. We are then apparently forced to conclude that the universe was not created with the primary object of producing beings in whom mind should lead to spiritual excellence.

THERE is, of course, no reason why consciousness should be associated with animals such as ourselves who represent transformations of carbon compounds at temperatures between the boiling and freezing points of water. It might, for all we know to the contrary, be associated with changes in the ionization of atoms or with the disintegration of their nuclei at temperatures of hundreds of millions of degrees. But of any such bases for the appearance of mind we have no knowledge. What we do know with certainty is that throughout the universe the raw material of which it is made is fairly uniform. The matter in distant stars is the same as that which exists in our own sun. We must then assume that there are planetary systems in distant island nebulæ, and that on some of them conditions resemble those which exist on our earth. So life, as we know it, must be distributed throughout the universe; but, if the collision theory of planetary origins is correct, the distribution is astonishingly sparse.

I do not, of course, suggest that there are human beings on other planets. The direction of the physical and physiological evolution of living things upon our earth would seem, if we can judge by the geological record, to have been somewhat erratic. Particular mutations coincided with particular conditions of environment to determine the direction of change at any instant. But, throughout the known geological process there has been large-scale progress, a possibly unsteady but quite definite development of mind. In the possibly very different living organisms of other planets there will have been a progressive development of mind. Our physical structure matters little in comparison with the kind of consciousness which it carries.

We can then, as it seems to me, assume the existence throughout the universe of conscious beings. If it be true

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Professor Tolman of the California Institute of Technology, like the Abbé Lemaître, is a mathematician

that our earth and all planetary systems similar to our own originated in a chance collision of suns, life elsewhere must be as a rule unimaginably more developed than with ourselves. Also planets carrying living organisms must be incredibly rare. After a life history of five million million years our galactic universe will have but one sun in a hundred thousand with satellites which can carry life. Such extravagant world-building for such meager results leaves one dubious as to whether the theory is correct.

In defence of such doubts as are forced upon me I might point out that the origin of our moon, with its exceptional density and massiveness, has not been finally settled. The theory that it was broken from the earth when the latter was mainly liquid owing to a chance "resonance" phenomenon Jeffreys, in a recent paper, deems untrue. Even present estimates of the age of the earth, in so far as they depend on the rate of disintegration of uranium, puzzle us because we do not know why there should have been any uranium in the earth at its birth. Thus I personally should not be surprised if new facts were forthcoming to give some other explanation of the existence of planetary systems. I suspect that such systems are much more numerous than is at present believed.

I need scarcely emphasize that the issue raised by the relative frequency of planetary systems is of great philosophical importance. From Judæa, through the Christian church, has come a belief in ethical theism which has been a strong and ennobling influence in European civilization. To-day such belief rests upon the conviction that we can only explain the universe by assuming that it is due to creative thought and will, associated with purpose and plan. Such purpose appears most clearly on earth in the progressive development of mind, which has ended in the recognition of moral values by humanity; and the religious outlook of many of us is determined by our belief that God has thus created man for His service. But, if consciousness should be proved to be but a rare accident of a vast, otherwise aimless, universe, such belief in God would be encumbered by a new perplexity. I may add that the belief would not disappear, since we should still have to explain why man has been created with the conviction that he must be loyal to goodness and truth.

SUCH philosophico-religious speculation is, however, premature. We need more facts and, that we may obtain them, we need new instruments of greater power and precision. The interferometer, we may hope, points the way to instrumental triumphs in the future. If only an instrument could be invented which should enable us to determine whether stars, within, say, a hundred light-years' distance, have planetary systems attached to them! We should then know whether any of the few thousand stars near the sun have planets on which life may conceivably exist. If even one such system were found, the present theory of planetary origins would collapse.

Failing any such invention of a super-telescope, there remains the possibility of wireless communication. As I have already indicated, I have no doubt that there are many other inhabited worlds, and that on some of them beings exist who are immeasurably beyond our mental level. We should be rash to deny that they can use radiation so penetrating as to convey messages to the earth. Probably such messages now come. When they are first made intelligible a new era in the history of humanity will begin. At the beginning of the era the opposition between those who welcome the new knowledge and those who deem it dangerously subversive will doubtless lead to a world war. But the survivors, when they extricate themselves from the economic consequences of the peace treaty, will begin what we may correctly term a strenuous correspondence course. I should like to be living then. We might get a true understanding of the evolution of the universe.

TEN GREENWICH AVENUE —FOR LADIES ONLY

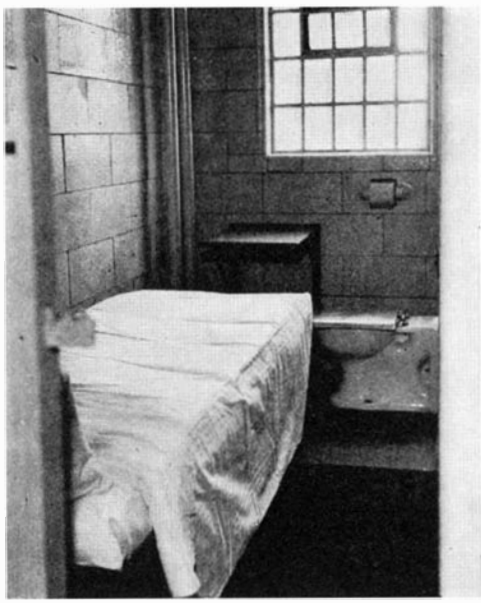
New York's new 12-story prison for women, entirely staffed by women

As we come away from "naughty Greenwich Village" we see at the corner of Tenth Street and Greenwich Avenue, New York City, a towering structure blending with the apartment houses of the neighborhood. Many couples have entered and asked for prices of apartments. Usually they beat a hasty retreat when they are informed that they are in the new women's prison. Every attempt (consistent with proper guardianship) is made to soften the rigors of imprisonment. It is known as the "House of Detention for Women" —some of them will be detained for a maximum of three years but they will be called "inmates". The building itself is the last word in penal practice and is the culmination of 22 years of study. The sky-scraper type of a building alone allows for proper classification and segregation. Above the office the entire building is staffed by women even to the doctors and the pharmacist. Each floor has a matron who is responsible for the safety of her charges. In the 12 stories there are accommodations for 410 women all in separate rooms, or "improved cells" as we might call them.

The prisoners are brought into the yard, detrained, examined by doctors, bathed, and booked. The "front entrance" is for visitors and here they find two electrically controlled gates breaking up a circular barred room. If a thug should attempt to make a jail delivery he would probably try to cut the telephone cord. This would be a futile gesture for it would only bring the strong-arm men from the police emergency truck. After the inmate is ready for her assigned place, she is sent up to the proper floor, but the elevator operator cannot open the door until the floor matron releases it. The erring one is conducted to her cell, which is provided with complete toilet facilities even to a metal mirror. There is nothing which can be torn loose for everything is fastened down. There are no bars, but the small paned window with a swinging portion admits air and a view of the busy strand of life below. Different dresses are provided for Sunday. Religious services are held in a modernistic chapel which has a novelty in the way of a turntable for altars and so on for the ritual of the Roman Catholic, Protestant, and Jewish faiths. The chapel is also used for movies and entertainments.

The cells are in aisles and each row is locked by the Adam system by which all the cells can be locked or unlocked at one time, but leaving in any prisoner who is to be left behind. Facilities are provided on the roof for exercise even in foul weather. Food is supplied to dining rooms on each floor from a central kitchen. Splendid hospital facilities are provided and when necessary the best medical talent in New York is available.

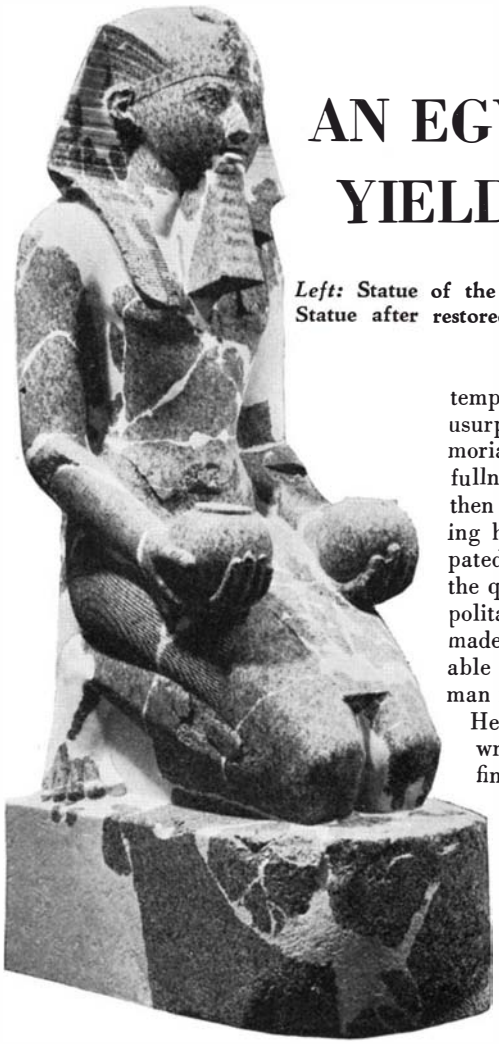
Much of the mass of detail was worked out by Third Deputy Commissioner of Correction J. F. Fishman to whom we are indebted for many courtesies.

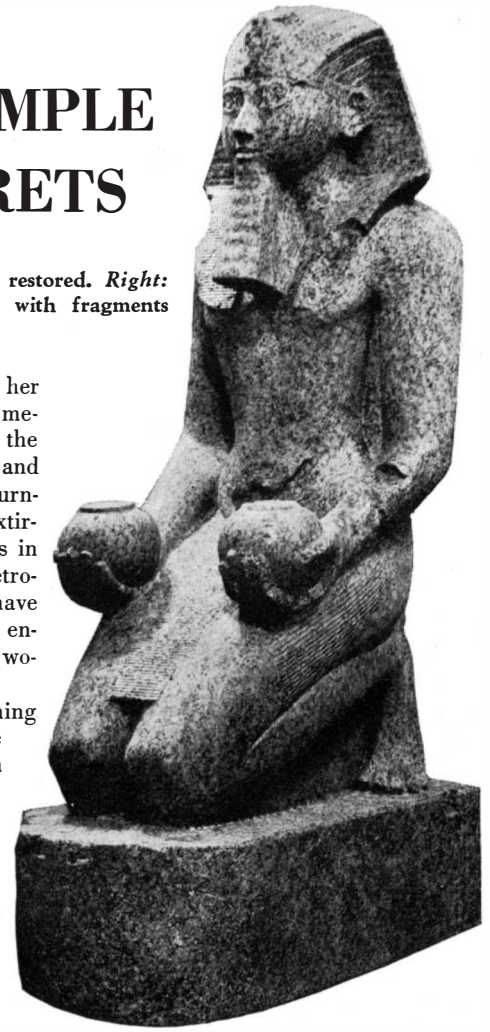


The doors of these daylighted cells can all be released from the corridor or a recalcitrant inmate may be left behind. All "rooms" are outside rooms in this skyscraper prison which embodies the latest in penology

Each cell has a window, not bars, with a swinging section for air and a glimpse of the forbidden world. Complete toilet facilities are provided, even to a metal mirror. There is a change of dress for Sunday. All furniture is securely fastened to prevent any misuse

AN EGYPTIAN TEMPLE YIELDS ITS SECRETS



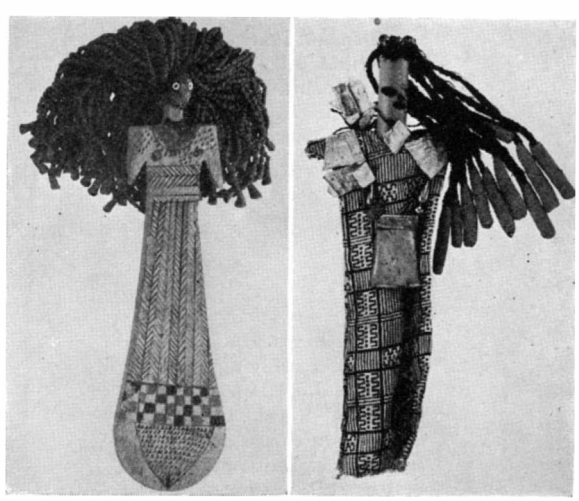


Left: Statue of the usurper queen Hat-shepsut as restored. *Right:* Statue after restored parts were colored to blend with fragments

THE annual report of the Egyptian Expedition of the Metropolitan Museum is always welcome because of the fascinating picture it presents of the life of an ancient people and intrigues of their rulers. The only trouble is that the story is a serial with the chapters one year apart. If you will refer to the January, 1929, issue of the SCIENTIFIC AMERICAN, you will find "Adventurous Archeology;" June, 1929, "Egyptian Vandalism 3400 Years Ago;" March, 1930, "An Archeologist-Detective at Work;" and in February, 1931, "Solving a 3400 Year Old Egyptian Enigma." These articles deal more or less with a remarkable woman usurper named Hat-shepsut. Her daughter married young Thutmose III, who was her nephew and stepson! Curious family relations these. The mother-in-law ran true to form and very kindly consented to act as regent during the minority of the heir to the throne but when he reached his majority she held on for 12 years longer. This indomitable mother-in-law, et cetera, was inordinately vain and built the temple of Deir el Bahri to justify her usurpation; the statues and other memorials depicted her as a man. In the fullness of time she passed away and then there was trouble. Without mourning her loss the irate son-in-law extirpated all memorials to her and it is in the quarries and dumps that the Metropolitan Museum archeologists have made their wonderful finds which enable us to see how this remarkable woman really looked.

Herbert E. Winlock, a most charming writer, continues the story of the finds and what was done with them in the latest bulletin devoted to the Egyptian Expedition. This is probably the last one which he will prepare for he has now been made Director of the great museum in New York.

Mr. Winlock says that while there are still some studies to be made and some plans to be drawn of the great temple of Deir el Bahri at Thebes, there does not seem to be much likelihood that any appreciable area of the temple remains to be excavated. Through parts of ten seasons the Metropolitan archeologists have worked there piecing together the temple's history bit by bit. Mr. Winlock says: "Altogether the temple must have been embellished with nearly 200 statues and sphinxes, if we count in the hundred or more sphinxes on the avenue. In the temple proper there were by the lowest estimate 22 sphinxes and 28 free-standing statues and at least 40 Osiride statues of limestone built into the structure. We had found the greater part of these last 80 pieces of sculpture, and as a practical matter we had started our task of restoration by sorting out the different materials, taking the granite fragments first and leaving those of sandstone and limestone until the last." An Osiride statue, by the way, is an effigy of a person in the guise of the god Osiris.



Left: Wooden doll 4000 years old. *Right:* A modern Nubian doll very like the ancient prototype

The work in the field has already been chronicled in the articles referred to and now the results of the labors of the archeologists are beautifully displayed, without crowding, in one of the galleries of the Museum. The work of restoration has been cleverly done but so long as these restorations remained visible the simple austere masses were confused and disfigured so in the end the restored parts were painted so that they blended in with the original. "Now, at first glance," says Mr. Winlock, "one sees

the statues as they were set up in the temple in Hat-shepsut's day. With a little attention one will discover the restorations, but lest there be any doubt, and to make our work doubly clear, photographs with all the new parts shown in white have been placed in the gallery." We present illustrations showing one of the statues before and after treating.

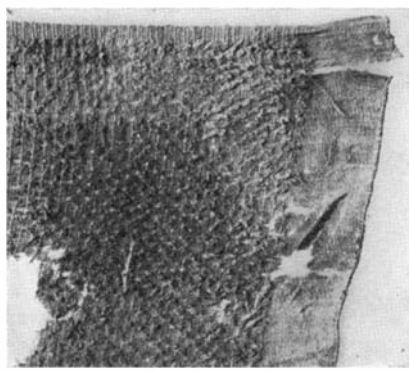
How archeological enigmas are solved is always interesting and Mr. Winlock gives a most interesting sidelight on one of the puzzles. He says: "A difficulty unexpectedly arose when we came to take a census of our fragments this year. While there were ten niches in the uppermost peristyle court of the temple, we found we had traces of more than ten statues, and many an hour was spent by all of us exploring every trace of column and wall for the position of another series of Osiride statues of which we had not suspected the existence. It was the very end of the season. We were packing up and hastily finishing those things which we ought to have done earlier, and it looked as though the puzzle of the statues was to be one important question for which we were not going to find any sort of answer.

"Our most pressing task was, for the moment, in the sanctuary of Amun. Wilkinson (the artist) was copying the unpublished scenes on the walls, and there were some fallen stones to be replaced and a cupboard, masked behind a Ptolemaic restoration, to be cleared and repaired.

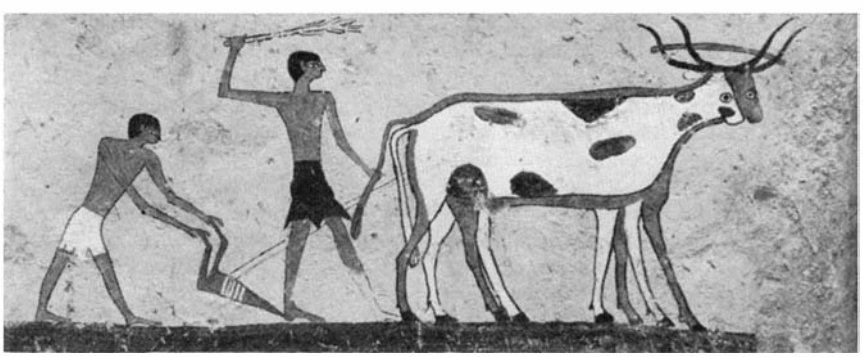
"The sun rises early toward the first of May, and far enough around to the north to penetrate right into the sanctuary (cut in the solid rock), and in order to see the mason's work in the best possible light I went up to the temple one morning before breakfast. It was a question that day of the stones fallen from the east end wall, and when I went into the chamber, usually black and gloomy, the sun was flooding the whole west wall and the fallen stones from the east wall, which lay on the floor. In that light a curious fact was to be seen. From the four corners of the room something had been cut away. The stones were still rough, both those in place on the west and the more easily examined fallen stones. Then I recalled a curious feature on the two side walls—on neither did the decorations go all the way into the corners. Something had originally masked them. Suddenly I remembered the niches outside in the peristyle with their traces of the cutout statues and their statue silhouettes in the blanks of the decoration, and the whole problem solved itself. Statues had been cut out of the four corners of the sanctuary, just as they had been cut out of the niches.

"A HASTY return to our storerooms cleared up all doubts. A new count established the fact that we had traces of exactly 14 statues—ten for the niches and four for the sanctuary. We had already noted how four of our statues differed from the others in having rose-pink faces, instead of red or yellow, and in having been varnished. In the sanctuary pink was used for flesh tints, and varnish had been applied over it. The sanctuary walls showed the thickness of the stone courses of the missing statues, and two of our heads had course lines at exactly the proper places."

The tomb of Djar, an 11th Dynasty tomb in a low hill beside the temple avenue proved to be a very curious document for the history of Egyptian art. Mr. Winlock says: "One must see the tomb of Djar to realize the monstrous ugliness with which the upper Egyptian surrounded himself in the generations between the fall of the Memphite kingdom and Mentu-hotpe's conquest of Egypt for the benefit of Thebes." We illustrate one of the paintings from the Djar tomb which shows the artist's conception of two cows yoked to the plough. He wanted to paint one of them red and one of them black and white, but he got their eight legs mixed up in ridiculous confusion. Towels very much like our bath towels of today were found in one tomb. Wooden dolls, possibly toys, which were found are not unlike modern dolls. The antique prototypes are no more uncouth than a modern doll bought last year at Amada in Nubia by Mr. Winlock for his daughter. Each thin plait of hair is tipped with a blob of clay like those which end every one of the coal-black tresses of many of the well-dressed Nubian women of today. The styles of Thebes 4000 years ago are still to be met with in Nubia.



Towels are actually 4000 years old. The surface was covered with knots



Two cows yoked to the plough. The local country painter made one cow red and one black and white, but he got their eight legs ridiculously mixed up

Clearing behind the lower porches of the temple of Deir el Bahri at Thebes during their rebuilding. A typical excavation scene where hand labor prevails

CONCERNING THE SHARK*

By CHARLES HASKINS TOWNSEND, Sc. D.
Director of the Aquarium of the New York Zoological Society

THERE was a time when I was more or less skeptical about the shark as a man-eater but after several cruises in the tropics with the *Albatross* my views underwent a change.

Our first observations on the shark were made one dark night off the Bahamas. The *Albatross* was sounding in the Gulf Stream and, as was the custom when the ship was sounding on calm nights, insulated and hooded electric lights were suspended a foot or more in the water on each side of the vessel and a couple of yards clear of the side. With gauze dip-nets the naturalists on board could pick up many small forms of surface life attracted by the light and otherwise not readily obtainable. On this occasion a school of young flying fish, dazzled by the unusual illumination, remained near enough to be reached with the long-handled nets and many were secured.

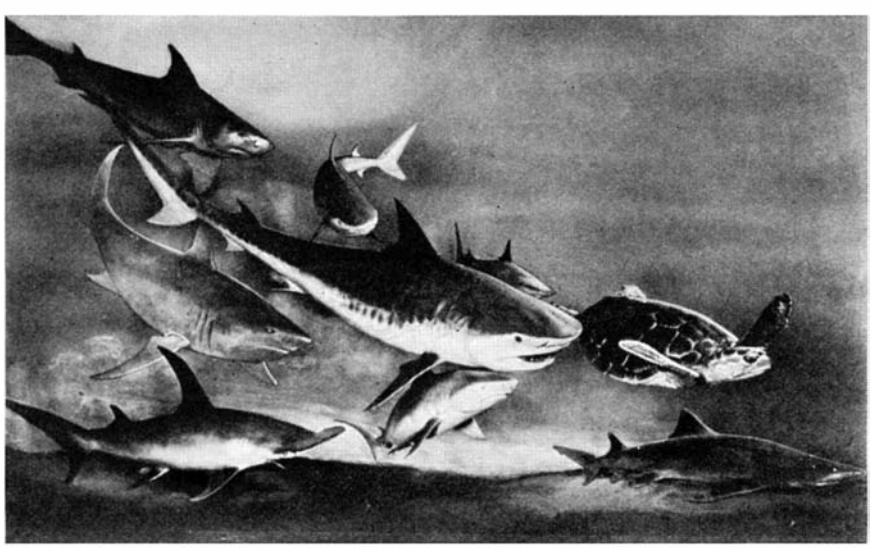
SOMEONE having observed a shark, the sailors put over a heavy shark hook with chain and stout line attached, and in a few minutes the big fish was dragged on board and killed. After being examined by the naturalists and more or less hacked by the sailors, it was thrown overboard. In a short time the ship was surrounded by sharks, the submerged and shaded lights rendering them visible. The shark tackle was kept busy and in half an hour the sailors had hauled on board and killed nearly a dozen, when the officer of the watch objected on account of the sanguinary mess on the deck. The sharks attracted by the bloody carcases gradually being thrown overboard provided an exhibition of how hungry sharks behave in the presence of an unexpected supply of food. Someone said to Lieutenant Benson (now Rear Admiral): "The water's fine; let's jump in." "Jump in yourself," he snapped, "I don't want a bath at present."

Sharks were usually around when the ship stopped for sounding or dredging in calm weather day or night and the sailors often caught them. They must be rather evenly distributed over the watery wastes for they soon appear in any warm sea when a vessel stops. At first there is a lone shark swinging carelessly about the ship, evincing no special interest in it. Other stragglers appear, each taking his own leisurely course. The size of the company depends chiefly upon the duration of the ship's stay but it may be affected considerably by what the cook's mate has been throwing into the galley chute. Killing one of the sharks is usually followed by a rapid increase in numbers, provided the evidences of its violent death have been washed off the deck into the sea.

It is likely that sharks can detect the beat of a steamer's screw at great distances but they gather as readily about a becalmed sailing vessel. The explanation probably is that the wandering selachians discover the more or less oily wake of the ship and follow it. We cut open the sharks killed from time to time to ascertain the nature of their food but discovered little more than such kitchen wastes as had been thrown overboard. There is little in the way of galley refuse that sharks will not pick up. We found by dissection that they swallowed things indiscriminately; there were ham bones, mouldy bread, decayed oranges, greasy rags, oily cotton waste from the engine room, empty sardine tins, and parts of other sharks killed by the sailors. When sharks have been excited by a few mouthfuls of food, they will seize almost anything. A fourteen-foot shark in captivity at Honolulu, after being fed a large piece of meat, seized a box a foot square and crushed it. The stomach of another large shark taken at Honolulu contained a horse's leg with hoof and shoe, a gunny-sack, a tin can six inches square, one squid, a peck of turtle shell and various small articles. It is evident that some of the stuff so cheerfully swallowed is indigestible.

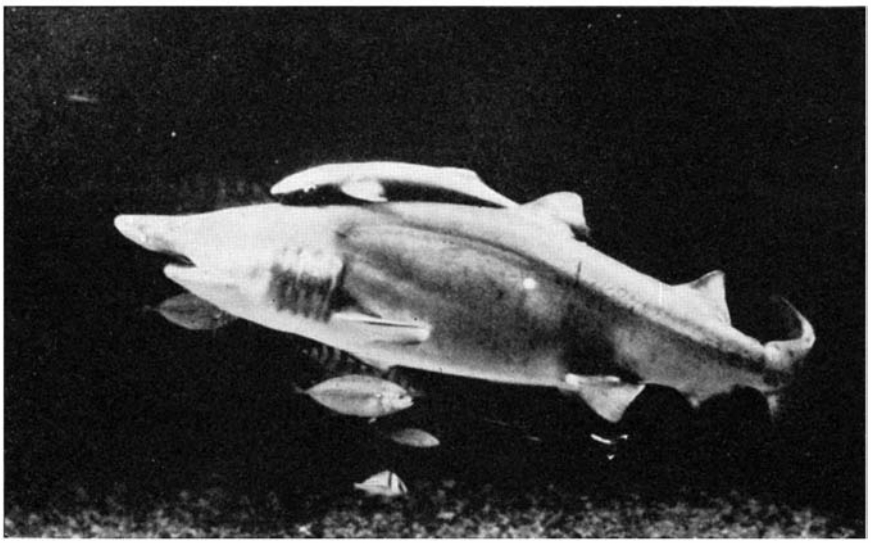
When our deep-sea explorations had carried us among the islands of Eastern Polynesia we caught many kinds of sharks large and small. The sailors were always ready to amuse themselves by dragging them on board for our examination. As we became acquainted with the island traders and natives we learned that they regarded sharks as dangerous under certain conditions and were accordingly circumspect in dealing with them. After a couple of winters' work in tropical waters we came to realize the great abundance and ferocity of sharks and that danger from them was not confined to those of large size. Each group of islands had its tale of injuries or fatalities to human beings from small or large sharks. A shark not as large as a man can easily mutilate and pull down the helpless swimmer without having the size to carry him away bodily.

THE Polynesian has the same regard for the shark's prowess that the African has for the lion and, like the latter, does not fear to hunt and kill him when the conditions are favorable. The shark, however, takes no such toll of human life as he cannot stalk his prey on land. The Polynesian is am-



A school of sharks, led by a 12-foot tiger shark, attacking a sea turtle. On the left is a large hammerhead shark, and in the background a huge man-eater. Sketch by F. L. Jacques, from group in the American Museum of Natural History

*Courtesy of the *Bulletin of the New York Zoological Society*.



A shark with two kinds of shark "satellites," the shark sucker and the pilot fish. One of the former is attached to the shark's back and another shows very faintly under its belly. The pilot fish are the two with black vertical bands; one is just above the shark's head, the other just below its body. The four lighter-colored fish merely happened to be in the group. The pilot fish is one of the mackerels and has a habit of accompanying sharks (which never harm it) on account of the fragments of food it picks up from the shark's ill-mannered luncheon

phibious and in some parts of the South Seas will plunge down after a lone shark and kill it with a knife, but this exploit is not attempted with all kinds of sharks, nor indeed, by many natives.

THE attitude of the native toward the shark is different in the daytime from what it is at night; the shark has the advantage in the dark and is more aggressive. In some parts of the South Pacific where sharks are numerous, they are persistent in following boats and canoes at night, nipping at the oars and paddles and not infrequently at the light outriggers of the native canoes. Large sharks are especially dangerous at night and frequently tear heavy oars away from the hands of the rowers. There are many authentic cases in which they have seized the floating outriggers used on all South Sea canoes and capsized them with fatal results to the occupants. A tragedy of the Ellice Islands was related to us at widely separated points in Polynesia. About 40 natives, crossing in canoes at night between islands several miles apart, were caught in a squall. One of the canoes was swamped and the occupants were seized by sharks which had been following the fleet of boats and nipping the paddles. In a few minutes great numbers of maddened sharks were seizing paddles and outriggers, until all the canoes but one had been swamped and their occupants devoured. Two natives only escaped to describe the disaster. We heard a similar account in the Fijis where one of the large double sailing canoes was capsized well off shore and over 20 natives clinging to the wreck were pulled under by sharks, only a few escaping.

When in the Low Archipelago we found that the natives often swim and dive freely in the lagoons of certain atolls, when they would not think of doing so in the deep entrances to the atolls, where a big lone shark keeps watch. He can be seen about dusk and it is best to visit him in the whaleboat. Natives will sometimes swim about anchorages or even bathe near the deep entrances to lagoons in the daytime, when they could not be persuaded to do so at night. Sharks are often so abundant about certain islands, that a regular fishery is maintained for shark fins—always marketable in China.

There are reefs here and there among the islands to which the natives resort for some of the larger food fishes and such places are usually infested with sharks which cause great annoyance by following the canoes and seizing fishes that have been hooked. When a too persistent shark menaces the frail canoe it must be beaten off with paddles or fish spears. The native fishing on the more distant banks off shore will gladly avail himself of the use of a good-sized dinghy or whale boat which has no outrigger to be seized by an ugly shark. It is not by any means the largest sharks that are most dangerous. Many small but active species move in schools and at times actually swarm about a canoe, not merely interfering with fish catching but endangering the light craft.

Sharks have always been regarded as distinctly dangerous in Australian waters where there are several large species. They were particularly so at Sydney, where for a time butcher shop wastes were allowed to be thrown into the harbor. Swimmers about the docks were carried off by sharks on several occasions in the daytime. In the Solomon Islands the singular ferocity and boldness of the sharks are said to be due to the native custom of throwing dead bodies into the sea. Where the carrion is, there will the vultures be gathered together. At such times sharks come to eat and their temper is not misjudged by those who understand them.

The *Albatross* sounded every five miles along the 2000-mile track between San Francisco and Honolulu. Every stop lasted an hour and toward the southwestern end of the route there was plenty of opportunity to get acquainted with sharks and put numbers of them out of business. Sailors like to torture sharks. We had to forbid such practices as propping their jaws wide open with a stick, or cutting off their tails and then heaving them over alive but helpless.

THE customary question of the skeptical, "Did you ever see a man killed by a shark?" may properly be met with a similar one: "Did you ever see a man murdered?" In conversation there is generally some one to defend the shark. I usually say, "Don't care to bother with amateurs."

Natives in the Hawaiian Islands are cautious about venturing into deep water near steep cliffs and then seldom without a long-bladed knife. The native surf-board riders disport themselves in waters where sharks are not often seen, the shallowness of the water and the disturbance made by the surf-board riders serving to keep the sharks at a distance, but accidents occur.

We need not consider here the comparatively few instances of loss of life from these big fishes in northern waters. It is in the warmer seas where sharks of all kinds are more abundant that we find them a menace. And yet the tragedies are rare. Sharks do not likely succeed in killing as many persons in a year in all Polynesia perhaps, as are killed by automobiles in any large American city in a single week.

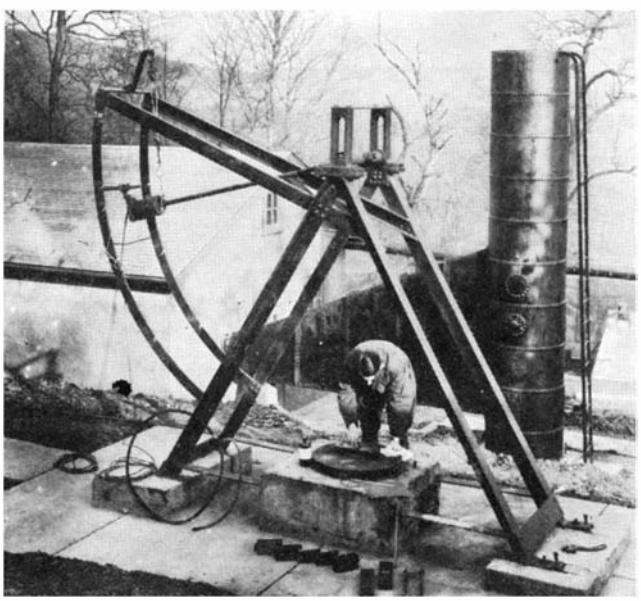
WHILE cruising with the pearl divers of La Paz, I once put on the heavy diving suit and went down on a coral bank, but the promised sharks did not appear. The divers did not fear them, saying that the upward-leaping air bubbles from their helmets kept sharks away. They had, however, a wholesome respect for the huge manta rays, always full of curiosity, whose broad wings had been known to hit their air and life lines, almost jerking them off their feet.

Fortunately for the commercial fisheries as well as for humanity in general, the recent extension of the shark-leather industry to many parts of the world has served to put a worthwhile price on the head and hide of an old criminal still at large, long known to sailors as "Jack Shark."

HOW THE BUREAU OF MINES AIDS THE MINERAL INDUSTRY

By ALBERT A. HOPKINS

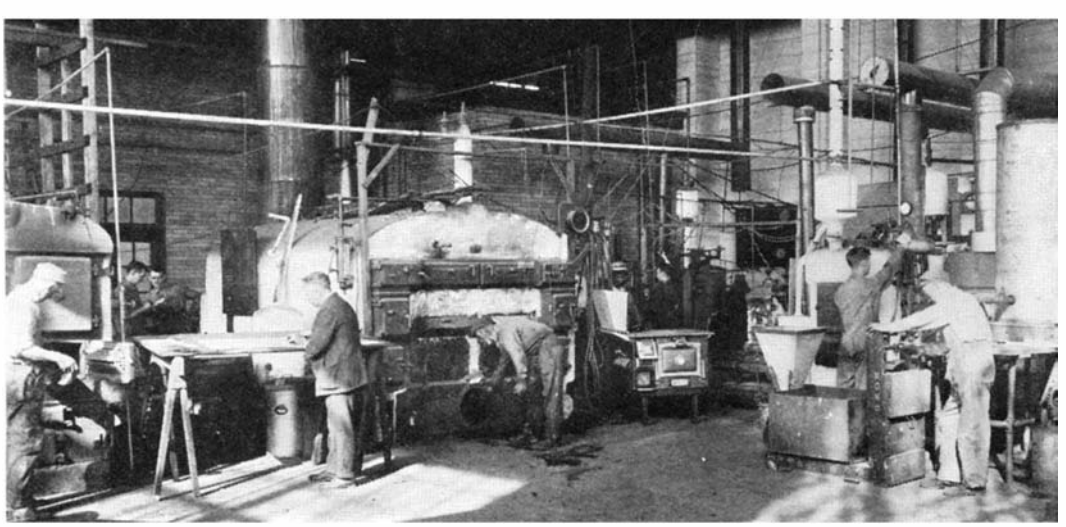
THERE is a lot of adventure in mining, for it is a hazardous business at best. The stories of heroism that occur almost daily indicate that personal bravery is far from being a lost virtue. We owe the great work of the Bureau of Mines to its first director, the late Joseph Austin Holmes, who saw that the mineral industry needed help in the matter of accident prevention and relief, but that the large problems of a technical nature were too many and too complex to be solved by the industry itself without the use of great laboratories, including a mine itself and numerous stations located at strategical points. To give a single instance of development: The government paid some 1600 dollars a cubic foot for the first helium obtained; now the military services can purchase their helium from the Bureau plant at Amarillo, Texas, at two cents or less per cubic foot.



Pendulum friction device for determining the sensitiveness of explosives to frictional impact. The explosive is placed on an anvil and a steel shoe strikes a glancing blow

Perhaps the United States Bureau of Mines carries on more diversified work than any branch of the government service with the exception of the Department of Agriculture. The Bureau of Mines is entrusted with two broad general lines of investigation: The conduct of studies looking toward safer and more healthful conditions among workers in the mineral industries; and the study of new and improved methods for mining, treatment, and utilization of the numerous minerals essential to the welfare of mankind. The mining, quarrying, metallurgical, and oil and gas industries of the nation give employment to more than 2,000,000, so it is

Surveys are made to determine the character and amount of acid water given off by mines so as to note the effect on streams. The man is taking a sample of polluted water



In the Pittsburgh Experiment Station the burning characteristics of fuels are studied in the laboratory. In this picture are shown tests on types of heating boilers and even on a lowly cook stove

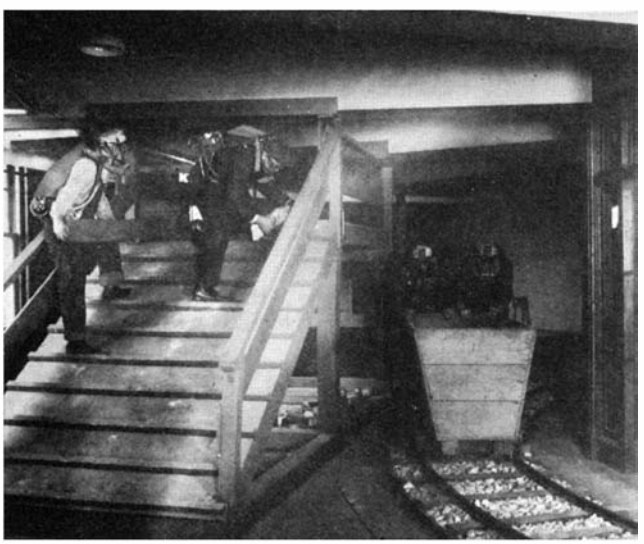
obvious that the Bureau's investigations designed to improve safety and working conditions are very important in relation to our economic welfare.

The Bureau of Mines has no authority to compel the adoption of its health and safety recommendations, the regulation of mining operations being generally one of state rather than federal jurisdiction. The Bureau, however, does rely on the co-operation of various state mining departments and the mining industry itself to make its findings effective in the betterment of conditions.

The work of the Bureau falls into four principal classes: 1, administrative; 2, scientific; 3, humanitarian; and 4, economic. It is organized under the office of the director as follows: 1, technologic branch; 2, economic branch; 3, health and safety branch; and 4, administration branch. The activities of the Bureau of Mines are so numerous that it takes many typewritten pages even to list them. There seems to be no phase of the mineral industry which has been passed by. In one year 81,000 men were trained in first-aid or mine-rescue methods. The Bureau maintains ten rescue cars in various parts of the United States which can be rushed to the scene of a mining disaster. When not engaged on such an errand of mercy, the trained staffs give instruction in first-aid and mine-rescue work.

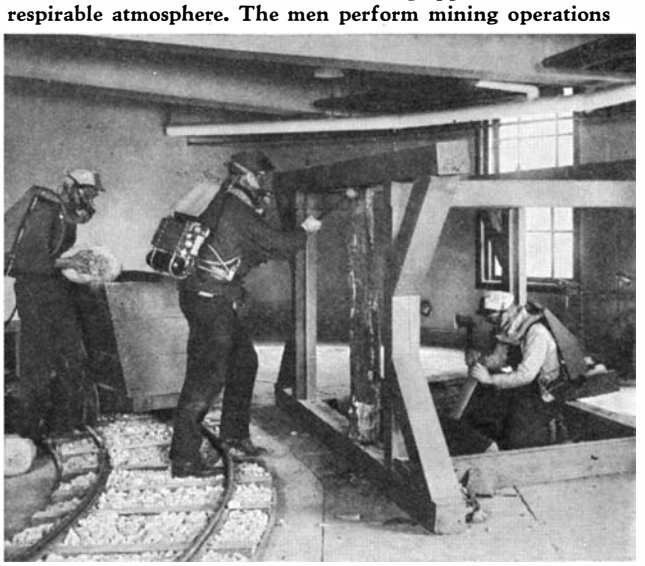
The property of the Bureau is widely distributed and totals less than 5,000,000 dollars, a small figure when the volume of work is considered. The Bureau is rapidly coming to be recognized as one of the greatest technical branches in the government group.

At Bruceton near Pittsburgh is located the experimental coal mine of the Bureau of Mines. Here is shown a violent coal-dust explosion. The white patches in the smoke are flame

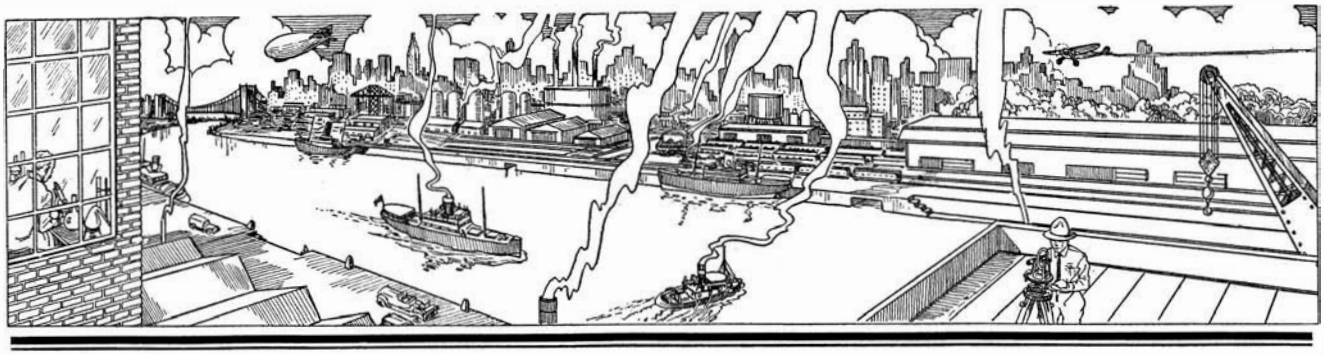


Another view of the training gallery at the Pittsburgh Experimental Station where men perform hard manual labor in a poisonous atmosphere with the aid of oxygen equipment

***Below:* Men being trained at the Pittsburgh Experimental Station with the Gibbs mine-rescue breathing apparatus in an irrespirable atmosphere. The men perform mining operations**



***Below:* Scene at a mine explosion in West Virginia. Two of the men are Bureau of Mines engineers. Officials are checking the men who are equipped with apparatus for rescue work**



THE SCIENTIFIC AMERICAN DIGEST

Conducted by F. D. McHUGH

Contributing Editors

ALEXANDER KLEMIN

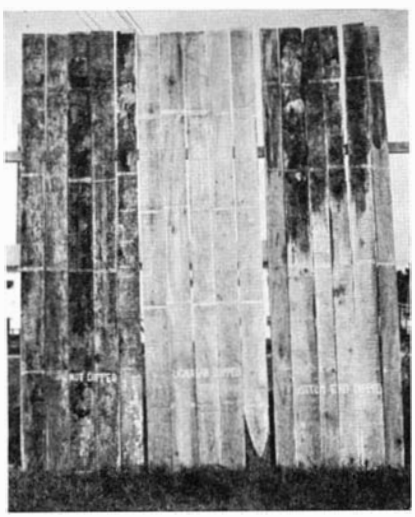
In charge, Daniel Guggenheim School of Aeronautics, New York University

A. E. BUCHANAN, Jr.

Lehigh University

Treatment Prevents Wood Sap Stains

LUMBER sap stains caused by fungi have long been recognized as the underlying cause of a serious problem in the industry. While there is some difference of opinion as to whether the stained lumber is materially weakened for structural purposes due to the presence of these organisms, it is generally agreed that the loss of its natural bright appearance brings about considerable depreciation in sales value.



The unstained boards and board ends were given the new treatment. All weathered for 60 days

Stain-producing fungi usually gain entrance to the sap wood within a few hours after the lumber is cut at the sawmill. Some infection may occur through wounds in trees before they are felled or in logs before they are taken to the sawmill. The spores of staining organisms are present in the air at all times.

In view of the fact that considerable moisture is required for the rapid development of sap stain, it is apparent that quick drying is one means of combating the causal organisms. Kiln drying of pine and end-racking of hardwoods are two methods of rapid drying which give good control.

About three years ago, pathologists of the United States Department of Agriculture planned a series of exhaustive experiments on sap-stain control. They decided to conduct tests with a large number of compounds known to possess fungicidal value. During the course of these experiments, approximately 100 products have been tested in a small way and the most promising ones used in commercial scale tests.

The commercial scale tests were conducted during 1930 at five mills located in Florida, Alabama, Mississippi, and Louisiana. The test piles were erected in June and July when climatic conditions are especially conducive to the development of the stain organisms. After 60 to 90 days, when the lumber was dry and no longer susceptible to stain infection, the piles were dismantled and records taken.

On pine, it was found that duPont disinfectant number 745 had given the most complete control of stain of the materials tried on both pine and certain hardwoods. Following the completion of two years of experimental work with the mills, this disinfectant was made commercially available under the trade name, "Lignasan," meaning healthy wood.

The new treatment can be used in cold solution, which saves steam for heating, and practically eliminates the evaporation loss accompanying hot treatments. Portable mills, which have no steam available for heating, can now treat their lumber for sap stain. Many hardwood mills are doing away with the expense of end-racking certain varieties and are flat-piling directly from the mill.

Lignasan is used at the rate of only one pound per 50 gallons of water. This is sufficient to treat approximately 5000 board feet of average lumber. The average cost of dipping is reported to be about 12 cents per thousand feet of lumber.

Fabrics Not Weakened by Cleaning Solvents

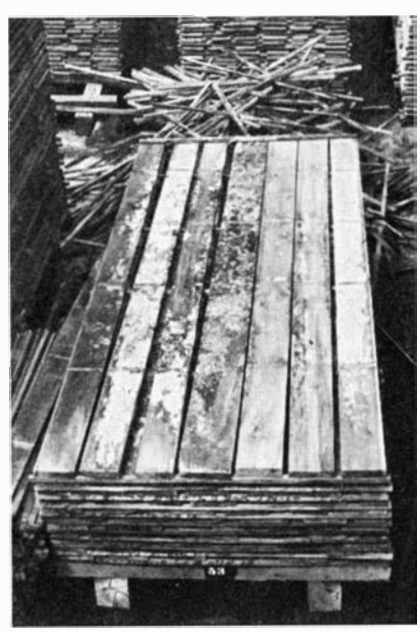
A SERIES of tests conducted by the Bureau of Standards at the request of the cleaning and dyeing industry proved that exposure to light and heat rather than the chemical action of solvents weakens fabrics.

The series of tests indicated that all fabrics were weakened by repeated cleaning, but that the loss of strength was in ratio to the time the materials were exposed to light and heat rather than any influence the solvents might exert upon the fabrics, according to Warren E. Emley, chief of the Organic and Fibrous Division of the bureau.

According to Mr. Emley, tests were made on materials soiled with carbon black, paint, tea, sirup, gravy, and lip stick. It was found that certain solvents were more efficient on certain types of stains in relation to the kind of material being cleaned. It was also found that the amount of moisture in the material being cleaned had a decided influence on the efficiency of some solvents.—*A. E. B.*

End of Quinine Taking in Sight

YELLOW fever will claim no more martyrs among scientists seeking to conquer it, and in time it will cease to be a dread peril to missionaries, explorers, business men, and the general population in tropical sections of Africa and South America, as a result of the work of a research team of the International Health Division of the Rockefeller Foundation. Immunity can at last be given to protect people



Badly sap-stained lumber in a pile that was untreated, at a lumber mill

against this disease as it is given to protect against smallpox, diphtheria, and typhoid fever.

Announcement of a successful method of protecting against yellow fever was made by Drs. W. A. Sawyer, S. F. Kitchen, and Wray Lloyd of the Rockefeller Foundation, at the recent meeting of the Federation of American Societies for Experimental Biology. In Dr. Sawyer's laboratory six members of his staff contracted the fever, but fortunately recovered. From these men he obtained the serum which when injected with yellow fever virus recovered from mice gives immunity to the disease in man.

It is now 10 months since the first human beings were immunized. By tests of their serum on mice, Dr. Sawyer finds that they still are immune. He has been able to test the serum of one of the original Walter Reed volunteers, and finds him also still immune, after 30 years.

The Rockefeller research team hopes that the immunity they are now giving will be equally lasting. At the end of a year, they plan to re-test the 16 persons immunized in their laboratories to see how much protection they will still have against the disease.

Sealed in glass tubes and frozen, some of the immunizing material was sent to Nigeria, in Africa, and to Brazil, where it was used successfully to immunize three other men. As yet not enough material has been produced to immunize large groups of population, but some is already available for scientists, explorers, educators, and missionaries, going to yellow fever countries.—*Science Service.*

Police Radio Broadcasts

"CAR No. 292, N. E. corner Lenox Avenue and 125th Street, Manhattan—signal 30." Thus goes out the alarm from police headquarters in New York City to one of the many police cars on patrol—but that alarm is no hit-or-miss alarm; it goes directly to the car in question by short-wave radio. The terse "signal 30" then gets prompt action for it means "investigate and take necessary police action as a report has been received of the commission of a felony."

Behind this simple routine is a complex and efficient system for patrolling New York City that has its center in the broadcasting room shown in an accompanying photograph. The dispatcher, Patrolman Cronin in this case, sits at a table on which is a map of the boroughs of the city, and takes news over the telephone of the necessity for police investigation anywhere in the city. Looking at his map, he notes the number of the metal disk, indicating location of a patrol car, that is nearest the scene of the trouble. Writing out instructions for that car, and others if necessary, he passes these instructions to the patrolman at the microphone in the background. The latter broadcasts the call and the desired car picks up the message with its short-wave radio receiver.

In the police radio station, the dispatcher keeps track of all patrol cars on the map before him; the "announcer," at rear switchboard, broadcasts calls to them

Magnesium Needed for Health

RESEARCH is continually developing the fact that metals, even in minute quantities, are essential to normal life. Professors McCollum and Orent, at Johns Hopkins University, have determined that magnesium is essential to the normal diet. About the tenth day on a diet free from magnesium, experimental rats went into spasms, and most of them died. The presence of magnesium in the diet is necessary, according to these investigators, to the proper function of the adrenal glands.—*A. E. B.*

Curing Brush Pitting

UNEVEN wear and pitting on carbon blocks or "brushes" of rotating electrical equipment has been eliminated. G. M. Little, Westinghouse research engineer, solved the problem by cutting spiral grooves in the whirling collector rings or "commutator," although this actually reduced the area of the contact surface 50 percent.

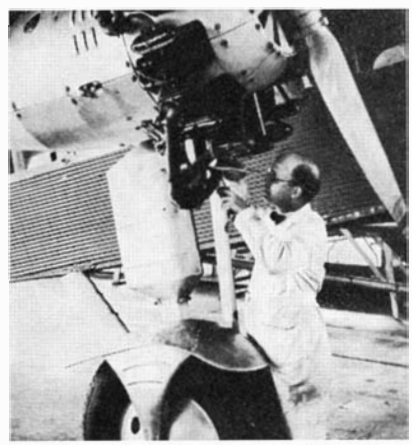
Artificial Fog Protects Fruits

ARTIFICIAL fogs have been developed by French chemists in a promising effort to protect growing fruits and vegetables against night frosts. Special devices have been evolved and the process used consists in dropping a compound such as chlorhydrin on chalk in an appropriate apparatus. The chalk thus heated throws off hydrochloric acid and other matters which mix with the damp air and produce intense opaque fogs. Despite the acidity of these dense vapors, their action on vegetation is not harmful. Experiments are now being conducted to attempt to improve the effectiveness of these artificial fogs by giving them properties destructive to parasitic growths.—*A. E. B.*

New "Universal" Solder

A SOLDER that will repair practically any industrial metal has recently been discovered by the Allied Research Laboratories of Glendale, California. This solder is known as Alumaweld, and it is claimed to repair any metal including cast iron, steel, aluminum, and die castings.

Alumaweld is now being used in the repair of steam and water pipes, heating plants, crank cases and cylinder heads of automobiles and tractors, aluminum pots and pans, vacuum cleaners, washing machines, and a host of other metal products. The solder is applied to aluminum, pot metal, and die castings without flux, while a special flux is required for cast iron and steel.



The new solder being used for repairs on airplane engine parts

Alumaweld is more than a surface solder. It is claimed that it actually breaks down the structure of the metal being repaired, fusing or welding with it to form a solid piece. Alumaweld is several times stronger than ordinary solder, is quite ductile, and will take a polish over which chromium or any other plating can be applied.

Alumaweld can be used by anyone regardless of experience. It replaces welding at a fraction of the time and cost without any danger of cracking during preheating or cooling.

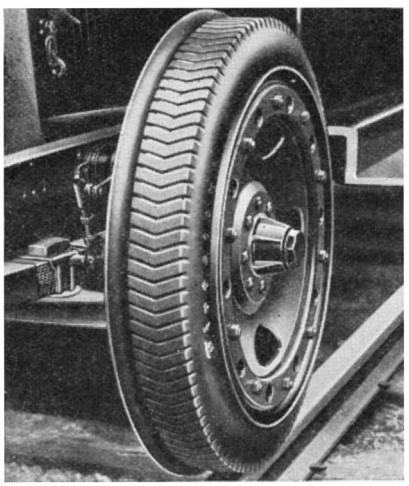
Poison!

THE metal thallium is apparently a dangerous poison. Therefore its use in human medicine and in wholesale poisoning activities against rodents and other lower forms of life should be restricted until more is known about its action and the habits of the animals against which it is used, warns Dr. Marcus Ward Lyon, Jr., of South Bend, Indiana, in a note in *Science.* Similar warning against the use of thallium as a rat poison has recently been issued by the American Medical Association.

Numerous deaths have followed the use of thallium as a depilatory for cosmetic purposes and in the treatment of ringworm of the scalp, Dr. Lyon points out. Several fatal cases of thallium poisoning have also been reported from the use of thallium-

poisoned grain for the destruction of ground squirrels. Thallium is also poisonous to plant life.

Besides total loss of hair, thallium poisoning may produce such symptoms as weakness, pains in the legs, neuritis, mental disturbances, kidney involvements, excess salivation, heart palpitation, and visual disturbances. In the latter cases, physicians were at a loss to explain the blurring and loss of vision, until they accidentally found



The new American rail tire

that a thallium depilatory had been used by all the patients. When this was discontinued the vision improved.

Studies by the Bureau of Investigation of the American Medical Association of the depilatory implicated in the poisoning showed that it contained over 7 percent of thallium acetate, whereas Raymond Sabouraud, one of the first to use thallium for removing hair, warned against using it in any stronger concentrations than 1 percent. The sale of this depilatory has recently been prohibited in San Francisco.—*Science Service.*

New American Rail Tire

FLASHING through the remote wilds of the Everglades of Florida at record making speed, a rail car equipped with a new type of pneumatic tires developed by Firestone has set a precedent which traffic experts believe will have a vital bearing on the immediate future of transportation in this country. For a year or more Firestone engineers worked to perfect the pneumatic tires used on this trip. Florida was chosen for the run because under the blazing semi-tropical sun of the Everglades, the tires would be put to a severe test. The route was from Miami to Jacksonville.

Commenting on the accomplishment, Mr. Firestone said that hundreds of miles of railroad tracks unused today may be put into service again through the development of this new type of transportation. He believes that the pneumatic tired wheel will not only be a great boon to the railroad industry in reviving the operation of these unused lines, but that it will bring new speed and comfort to rail travel.

With Clifford D. Smith, the engineer who has charge of tire development, at the throttle, the car carrying three passengers hummed over the 405.7 miles in 378 minutes, elapsed time, for an average speed of 64.39 miles an hour, bettering by 42 minutes the best previous rail run between the two Florida cities made over a route 40 miles shorter. Deducting the 31 minutes for stops, the actual running time was 347 minutes or five hours and 47 minutes, for an average speed of 70.2 miles an hour. A maximum speed of 87.3 miles was maintained for several minutes between Baldwin and Jacksonville.

An important feature of the new rail tire is a device which assures safety in case of deflation due to a puncture or tube failure. As a test the front left tire was punctured with a bullet from a caliber .38 revolver while the car was going at high speed. The trip was continued at a speed of 40 to 50 miles an hour. The car operated perfectly around curves and through switches on the deflated tire.

Snake Charmers and the Cobra

SHORTLY after we published in our May issue, the article "The Snake-Charming Sisters of Holy Popa," Mr. J. D. Marsh, of North Bloomfield, California, who says that he "lived for 13 years within 50 miles of this extinct volcano Popa," gave in a letter further information, first-hand, concerning the cobra and the Oriental snake charmers. The most interesting parts of this letter are quoted below.

"The snake charmers have made my servant-quarters their temporary abode while exhibiting their snake charming abilities and incidentally begging for money. The snakes were all king cobras, the largest of which measured over 14 feet.

"Unlike the Indian charmers, they did not remove the deadly fangs, but I noted that this group of charmers, two women, one man and a boy, who yearly visited my bungalow arrived during the tropical fall or winter; when the reason was requested the man answered that 'during the cool weather the snakes were sleepy, and were too alert and active for handling during the warm months.' They really handled the snakes during the hibernating period only or when these cold-blooded reptiles were sluggish, as Popa and the district in which these exhibitions were given are sufficiently far from the equator, 21 degrees N. latitude, to have a pronounced cool season of nearly four months.

"During all my many hunting excursions to and around Popa during these cool months neither I nor any of the beaters saw a snake, but have had a number of coolies bitten during the warm weather, luckily with no fatalities.

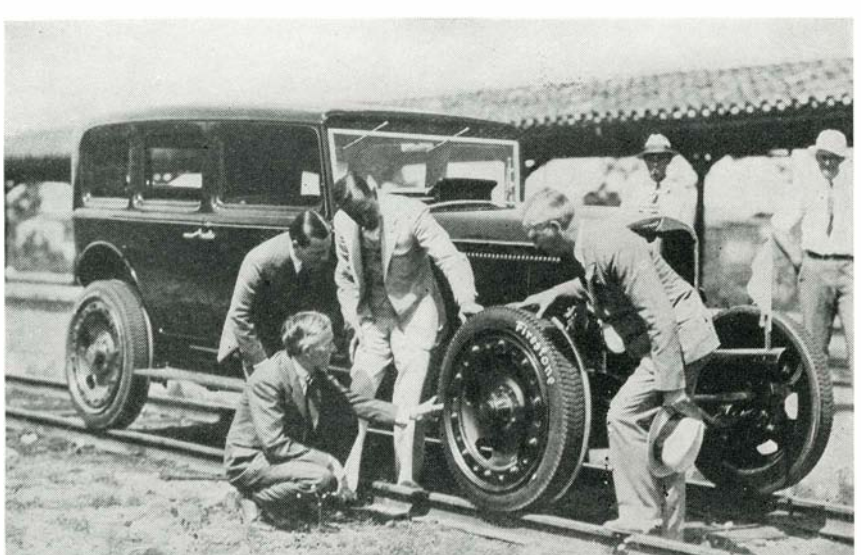
"Many thousands die annually in India and Burma from poisonous snake bites but, according to government statistics, this number constitutes only 35 percent of those bitten, for when in pursuit of food the snake's poison may all be expended in overcoming the victim, and if a person is bitten before a sufficient supply of poison is stored in the poison sacs, recovery generally follows.

"While the king cobra's poison is no more deadly than that of the common cobra, due to the size and poison capacity of the former, recovery is less frequent.

"But to return to snake charming. Hindu snake charmers cannot charm a snake, in so far as my observations go, but they do possess snakes that will come to the shrill monotonous sound of the gourd hornpipe. In your absence, these snakes are, through intrigue with your servants, secreted around your bungalow, and upon your return home a sad-faced servant meets you with a tale of your snake-infested bungalow and advises calling a charmer to rid the premises of these deadly intruders. The charmer is duly called and demands a rupee for each snake captured and a promise that he may take possession of all snakes alive and unharmed—always cobras.

"The Burman snake charmer has not reached this nearly perfect stage of extortion and simply tantalizes a nearly dormant snake to a sluggish attack by performing squatting contortions in front of the snake; failing in this he slaps it on the head or under the chin; if the snake attempts to crawl away he is promptly seized by the tail and dragged back. When the snake is sufficiently aroused to strike, the charmer either avoids the deadly thrust or guards it by deftly extending the arm in such a position that the charmer's wrist engages the snake's throat, or by deftly spreading the knees the snake's fangs engage the *loongyi*, or skirt, stretched taut between the knees.

"Death from the bite of the cobra or the viper occurs anywhere from a few hours to 10 or 15 days, depending upon the size of the snake and the amount of poison injected, distance of wound from an artery or vital organ, and the health or physical con-



Harvey Firestone, stooping, examines the new tires after their long test

dition of the victim. Fright also occasionally is the real cause of death.

"In spite of all the deaths and suffering poisonous snakes cause the Indian and Burman, the Indian worships the cobra and will not kill them, while the Burman, a confirmed Buddhist, refuses in nearly all cases to take life of any kind, though occasional exceptions are found in both races.

"Due to this attitude of the natives, poisonous snakes are very plentiful in some localities. I personally killed 42 poisonous snakes in and around one bungalow in which I lived during a period of 18 months, though this was a very exceptional case.

"In conclusion, the female king cobra with young is the only snake known to attack human beings without provocation; her attack is swift and vicious."

Plane Skids Live Longer

THE life of airplane tail skids made of nickel-chromium cast iron is three to five times longer than that of cast steel skids, according to practical tests reported in the *Nickel Cast Iron News*. Results were compiled from 200 airplane landings, about one third on asphalt runways and the remainder on turf fields.

Plane Pilots Whip Freak "Skip Distances"

AN atmospheric peculiarity known as a "skip distance" plays tricks with short-wave telephony from airplanes of United Air Lines. The voice of a pilot of a night airmail-passenger plane flying between New York and Chicago was heard clearly at Ft. Worth, Texas, a thousand miles distant, when the ground station operator at Chicago could not hear him. Another pilot flying over Redding, California, was heard at Des Moines, approximately 1900 miles away, when his voice could not be distinguished by the dispatcher at Oakland, only 300 miles distant. The voice of a flier over Kansas City was heard more distinctly at Spokane, Washington, than at Moline, Illinois, and a pilot flying over the eastern part of the state of Washington picked up the voice of another airmail flier reporting his position to Oklahoma City.

Provision is made to counteract these unusual atmospheric conditions by having the pilots covered not only by the home station but by distant dispatchers who can serve as middlemen between the pilot aloft and his designated station.

A Modern Observation Plane

"ALL airplanes look alike." So it is often said, with a great measure of truth, and the BJ Aircraft Navy Observation, the XOJ-I, looks like many other airplanes. Yet from an Army or a Navy point of view, there are very marked differences in planes that look very much alike but have entirely different characteristics from a service point of view.

To the XOJ-I, we are informed by a reliable authority, exhaustive wind tunnel experiments have given perfect co-ordination of control. It can be barrel-rolled both as a land plane and as a seaplane, and can be flown upside down as a seaplane. It is an incongruous and almost alarming sight to see it fly with the floats high up in the air, above the fuselage!

The XOJ-I is provided with a hook to work with the arresting gear on an aircraft carrier. The rear gun can be pointed skyward so that there is defense even against the enemy plane swooping down on one's tail, although it has hitherto been accepted that there was little or no defense against an enemy in such a maneuver. The cockpits have been studied with great care to give the occupants perfect vision, with maximum protection against the air blast and minimum air resistance.

The greatest fear of the airplane designer, whether engaged on Army, Navy, or commercial types, is that his craft may be over-weight and under-speed. The makers of the XOJ-I claim that they created something like a sensation with the Navy Bureau of Aeronautics when they delivered their plane for test, and it was proved to be 123 pounds underweight and 14 miles over its guaranteed speed!—*A. K.*

Airplane Chairs

IN the airplane everything must be of the most refined construction because of the stringent limitations of weight. The weight must be kept down to a minimum and at the same time the required strength is enormous.

When the plane is maneuvering in the air, the force of gravity may be multiplied three or four times. This means that a 180-pound passenger in a chair may be pressing down with a weight of over 600 pounds. If our drawing-room chairs had to support such weights they would be clumsy and bulky affairs.

In the airplane, chairs supporting these enormous loads must not weigh more than ten pounds. Our photograph shows the latest product of engineering art in a

For maximum strength with light weight, plane chairs are of tubes

chair produced by Metlab. This is not built of wood or even of a strong duralumin alloy, but is constructed of chrome-molybdenum steel tubing welded and finally heat treated to a strength of 160,000 pounds per square inch. This material has great shock-absorbing properties and in case of a crash the chair will crush before giving way. The safety belt is attached to the main diagonal side member. The model shown has a width of 18 inches between the arms. Its frame weight is only 9 pounds and the upholstery weighs 6 pounds.

Designers spent arduous days in working up these chairs, giving them clean design and avoiding all corners or points that might catch in a passenger's clothing. By raising or lowering the seat the back is adjustable to three positions.

The photograph of the chair is well worth studying. It is really surprising what engineers can do in commonplace things such as chairs, but a well-designed chair may be a real safety measure in case of a crash.—*A. K.*

The rear gun of the new Navy observation plane can fire upward to protect the craft against an enemy over the tail. Note arresting hook under fuselage

An Effective Rejoinder for the Autogiro

IN our March issue there appeared in these columns reports of certain criticisms of the autogiro.

While these criticisms were no doubt sincere and well meant, further personal investigation of the situation leads to the definite conclusion that such opinions were in some respects based on incomplete knowledge and in other respects affected by natural scepticism toward a new type.

It is only fair to the men who have expended so much energy and effort in developing the autogiro that all sides of the picture should be given to our readers.

There is the question of the rapidity with which the art of autogiro flying may be acquired. It is quite true that a man cannot just sit down in the cockpit, receive a few words of instruction and take off. But there are very few people capable

of performing a similar feat in their first experience with an automobile. Autogiro instruction is needed, but experience shows that a man can "solo" in an autogiro more quickly than in an airplane.

The airplane pilots who claim that an autogiro is very difficult to fly are experienced aviators who expected to be just as expert in handling a 'giro for the first time, as they are with an airplane after hundreds of hours of flying. There is a very definite analogy here with the case of the skilled land-plane pilot who handles a seaplane for the first time. Full of confidence, the land pilot may nevertheless make an exhibition of himself with a flying boat, taking off too soon, "porpoising" or settling back roughly on the water, and subsequently making a very poor landing. If the airplane pilot would treat autogiro flying with confidence but also with respect he would find an hour or two quite sufficient for the additional wrinkles required and would change his viewpoint entirely.

Our air strength may be relatively low, but this view is impressive

Another criticism raised against the autogiro is on the score of accidents. It is quite true that a number of autogiros flown in America have been damaged; but so far no commercial or private-owned autogiro has been completely washed out, and in no case has there been even a serious accident. Where accidents have occurred, they have for the most part been due to lack of experience in slow flight. If pilots will be patient enough to receive a little instruction, the accidents will largely disappear. The general public and the daily press, free from prejudice, have perhaps a truer sentiment in the matter and consider the autogiro to be a very safe form of craft.

On the score of performance, it is quite true that the autogiro to date lags considerably behind the performance of the airplane for the same loading per horsepower. But the autogiro is young, and a 200 horsepower autogiro has been definitely clocked at 110 miles per hour. Refinements and improvements tending to greater speed are constantly being introduced. In considering climb, it is also worth noting that the autogiro has a rate of climb which compares very favorably with that of the airplane, and has perhaps a better angle of climb. For purposes of getting out of a small field, it is the angle or steepness of the climb which is important and not the actual rate of climb.

There is one very striking yet simple fact which is forgotten in the comparison of the two types. If an airplane lands normally at 50 miles per hour, and to increase safety it were desired to land at half this speed (which is what the autogiro can do), it is necessary to multiply wing area by four. If the airplane designer started with a wing area of 150 square feet for a craft of moderate size, he would have to use an area of 600 square feet to secure a landing speed of 25 miles per hour. Even if the airplane designer made use of slots and flaps or other lift increasing devices, it is doubtful whether he could do with less than 300 square feet to achieve this 25 miles landing speed, but he would then have actually a slower craft than the autogiro!

The absence of the dangerous spin, the ability to glide in on a very steep path, almost vertically if need be, the practical elimination of the landing run, the decrease in "bumpiness" in gusty weather are 'giro advantages of the greatest value.

The most impartial view of the situation is this: For certain types of flight work such as fast air transport the airplane has a definite superiority. For other types of flying, such as "popular" flying, flying in rough or restricted territory, and so on, the autogiro is likely to render the greatest possible service.

It seems, in fact, useless to argue as to the superiority of one type over the other. They are both here to stay, both valuable in their appropriate spheres, both likely to be continuously useful (until a gravity annihilating device makes even flying old-fashioned!).—*A. K.*

Our Air Strength

THE strength of our air forces has been variously estimated at third, fourth, and fifth place in the world's armament, and there has been a great deal of controversy as to whether the five-year aviation program of the Army and Navy has been successful or not.

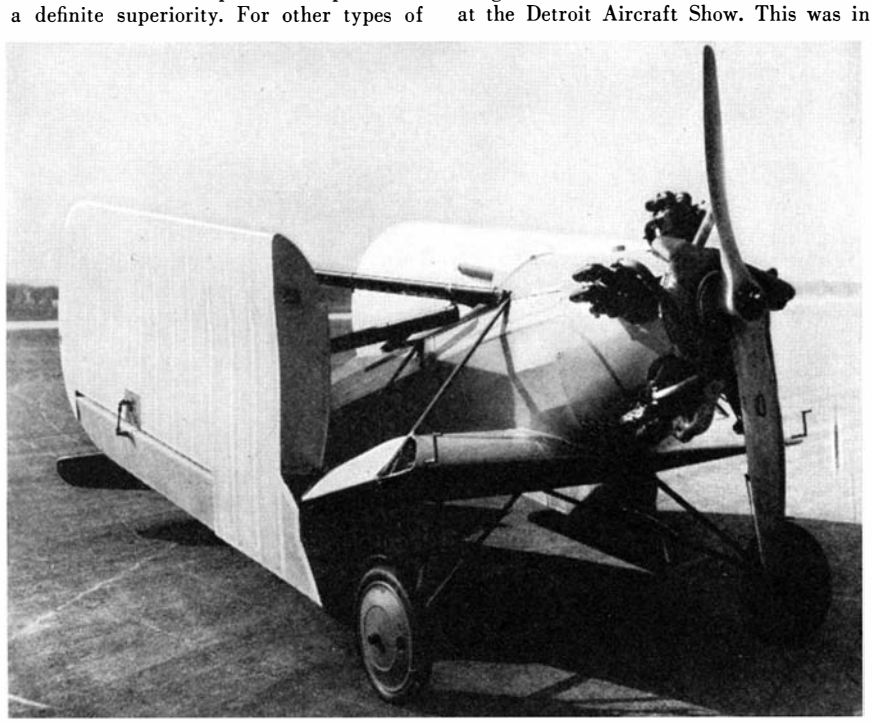
There is a little reassurance in our picture of three squadrons of Boeing Wasp-powered pursuit planes lined up at Selfridge Field, Michigan, which is the base of the Army Air Corps' First Pursuit Group. These trim biplanes are capable of a top speed of around 190 miles per hour and can be maneuvered in every imaginable way by their experienced pilots. It would be an unpleasant thing to have these airplanes in formation attacking one's bombing plane!—*A. K.*

Folding Wings

FOLDING wings are designed, of course, to save hangar space which is a source of expense to the airplane owner, and to make the handling of the airplane easier on the ground.

Pilots are sometimes a little worried by the folding wing mechanism. They think that a wing which can be folded back may not be perfectly safe, but of late years our constructors have learned the art of so designing folding wings as to leave no doubt of their security and have also made the folding mechanisms extremely simple.

An interesting example of this folding wing mechanism attracted much attention at the Detroit Aircraft Show. This was in

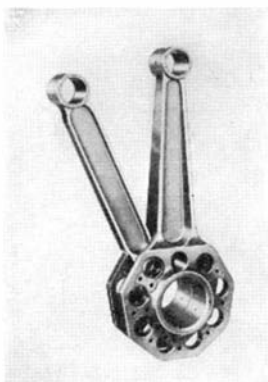


With wings folded, this plane can be stored in a nine-foot space

the new Kinner *Airster*, a moderate priced two-seater plane equipped with a 100-horsepower Kinner engine. The tendency in plane design for private ownership is to seat passengers side by side. It is far too lonely to undertake long flights with tandem seating; that is, with one seat behind the other. Moreover, side by side seating makes flight instruction perhaps a trifle easier.

The Kinner *Airster* with its low wing has a span of 36 feet, mean chord of 5 feet 6 inches, an over-all length of 24 feet, and 200 square feet of wing area. The gross weight is only 700 pounds, so that the landing speed is low, while the top speed is 110 miles per hour.

Our photograph shows the folding wings in the backward position. One man can fold the wings in approximately three minutes, which permits storage of the plane in a nine-foot space.



The wings are positively locked when in flying position and a simple screw crank located at the leading edge of each wing quickly pulls back the front pin. The wings can then be swung around by hand without any effort, hinging about the rear spar.—*A. K.*

More Aviation Engine Power

THE demand for more power by Army and Navy and commercial aviation is apparently insatiable. Moreover, this power must be obtained as far as possible without increasing the weight of the power plant. Consequently, our airplane engine manufacturers are always hard at work increasing what is known as the specific output; in other words, the horsepower output for a given volume of cylinder displacement.

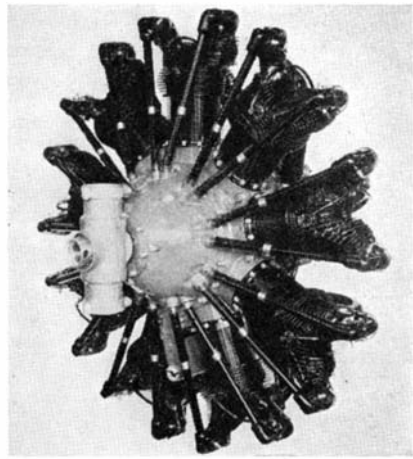
The first line of attack is to increase compression ratios; that is, the ratio of the total volume of the engine cylinders to the small volume occupied by fuel mixture when the piston is at the top of the compression stroke. The greater the compression ratio, the greater the power delivered and the greater the efficiency of operation. Unfortunately, as the compression ratio increases, the danger of detonation or preignition and knock also increases. Fortunately, our large oil companies have now produced fuels which have much higher anti-knock ratings. Whereas a few years ago a compression ratio of five to one was considered the practical limit, now it has been pushed to well over six to one.

Another line of attack for increasing power has been the "step-up" of the rate of supercharging at sea level. The gear-driven superchargers now rotate considerably faster than in early days and it is possible to operate engines at full throttle at sea level with supercharging ratios which were formerly possible only at high altitudes. Simultaneously with increased compression ratios and greater supercharging have come other refinements in design.

Master rods such as shown in one of our photographs have been strengthened; forged pistons have been substituted for cast; crank pins have been hardened; oil systems have been improved to permit the use of high bearing pressure. Crankcases are being forged from aluminum alloys instead of being cast; cylinder heads are more completely finned to provide the greater cooling necessary.

As the engine rotates faster and faster, gear reductions are incorporated to keep down excessive speeds of the propeller.

Our photograph shows a Pratt and Whitney Hornet Engine of the direct-drive type developing 525 horsepower and weighing only 780 pounds. Some of the new Hornets develop 650 horsepower with only a comparatively slight increase in weight. These air-cooled engines weigh less than one and a half pounds per horsepower.—*A. K.*



***Right:* A good example of modern airplane engine design in which the manufacturers have increased the specific output by refinements in design. *Left:* One of the master rods of the new engine**

Preventing Corrosion in Airplanes

IN the practical construction of the airplane, one of the important problems is the protection of the aluminum alloys against corrosion under ordinary atmospheric conditions. When the aluminum alloy is exposed to a salty atmosphere, as is the case with flying boats or seaplanes, the danger of corrosion is more pronounced.

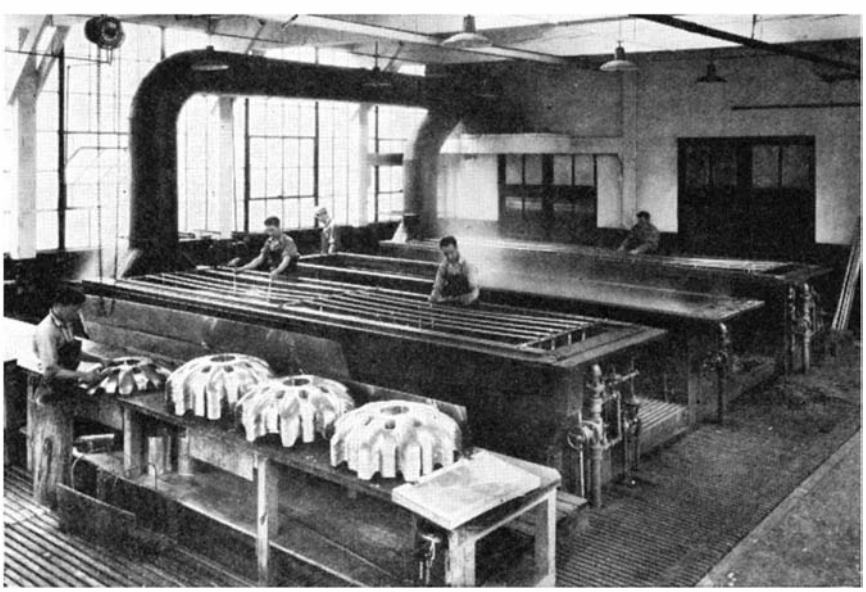
Corrosion may destroy the metal or cause the surface to become brittle. Either condition is disastrous from a maintenance and safety point of view. The aluminum alloys which are susceptible to corrosion contain in addition to the aluminum a certain amount of copper, silicon, and magnesium. The pure aluminum itself is free from corrosion to a high degree. Accordingly, a material called Alclad is frequently used; it consists of a strong alloy core with integral surface layers of pure aluminum. Of course, the introduction of the comparatively weak aluminum on the surface increases the weight for a given strength, and this is a decided disadvantage.

Another way of protecting aluminum alloys is to use a paint coating which must be applied with extreme care. The surfaces must be absolutely dry and clean. Oil and dirt may be removed by chemical cleaners or by mechanical methods.

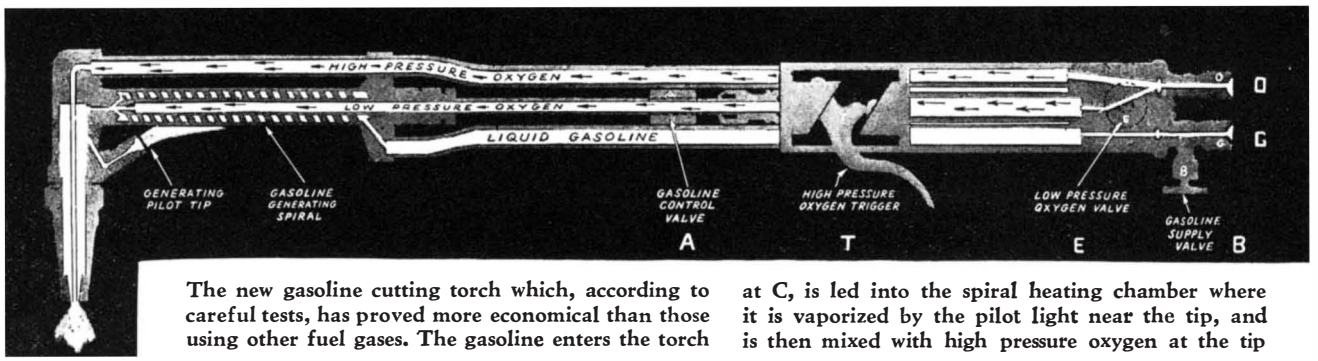
Still another and perhaps the most satisfactory of all methods of preventing corrosion is what is known as the Anodic process. The material to be treated is placed in an electrolytic solution, generally one of chromic acid. The temperature of the bath is maintained at 40 degrees, Centigrade. A current of low amperage is applied at a voltage increasing gradually to 50 volts.

After the parts have been submitted to this electrolytic bath for an hour or so, a complete oxide film is formed over the surface. Now since corrosion is itself a process whereby the metal combines with the oxygen of the air, the artificially induced oxidation of the surfaces prevents all further corrosion or oxidation.

Our photograph shows the long Anodic tanks used at the plant of the Boeing Airplane Company in building Navy planes.



To prevent corrosion of metal in airplanes, manufacturers now treat metal parts of planes electrolytically in tanks such as these which are in the Boeing plant



The new gasoline cutting torch which, according to careful tests, has proved more economical than those using other fuel gases. The gasoline enters the torch at C, is led into the spiral heating chamber where it is vaporized by the pilot light near the tip, and is then mixed with high pressure oxygen at the tip

Such tanks are now a part of the equipment of all the best airplane manufacturers and are rendering useful service to that phase of industry.—*A. K.*

Aerial Firefighting

THE Wright brothers certainly could not have foreseen all the uses to which the airplane would eventually be applied. In the *Weekly Underwriter* is described a curious example of the service which aviation can give at times. A farmer living near Evansville, Indiana, saw fire consuming his barn, granary, and smoke house. The wind blew the flames towards his house, which was apparently doomed. Then came an intrepid aviator who swooped low between fire and dwelling so that the propeller's backwash changed the direction of the air flow. Forty or 50 of these flights saved the day, so runs this extraordinary yet credible story.—*A. K.*

Oxygen Equipment

THE cold and unbreathable air at high altitudes spells mystery and danger to all of us. With the pilots of the Navy, the use of oxygen in flights at 25,000 feet and over is a matter of routine. At the same time extraordinary care is taken that the oxygen apparatus *does* function when needed, since its failure may mean death.

The equipment used is, in reality, very simple. The following are the elements and the process by which the pilot is supplied with the "make-up feed" of oxygen as the Navy calls it. The initial supply is contained in the flask at a pressure of about 120 atmospheres, or 1800 pounds per square inch, which would be extremely dangerous if it were suddenly freed. From the flask the oxygen is led through heavy-walled copper tubing to a regulator, which is within reach of the pilot and by which the pressure is reduced to a pressure suitable for breathing. This pressure reduction is accomplished either by manual control of the pilot, by automatic control, or by a combination of the two. The oxygen, at reduced pressure, is then finally led to the pilot, sometimes passing through a flowmeter which indicates the actual rate at which the oxygen is being supplied.

For moderate high-altitude work most pilots prefer to "smoke" the oxygen; that is, to take in the oxygen through a pipestem on the outlet tube held in the pilot's mouth. This is the simplest method since it permits the individual to breathe freely of the outside air while being fed the concentrated supply of additional oxygen. The pilot can then readily adjust the percentage of oxygen he requires.

If oxygen is used at any height about 15,000 feet, and is cut off on descent at about 12,000 feet, all ill effects such as nausea, and so on, are avoided.

While the apparatus is simple in principle and construction, there are nevertheless a good many precautions to be observed. The oxygen must be pure and dry. If the oxygen has a large moisture content it may freeze in the regulator with very unpleasant results. It is possible that when the oxygen begins to freeze, the pilot will gradually "go out", without realizing what is happening.

There are some simple methods of checking up on one's physical condition while at altitude. One wrinkle is merely to observe frequently a particular instrument or a wing brace, or similar part of the airplane. If the object becomes blurred, the pilot is immediately warned that something is amiss with his oxygen supply.

Our Navy pilots certainly have an adventurous life!—*A. K.*

Faster, Lighter, Better Trolley Cars

BULLET-TYPE, high-speed, light-weight trolley cars have been placed in interurban service from Fonda, Johnstown, and Gloversville to Amsterdam and Schenectady, New York. Weighing less than half as much as the cars they have replaced, requiring only half as much electric power for operation, and capable of higher running speeds and quicker stopping because of their magnetic track brakes, they have decreased the scheduled time of runs by from 15 to 20 percent.

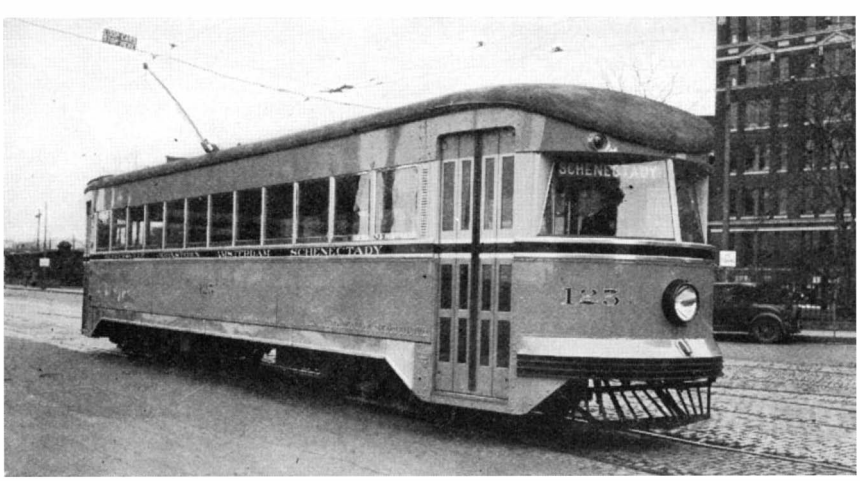
The five cars which have been placed in service were built by the J. G. Brill Company of Philadelphia, and were electrically equipped by the General Electric Company. They weigh 42,000 pounds each, and have seats for 48 passengers; the cars replaced weighed 86,000 pounds and seated 54 passengers.

To meet the requirements of the trolley line, the motors are geared for a maximum speed of 60 miles an hour, operating with full voltage (600 volts) on level track. Each car is equipped with four 50-horsepower motors, and General Electric air brakes. The new cars can be stopped in from 30 to 35 percent less time and in from 25 to 30 percent less distance by reason of their magnetic track brakes, which are additional to the air brakes. These magnetic brakes clamp down on the rails, greatly increasing the amount of braking surface. The cars are capable of accelerating at two miles per hour per second, sufficiently fast to hold their own with automobiles stopped by traffic lights.

Gasoline Cutting Torch

A NEW cutting torch which does any work that the acetylene torch will do, but is far more economical and is absolutely safe insofar as flash-backs through the fuel lines are concerned, has been brought out by Topping Brothers, of New York. Two gallons of gasoline used with this torch will cut as much material as the full size acetylene container of 250 cubic feet used with the regular acetylene torch, and no greater volume of oxygen is used in cutting given thicknesses of metal. Thus the full weight of the gasoline cutting equipment is only 180 pounds and the carriage is narrow and convenient contrasted to the cumbersome 440 pounds of the acetylene equipment.

An accompanying illustration gives a sectional view of the new torch. The gasoline supply enters the torch at C, from which point it is led into the spiral heating



One of the new streamlined, speedy, light weight cars used on a New York route

chamber. In this chamber the liquid gasoline is vaporized by the heat generated by the pilot light. The end of valve A, which is cone shaped, controls the supply of gasoline vapor entering the mixing chamber. This chamber is located in the head of the torch. The tip of valve A is also the end of the low pressure oxygen line and the amount of oxygen mixing with the gasoline vapor is controlled by valve E. The fuel vapor and low pressure oxygen enter the mixing chamber at the same point and are perfectly mixed through the action of the slotted baffle within this chamber. The high pressure oxygen is led to the end of the tip and controlled in the same way as in the ordinary acetylene torch.

Sweetest Sugar Made From Artichokes

SUGAR that is "sweeter than sugar" is the product of a model experimental plant at Iowa State College. Here Professor J. H. McGlumphy and J. W. Eichinger have developed a process for the production of levulose, a form of sugar which is sweeter than ordinary sucrose or cane sugar, and which has never before been produced at a cost permitting commercial exploitation.

The source of their sugar is the Jerusalem artichoke which contains from 7 to 24 percent of levulose. The artichoke is said to produce more sugar per acre than any other plant except sugar cane, while the cost of production per acre is less than for any other sugar-yielding plant.

The artichokes are harvested about November 1, washed, sliced, and dried. The dried chips will keep indefinitely without losing their sugar content. As needed, chips are "extracted" with hot water, dissolving out the sugars. This solution is acidified to convert the natural inulin and levulin to levulose which is then precipitated by the addition of lime. It is at this point in the process that Prof. McGlumphy has developed a new technique that makes the process commercially practical for the first time. After precipitation, the lime is liberated from the lime levulate by carbonation, the calcium carbonate filtered out, and the filtrate evaporated in vacuo to a thick syrup. Crystallization is accomplished by the usual sugar-house methods.

Levulose possesses unique properties which will make its introduction into our list of available sugars invaluable. These properties have been so widely discussed in scientific and popular literature that an almost ready-made demand awaits the advent of levulose. Chief among its possible uses is to supply the desire for a sweet and the necessity of carbohydrate to the ever increasing number of those suffering from diabetes. The high solubility of levulose makes it valuable for cold drinks. It has been used for infant feeding, since it is one of the most easily digested of the sugars.—*A. E. B.*

Avoid Nasal Infection

THE germ or virus causing infantile paralysis is not carried by lower animals but is confined to man. It enters the body chiefly through the membranes of the nose, and passes along the nerves of smell to the brain and spinal cord, where its main attack on the body is made. These are the conclusions which Dr. Simon Flexner, director of the Rockefeller Institute for Medical Research, has reported to the National Academy of Sciences.

The germ's chief avenue of escape from the body is back along the nerves of smell from brain and spinal cord to nasal membranes, Dr. Flexner said. This indicates that the nasal secretions carry the germ and may be the means of spreading it to cause new cases of the disease.—*Science Service.*

Tires for Shoes

AFTER America has worn out its automobile tires, peasants in Mexico, China, Spain, and Portugal get a lot more mileage out of them. Not that the impoverished peasants drive on them, for a motor-car is a "rara avis" on the sagebrush or mesquite-covered wastes on which so many of them live. They shoe themselves with the tires, instead.

Every year, America exports more than 50,000,000 pounds of discarded rubber, valued at more than a million dollars. Most of it is cut up into soles for primitive types of shoes worn by natives of many foreign lands.

In Spain, shoes known as "alpargatas," with rope or rubber soles, are popular in the rural districts. Within recent years, a type of this shoe, known as the "arbaca," with soles made from the discarded automobile tires, has become very popular.

Next to Spain, China and Hong-Kong provide the best markets for America's old automobile tires. Chinese coolies cut the tires into soles for their cheap shoes. The thinner and more worn parts of the old tire are cut out by hand to make shoes for 'rickshaw pullers. The sale price is about three cents a pair.

Shepherds in Portugal use inner tubes as overshoes for their wooden sabots and pieces of casing as supplemental soles and heels on wooden shoes. At Portuguese country fairs, it is not uncommon to find two or three stands dealing in used American tires and tubes.

In the accompanying photograph is shown

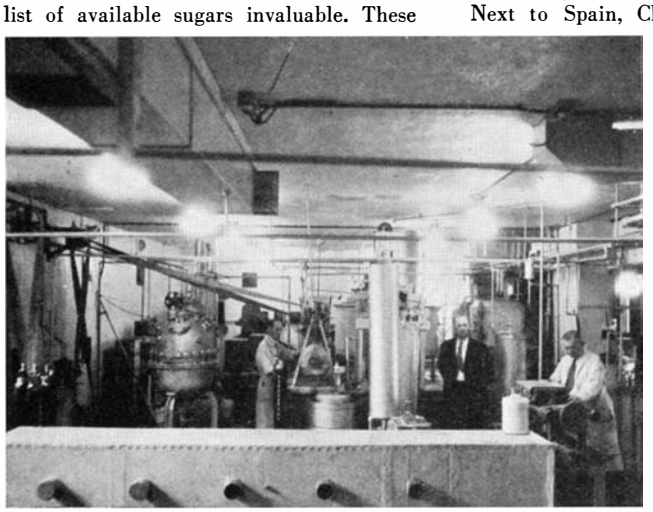
A stage headliner displays sandals made of old tires; shows a new one

a pair of the "arbaca" such as the Mexican peons wear. Miss Ann Greenway, displaying the shoes, smilingly admits that she would not care to have to walk far in them.

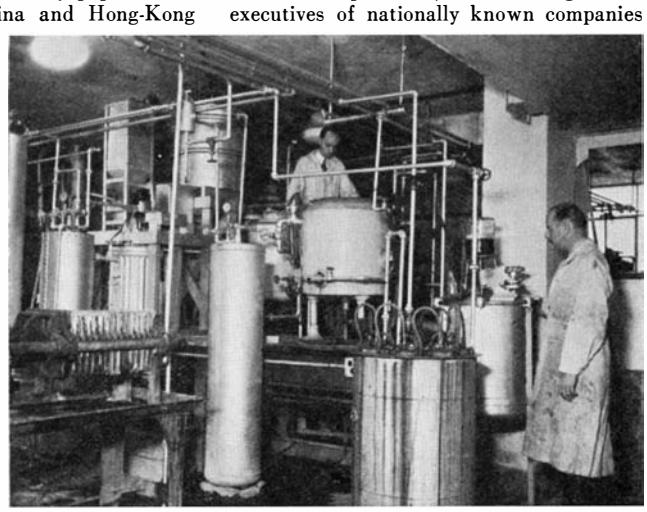
The tire on the car is the new General streamlined Jumbo.

Society of Tool Engineers

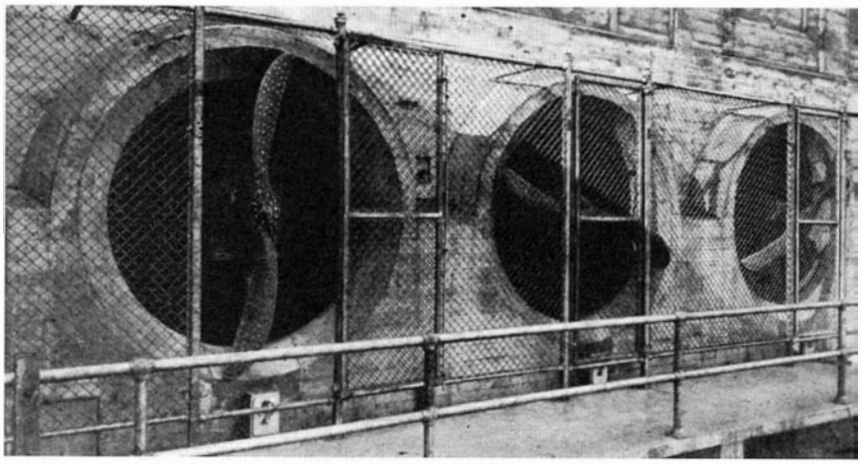
TO advance, promulgate, and further the arts and sciences of tool engineering, to hold readings and discussions of professional papers and reports at meetings, and to publish and disseminate such papers and reports to members, the American Society of Tool Engineers has just been organized with headquarters at 8316 Woodward Avenue, Detroit. Its officers, to hold office until April 1933, are tool designers or executives of nationally known companies



General view of the semi-works plant at Iowa State College where sugar is extracted from Jerusalem artichokes



Professor J. H. McGlumphy and J. W. Eichinger in the experimental sugar mill, showing complex apparatus



Installation of airplane propellers for forced-draft cooling of condensers

in the Detroit area, the president being Assistant Chief Tool Designer of the Packard Motor Car Company, and the vice president being Tool Designer of the Chrysler Corporation.

We extend our felicitations to the organizers. As a forum for the exchange of ideas and knowledge of tool design, the association has a promising future.

Chemicals in New Gas Refrigerator

REFRIGERATION from a gas flame is hardly a novelty, since an automatic refrigerator operating on this principle has been successfully marketed for several years. However, the announcement that General Motors, whose "Frigidaire" had come to be almost synonymous with electric refrigerators, is placing a gas-operated unit on the market has caused something of a stir.

The new refrigerator, to be known as the "Faraday," operates on the solid absorption principle, using strontium chloride powder with lithium nitrate as a binder for the absorbent. The refrigerant is liquid ammonia, and a fluorinated hydrocarbon liquid transfers the heat to and from the absorber. When refrigeration is needed, the ammonia vapor is evaporated from the strontium chloride absorbent by heating. This causes the ammonia vapor to flow through the condenser. It changes to a liquid and continues to the chilling unit. The absorber is connected by a single tube to the freezing unit in the food compartment.

The absorber unit is very compact and if desirable can be located on a shelf or in the basement at a distance of several feet from the freezing unit. Its placement does not in any way interfere with the operation of the temperature regulator which remains on the cabinet. A new type of metallic insulation is used which provides enlarged storage space inside the cabinet.—*A. E. B.*

Airplane Propellers in Power Plant

AIRPLANE type propellers are now in use in the largest forced draft cooling towers in the world—a feature of the Hawthorne Works of the Western Electric Company, Inc., near Chicago—for the purpose of cooling the condenser water used in the electric generating plant. Each reinforced concrete tower, 180 feet long by 38 feet wide by 50 feet high, is divided into eight independent compartments served by airplane type propeller fans, placed on each side, for forcing air up through the tower.

The two towers have a capacity of cooling 3,648,000 gallons of water per hour 17 degrees, Fahrenheit, or, speaking in terms of refrigeration, equivalent to the manufacture of about 900 tons of ice per hour. (This would be sufficient for ice-box requirements for about 1,500,000 families.) The condenser water is pumped to a distribution system of troughs near the top of the tower and from there falls downward through a current of rushing air, forced upward by the airplane propeller fans. For the purpose of dividing the water into small drops and to produce an intermingling of opposing currents of water and air, the inside of the tower is provided with a network of cypress wood slats. The water after falling through this network is collected in a four million gallon concrete reservoir, which serves also as a ready supply for fire protection purposes.

New Pop Corn Variety Pops to Greater Size

POP-CORN specialists have surpassed the record of two blades of grass for one. Through selection, they have produced a new strain which pops to 26 times its original volume.

The new strain, a yellow pearl pop corn named Sunburst, was produced during a seven-year period by agronomists of the United States Department of Agriculture in co-operation with the Kansas Agricultural Experiment Station.

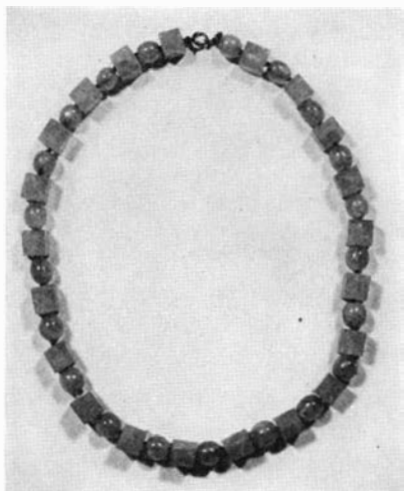
They produced the new strain by testing ears of pop corn and retaining for seed the ones which gave the greatest volume of popped corn. The test consisted of popping a sample of the seed from each of the selected ears and measuring the volume of the resulting popped corn. Each sample was also tasted for flavor and texture. The remainder of the seed on the good ears was kept and planted the following year. The process was then repeated year after year.

Although the testing was a long job, it proved worth the effort in producing better popping corn. It took one man a day to test from 60 to 75 ears of corn. However, the new strain showed an average of 26 times the volume of the seed when popped, while Queen Golden, the variety from which Sunburst was developed, gives only about 19 times the volume of the grain.

Such careful selection of seed, while not practical for the small grower, has possibilities for the commercial grower of popcorn seed, declare the agronomists who made the Kansas tests.

Amateur Gem Stone Polishers

IN our March issue, Mr. J. H. Howard introduced a new hobby: "Gem Stone Cutting for the Amateur." Evidence obtained since the publication of that article indicates that several hundreds have taken up or plan to take up this hobby. On this page we publish a photograph of a beautiful 22-inch necklace of rich rose quartz made by



An amateur gem polisher's result

Mr. Howard. It is desired to publish other photographs of amateur gem polishers' work performed according to Mr. Howard's practical instructions, devoting a special feature page to them if enough are submitted. Preferably, such photographs should be on glossy paper as these can be more easily reproduced. Credit will, of course, be given to the amateur workers in each case.

Gassing Ants in the Lawn

ACCORDING to entomologists at the New York State Agricultural Station, the most effective means of ridding lawns of ants is to "gas" the insects with carbon bisulfide placed in holes in the ground around the infested area. One treatment is usually sufficient, say these specialists, and will have no harmful effect on the lawn.

"Ants may show themselves in various ways in the lawn, some species building quite conspicuous and unsightly nests or 'hills' while others cover wide areas in the lawn with the openings to their underground quarters," says the statement by the Station workers. "In either case the treatment is the same—gassing with carbon bisulfide.

"The best way to get the fumes of the carbon bisulfide into the ant colonies is to make small holes about 8 to 12 inches deep and 6 to 8 inches apart around and through the infested area in the lawn. In each of these openings, place one tablespoonful of the carbon bisulfide and cover it immediately with soil. The treatment is made more effective by placing a wet blanket over the

infested area for about four hours to confine the gas. Carbon bisulfide is heavier than air and will replace the air in the tunnels occupied by the adult ants and the immature stages of the insects, thus effecting a quick death. One treatment usually suffices as most of the adults will be killed, and the young, if not killed outright, cannot survive without the care of the adults.

"It is not necessary to purchase highly refined carbon bisulfide, which is often quite expensive, the so-called 'technical' grade being entirely satisfactory for the purpose. Carbon bisulfide is highly inflammable and should be handled and stored with just as much care as would be exercised with a similar amount of gasoline. Also, special precautions should be taken while working with this material to avoid close contact with a lighted pipe, cigarette, or cigar."

Test Corrosion of Welded Joints

METAL welding has been developed to such an art that, nowadays, no one questions the physical strength of a welded joint. A factor that still bothers engineers, however, is the tendency for corrosion or rust to begin at a welded joint. In a weld of low-carbon steel, for example, corrosion may be expected to start in the zone where weld metal meets parent metal. At this point, according to the electrolytic theory of corrosion, a potential difference may exist which is responsible for an accelerated attack. Oxides and other heterogeneous particles, if present in the weld, tend to hasten corrosion by the formation of electrolytic cells. The soil corrosion of pipe line is an example. A more homogeneous weld should be expected with coated welding

wire than with bare electrodes since the coating resists the entrance of foreign elements.

To corroborate many facts already known on this subject and to uncover others, a special corrosion device has been built by the Westinghouse Research Laboratories which greatly hastens the slow process of rust. In it the test specimens are subjected to intermittent immersions in a corroding liquid. The apparatus suddenly immerses the samples for a definite period, leaving them at rest, and then exposes them to air for a definite period. The samples are moving only when being lowered or raised—a time which is a very small fraction of the cycle.

Samples are suspended from a rack by glass hooks, horse hair, or silk, and a motor-driven crank shaft raises and lowers the rack. The driving motor is controlled by a timing device composed of a synchronous motor operating a contact, which causes the motor periodically to turn the crank shaft a half revolution. The timing can be set for any cycle of test operation. To obtain reproducible results the corrosive liquids are kept at a constant temperature by circulating water of a constant temperature along the outside of the vessels containing the corrosive liquids.—*A. E. B.*

Copper-lined Ether Containers

ANESTHETIC ether is best preserved in its original purity by copper-lined containers, and when packaged under these conditions will remain entirely free from impurities for an indefinite period.

Investigations on this subject are reported by F. W. Nitardy and Dr. E. C. Billheimer of the Chemical and Pharmaceutical Laboratories of E. R. Squibb and Sons, Brooklyn, New York.

Experiments were made, according to the report, with various types of containers used by both domestic and foreign manufacturers of ether including ordinary tin cans, and bottles made of glass of varying types and degrees of transparency, wrapped and sealed with various materials designed to protect the ether from deterioration.

"It was found," the report states, "that peroxide-free anesthetic ether packaged in containers of this type almost invariably developed peroxides after varying storage periods, but that the same ether packaged in copper-lined tin cans, even though kept at elevated temperatures over long periods of time, remained free from peroxides or other decomposition products for an indefinite period."

The superiority of copper as a lining for ether containers, in preserving the original purity of the ether, was demonstrated in earlier tests, and has now been confirmed by these later investigations and by market experience.

"The purity of ether," Mr. Nitardy and Dr. Billheimer state, "is of extreme importance and should be a subject of interest to the layman because of the harmful effects which may result from the use of ether which is contaminated with only a small percentage of peroxide.

"There recently appeared in the medical literature a report of an investigation into the reasons for the development of pneumonia in certain patients following surgical operations in which contaminated ether was employed as an anesthetic. Experiments were conducted in which the behavior of oyster cilia was observed when treated with pure ether and with ether containing 0.003-5 percent peroxide.

"It was found that pure ether was not particularly toxic to the cilia, but that the contaminated ether produced prompt paralysis of the ciliary mechanism. Ether containing 0.01-0.02 percent peroxide had the same general but more deleterious effect. The conclusion drawn from this work is that the impure ether causes paralysis of the ciliary mechanism so that there are no active cilia to expel cocci during anesthesia, thereby giving ample opportunity for the development of pneumonia. Investigations are being extended to mammalian cilia to determine whether this effect is also observed in higher animals."

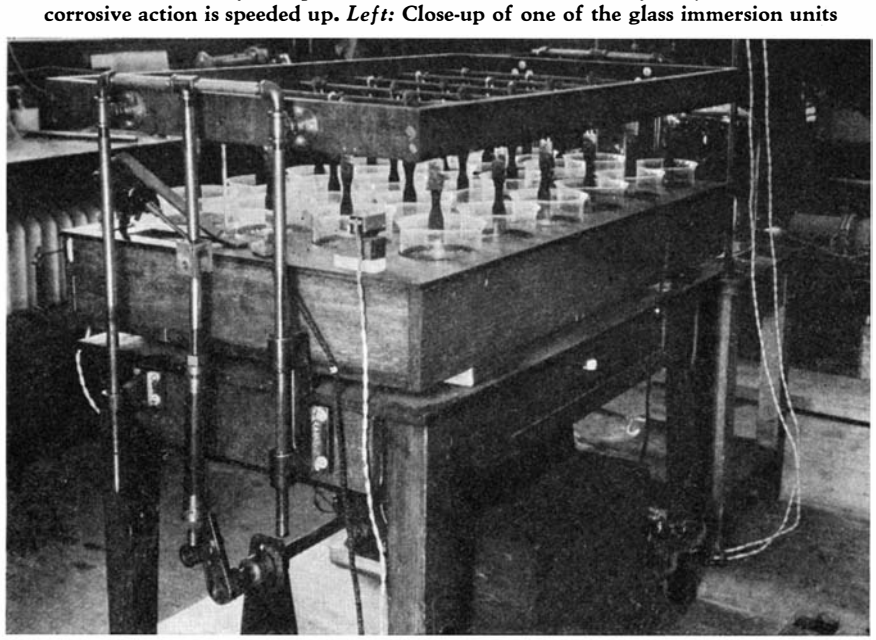
New Talkie Film Printer

A DEVICE for simultaneously printing pictures and sound-wave records on talking motion-picture film, resulting in fuller tone effects and clearer and better defined pictures, is announced by Bell & Howell Company. With the new machine, pictures and sound records are printed in one operation instead of separately. The printer is fully automatic, and one untrained worker can operate six machines.

After a film mask, or matte, has been made for the original negative film shot by the cameraman on location, and another matte for the sound record has been prepared, negatives and mattes are threaded into the machine in synchronism, and everything is ready to go. The masks, or mattes, automatically adjust the printing light intensity at every change of scene for both pictures and sound.

Once set up, the machine will turn out any number of finished prints without any other attention than that of threading fresh film stock and pushing the starting lever. It is entirely "fool proof," and cannot function if any of its parts are not correctly

Below: **A laboratory set-up to test the corrosion of welded joints, in which the corrosive action is speeded up.** ***Left:*** **Close-up of one of the glass immersion units**



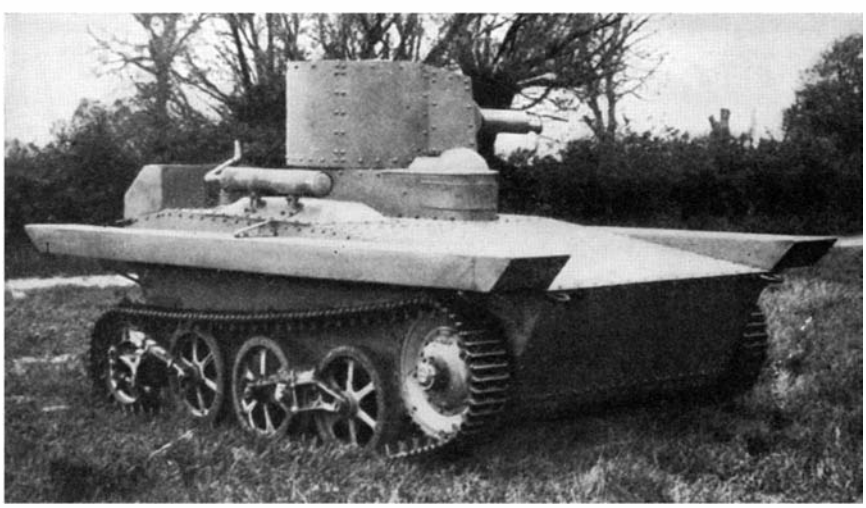
set. Accidental burning out of a lamp, breakage of film, or any error in threading, will lock the machine, or stop it automatically if the accident occurs while the machine is in operation.

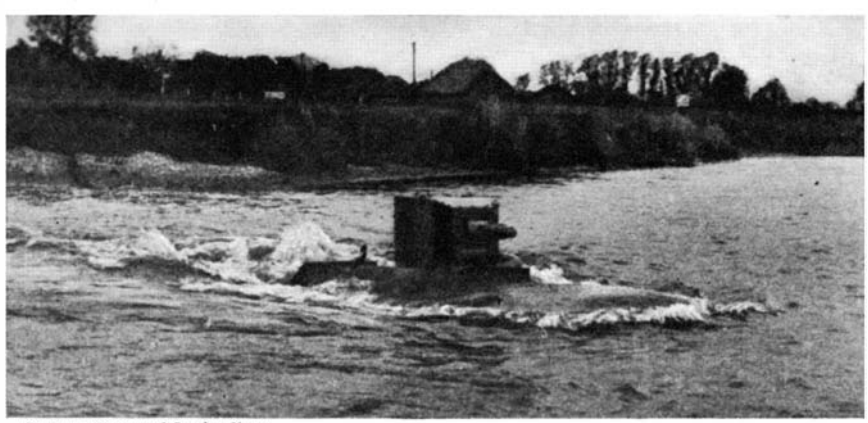
British Amphibious Tank

THE effect of the introduction into modern armies of armored vehicles, both tracked and on wheels, has been revolutionary in its influence upon the application of tactical principles. Illustrations on this page show the Carden-Lloyd amphibious tank which is able to cross wide stretches of water as well as to travel at high speeds over roads and fields. Should a commander in a future war wish to make a wide strategical turning movement against an enemy who is relying on a water line for protection, he will be enabled, by forming a flying column of tanks of this nature, to strike at the flanks of his enemy from whatever direction he pleases.

This amphibious tank is the result of much research and development work by the well-known British firm of Vickers-Armstrongs, Ltd. It has all the fighting qualities of the latest light tanks of comparable size, but, in addition, can navigate deep water with the same ease with which it crosses rough country. On land, traction is obtained by means of an articulated tread, while in the water, the tank is propelled by a marine propeller and steered by a rudder. Change from one method of propulsion to the other, as when entering or leaving the water, may be so quickly effected that movement forward is uninterrupted.

Two men constitute the crew of this tank. It carries a machine gun and 2500 rounds of ammunition. It weighs approximately 2¾ tons, is well armored with special bullet-proof plate, and naturally is of water-tight construction up to the conning tower. Its road speed is 40 miles per hour, but it can climb a continuous slope of 30 degrees and navigate water at a speed of six miles an hour.





Courtesy *Illustrated London News*

Above: **The British amphibious tank that has a road speed of 40 miles per hour and a water speed of six.** ***Below:*** **The tank as it appears over its depth in water**

Corrosion Resistant Paint

AN entirely new kind of paint, possessing remarkable corrosion-resisting qualities, has been developed as a result of the duPont company's researches on artificial "rubber." Chemists found that the same compounds formed in the synthesis of the rubber compound from acetylene gas could be dissolved in coal-tar naphtha or xylene to produce a paint base which is about 15 times more impervious to moisture than equally thick films of linseed oil paint. The compound from which Duprene, the artificial rubber, is produced, is known as monovinylacetylene. Its first cousin, divinylacetylene, produces the new paint base, to which duPont chemists have given the name "S-D-O" an abbreviation for "Synthetic Drying Oil."

According to O. M. Hayden, writing in *Industrial and Engineering Chemistry*, S-D-O base is an amber-colored, viscous liquid soluble in all proportions in aromatic hydrocarbons. When applied to a surface, it hardens by a chemical change known as polymerization instead of by the absorption of oxygen from the air. The rate of hardening is much faster than that of natural drying oils. S-D-O films usually dry dust-free in from 60 to 90 minutes, and tack-free in from one to two hours, depending on the thickness of the film, temperature, air circulation, and the presence of driers or inhibitors. They reach a high degree of hardness in from 12 to 24 hours, and are fully polymerized in 48 hours.

Fully polymerized S-D-O is not dissolved or softened by any solvent or combination of solvents. Acids and alkalies have no effect except to cause darkening, while corrosive vapors in the absence of moisture have no effect. It is not attacked by chlorine, bromine, brine, ammonia (solutions or anhydrous), hydrogen sulfide, crude oil, or refined petroleum products. The only chemicals that do attack S-D-O are strong oxidizing agents, such as concentrated hydrogen peroxide, chromic acid, nitric acid, and hot concentrated sulfuric acid. Hydrofluoric acid penetrates S-D-O films, but does not destroy them. With these exceptions, no chemicals have been found against which S-D-O does not give exceptional protection. Completely polymerized S-D-O will withstand temperatures as high as 200 degrees, Centigrade, without change.

The application of S-D-O to concrete walls, either from the inside or outside, prevents seepage of moisture through the wall, even though it be submerged in water under moderate hydrostatic pressure. The treatment of a concrete floor with S-D-O not only makes it acid-, alkali-, and moisture-proof, but also makes it non-dusting and considerably improves its wearing qualities. Concrete tanks, vats, absorption towers, and so on, are made acid- and alkali-proof by painting with S-D-O, and the same treatment might be used for concrete silos, swimming pools, water storage tanks, municipal water and sewage lines, and the like. Brick work and the various types of wood-fiber board, insulating lumber, and other cellulose products may be similarly treated. S-D-O has high dielectric strength and may, therefore, be used as an impregnating agent for insulating materials to render them moisture-proof.—*A. E. B.*

Female Hormone Plays Rôle in Bleeders' Disease

ONE of the female sex hormones may play an important part in the future treatment of the strange bleeders' disease known as hemophilia, if the preliminary studies reported to *Science* by Dr. Carroll La Fleur Birch of the University of Illinois College of Medicine are confirmed.

This condition is a rare disease of the blood with a strong hereditary tendency. Only males suffer from it, but it is transmitted through the unaffected women of the family. The outstanding symptom is a tendency to excessive bleeding which may be spontaneous or may result from a slight injury that would pass unnoticed in an ordinary individual.

A strong hemophiliac tendency exists in several of the royal families of Europe today. The oldest son and heir of the deposed King of Spain suffers from this disorder, as did the ill-fated Czarevitch of Russia. An-

(*Please turn to page* 55)

THE AMATEUR ASTRONOMER

Conducted by ALBERT G. INGALLS

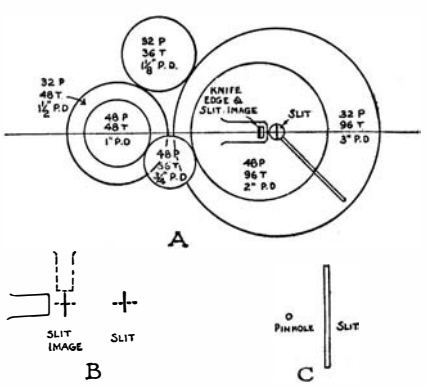
INSTEAD of a pinhole, Russell W. Porter and others have been experimenting with a slit for the knife-edge test, and it appears there is a decided gain in delicacy. Mr. Porter sends in the following description of the new test:

"Here is, so far as I know, something new in knife-edge testing:

"In the last stages of testing an optical surface by the knife-edge method of Foucault, it is often found desirable to increase the contrast of the so-called knife-edge shadows without loss of sensitivity due to enlarging the size of the pinhole.

"If one should imagine a series of pinholes placed one over the other, together forming what in effect would be a slit, and if the knife-edge were brought up in the usual way until the shadows were most distinct, it would be found that there was no loss in sensitivity, but at the same time that the contrast due to the increased illumination had been enhanced many fold. The proper method of controlling this rather unusual light source will be described here.

"We can state this improved condition in another way: If a slit is used whose jaws are separated so as to let through to the mirror under test no more than the same amount of light that would be delivered by a pinhole, then the slit will be so narrowed that the delicacy of the test is greatly increased.

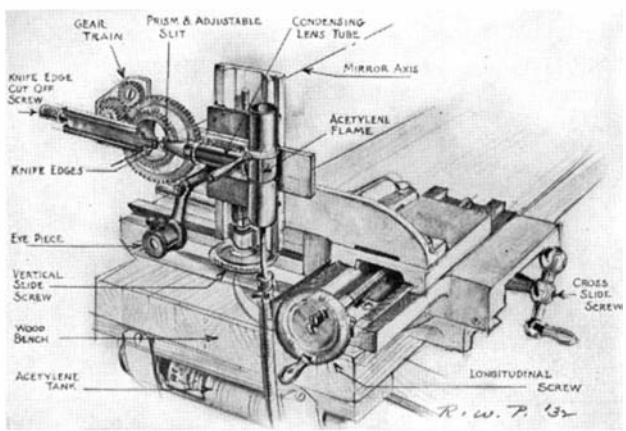


Diagrams of gears, images, slit

"The perspective drawing shown will give a clear idea of the whole knife-edge equipment as used here at the California Institute of Technology. The light source is an acetylene flame. Two lenses in the tube adjacent to it form an image of the flame on the adjustable slit placed just in front of a small prism.

"If one now refers to the diagram at B, he will see the following situation: A vertical slit (full line) will produce an image parallel to itself—that is, the other vertical full line—by reflection from the concave mirror under test. If the slit is rotated 90 degrees it (and its image) will take the positions given by the dotted lines shown.

"The problem is to tie the knife-edge to the slit in such a manner that the edge of the knife will always be parallel to the image of the slit, no matter what position-angle is used, whether horizontal, vertical or diagonal. Of course, the same purpose can be accomplished by graduating a dial concentric with the center of the slit, and a similar dial for the knife-edge, and setting these at the same angle, thus obviating the gear train. But the relations of slit image and knife-edge may be made automatic by means of the gear train shown in the upper part of the diagram. For anyone who cares to make this automatic control, the characteristics of the different gears are given.



Machine for the new slit test, at "Cal Tech"

"The slit revolves with the largest gear shown, and the knife-edge with the next largest. The slit and its image are normally about an eighth of an inch on either side of the axis of the mirror, or a quarter of an inch apart.

"The actual test is made just as with the familiar Foucault test and the shadows also are like those of that test. The necessity of rotating the slit and knife-edge arises when testing a flat in combination with a spherical mirror, the cut-offs being horizontal and vertical. Diagonal cut-offs are useful in locating astigmatism. The arrangement for the amateur who is figuring a telescope mirror may be simplified by using as a light-source a small electric lamp covered with ground glass, and the entire instrument may then be rotated as a unit. The eye-piece shown in the sketch is for examining the image of the light-source produced by the mirror as in the eye-piece test."

HERE is another short contribution by Mr. Porter:

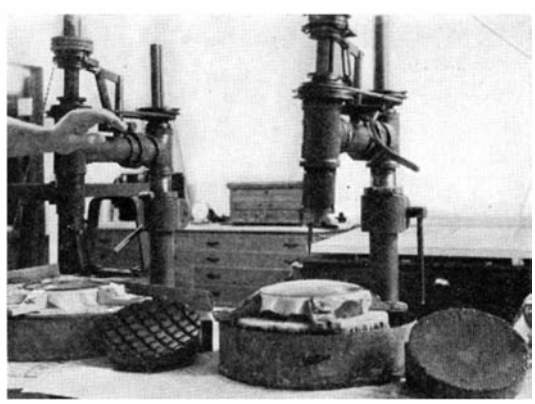
"It may be of interest to users of HCF to know that comparison tests have been made here on a number of lenses, half of them polished with a cast-iron tool covered with the comb foundation and half with the ordinary tool of pitch facets painted with beeswax. These lenses are commercial plate glass, 19 in number, 7¼ inches diameter, plano-convex, the convex surfaces all having a radius of 12.6 inches.

"Aside from the differences in the tools given above, these lenses received identical treatment on the machine. The photograph shows the machine with two of the lenses on their revolving tables, their respective tools lying face up on the bench. The stroke employed was circular, the tool being driven from a pin set eccentric to the driving spindle, this spindle being offset from the axis of the table below by the desired amount.

"A glance at the work sheets of Mr. Brown, the optician in charge of the work, indicates the following results:

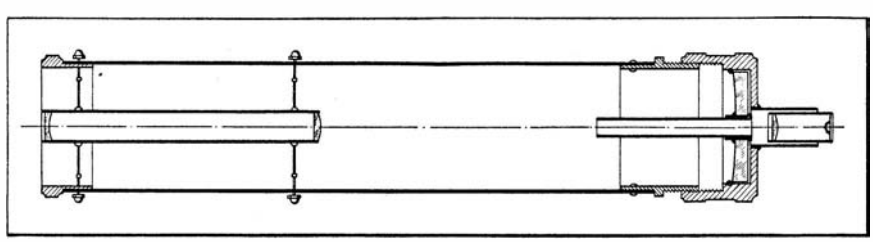
1.—The length of time required to produce a complete polish was about ten hours.

2.—The rapidity of polishing with the two tools was about the same.



Testing HCF against pitch

"Since the lenses are to be used as condensers only, no figuring of their surfaces has been attempted, the only point I wish to bring out in this run of work being that there seems to be very little difference in the polishing speed between the two tools.



Nicholson's combination, the Cassegrainian secondary being removable

"At first the comb foundation tool had three layers of wax. With this tool the polish came up unevenly from center to edge, depending on slight differences in the radii of the lenses. This, Mr. Brown thinks, is undoubtedly due to the unyielding nature of beeswax. But when the number of layers was increased to six, sufficient air cavities between the different layers permitted good contact to be secured after a period of cold pressing. As a matter of incidental interest, the first pairs of lenses were fine ground with No. 303 emery. Later on, several pairs were finished

Nicholson's telescope, made from instructions in the book "Amateur Telescope Making" and elsewhere

with No. 303½, but the time required for polishing was about the same.

"The particular batch of plate glass used contained a quantity of extremely fine bubbles. These bubbles made it somewhat difficult to determine just when complete polish had arrived."

AMONG those enterprising "Amateur Telescope Makers and Astronomers of Tacoma," there is one, Ben L. Nicholson, who has juggled the "makings" of a Cassegrainian and a Gregorian into a neat combination of the two. The idea is sufficiently well shown at the bottom of the opposite page, and a picture of the completed telescope is shown above. This makes Mr. Nicholson a magnate in the "Cassegrainian Club" and we therefore dub him a count—"Count Gregorian Nicholson."

LAST month we told how a snake possessed of a predilection for ladies (it seems they digest more comfortably) chased a lady twice around *Stellafane* at the 1931 get-together held there. Several indignant Vermonters now assert that Vermont is as free from snakes as Ireland. But this was no ordinary Vermont reptile, being one of the rare sub-arctic boa-constrictors. It had stopped off on its seasonal migration from Baffin Land to Tierra del Fuego. During their two yearly crossings of the tropics these snakes find plenty to eat and reach a length of 46 feet. However, by the time they reach Vermont they have shrunk to a mere 16 or 18 feet but they are hungry. The meeting this year will be on August 27. Men, bring along snake-bite remedy.

CURRENT BULLETIN BRIEFS

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

PLANTING BLACK WALNUT (Leaflet No. 84, U. S. Department of Agriculture). The eastern black walnut tree is widely known because of the high value of its dual product of timber and nuts. The little leaflet gives full information. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

MORE TURPENTINE, LESS SCAR, BETTER PINE (Leaflet No. 83, U. S. Department of Agriculture). This leaflet recommends low chipping. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

BEAUTIFUL ONTARIO—CANADA'S PREMIER PROVINCE is beautifully illustrated; several pictures are in color. It will be of great help to prospective tourists. *Tourist and Publicity Bureau, Parliament Buildings, Toronto, Canada.—Gratis.*

KNIT UNDERWEAR (EXCLUSIVE OF RAYON), (Commercial Standard CS 33—32, Bureau of Standards), gives standard methods of measurement for the guidance of producers, distributors, and users in order to provide a uniform basis for guaranteeing full size. It includes recommendations for standard box sizes and washing methods. *Superintendent of Documents, Washington, D. C.—15 cents (coin or money order).*

AIRWORTHINESS REQUIREMENTS OF AIR COMMERCE REGULATIONS FOR AIRCRAFT (Aeronautics Bulletin No. 7-A) are based on present developments, and experience indicates that, when applied to conventional types of construction, they will result in an airworthy and well-proportioned aircraft. *Aeronautics Branch, U. S. Department of Commerce, Washington, D. C.—Gratis.*

THE EFFECT OF THE PRODUCTS OF COMBUSTION ON THE SHRINKAGE OF METAL IN THE BRASS INDUSTRY (Engineering Research Bulletin, No. 22, December, 1931, University of Michigan), by C. Upthegrove and A. J. Herzig, bears on three phases of the subject: the temperature and character of the furnace; the character of the furnace atmosphere; and the use of fluxes to minimize shrinkage. *Department of Engineering Research, University of Michigan, Ann Arbor, Michigan.—$1.00.*

ZINC AND ITS ALLOYS (Circular of the Bureau of Standards, No. 395). The Bureau of Standards is doing good work in getting out monographs on individual metals or alloys. Such information as these pamphlets contain is rarely found in systematic form, with correct data properly interpreted. Here we have a 214-page book giving most valuable information. *Superintendent of Documents, Washington, D. C.—70 cents (money order).*

FUNDAMENTAL PRINCIPLES OF RADIO (The Universal Library, Volume II), by Louis Martin, B. S., describes the origin, nature, and functions of radio. There are 80 illustrations and diagrams as well as a valuable chart of radio symbols. *Press Guild, Inc., 16 Murray Street, New York City.—50 cents.*

REPORT OF COMMITTEE ON AIRPORT DRAINAGE AND SURFACING has just been issued. Although not intended as a text-book on the general subject it does offer detailed suggestions as to the methods of providing the facilities that are needed in this connection for the operations of aircraft. *Aeronautics Branch, Department of Commerce, Washington, D. C.—Gratis.*

EFFECT OF CALCIUM AS AN ADMIXTURE IN PORTLAND CEMENT CONCRETE (Bulletin No. 61). Calcium chloride added to Portland cement gives a higher early strength, a safer and speedier curing. This monograph goes deeply into the subject. *Engineering Experiment Station, Ohio State University, Columbus, Ohio.—50 cents.*

DISTANCE RANGES OF RADIO WAVES (Letter Circular 1317, Bureau of Standards) is given mainly on two graph sheets, one for day and one for night transmission. *Bureau of Standards, Washington, D. C.—Gratis.*

THE MINERALS OF CONNECTICUT (Bulletin No. 51), by John Frank Schairer, Ph. D., is an excellent monograph on the minerals and aggregates of the state. *George S. Godard, State Library, Hartford, Conn.—75 cents, postpaid.*

COTTON CLOTH FOR RUBBER AND PYROXYLIN COATING (CS32-31, Bureau of Standards) contains some out-of-the-way information in giving a recorded standard of the industry. There is a full list of manufacturers. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

ELECTRIC HOTBEDS, COLD FRAMES, PROPAGATING BENCHES, AND OPEN SOIL HEATING (Reports No. 5 and 6 National Rural Electric Project) is in two parts; the first deals with construction and use and the second with investigation and research. The pamphlets are fully illustrated with pictures and diagrams. *National Rural Electric Project, College Park, Maryland.—Gratis.*

CONSERVATION OF FERTILIZER MATERIALS FROM MINOR SOURCES (Miscellaneous Publication, No. 136, U. S. Department of Agriculture) tells how to utilize a great variety of waste substances. Such materials should be saved and either applied direct to the soil or composted with manure before using. *Superintendent of Documents, Washington, D. C.—5 cents (coin).*

TREATED LUMBER—ITS USES AND ECONOMIES (Report of the subcommittee on retail distribution of treated lumber of the National Committee on Wood Utilization, U. S. Department of Commerce). This pamphlet brings to the attention of the consumer the importance of treated wood and also attempts to interest the retail lumber dealer in making it possible for the small consumers to purchase such treated wood. *Superintendent of Documents, Washington, D. C.—15 cents (coin or money order).*

SOUTH BEND JUNIOR EIGHT-INCH BENCH LATHE describes a lathe which embraces many novel features. It also explains the blueprint and instruction service inaugurated by the builders. For a free copy mention this magazine. *South Bend Lathe Works, South Bend, Indiana.—Gratis.*

THE WONDER BOOK OF RUBBER is a story of rubber manufacture and use of rubber products, well illustrated. *B. F. Goodrich Company, Akron, Ohio.—Gratis.*

WAGE-EARNING WOMEN AND THE INDUSTRIAL CONDITIONS OF 1930—A SURVEY OF SOUTH BEND (Bulletin of the Women's Bureau No. 92, U. S. Department of Labor), by Caroline Manning and Arcadia N. Phillips, is a community survey intended originally to serve as a background for more specialized studies of the effects of the modern trends in industry, but owing to the business depression the survey quickly resolved itself into a study of unemployment. *Superintendent of Documents, Washington, D. C.—15 cents (coin or M. O.).*

THE EVOLUTION OF THE HORSE FAMILY (Special Guide No. 1, Peabody Museum of Natural History), by Richard Swann Lull, is an illustrated guide to the magnificent collections in the specialized museum at Yale University. *Peabody Museum of Natural History, New Haven, Conn.—15 cents.*

A PRACTICAL PROGRAM IN CANCER PUBLICITY (Reprinted from *Hospital Social Service*, XXIV, 1931, 215), by Ella Hoffman Rigney, gives valuable information as to what is being done to disseminate information about the second greatest cause of death in the United States. *American Society for the Control of Cancer, Inc., 25 West 43rd Street, New York City.—Gratis.*

SHORTLEAF PINE (Farmer's Bulletin No. 1671, U. S. Department of Agriculture), by Wilbur R. Mattoon, describes one of the most profitable forest trees to grow as a crop over a large area of the uplands and mountains from New Jersey to Georgia and west to Oklahoma and Texas. *Superintendent of Documents, Washington, D. C.—10 cents (coin).*

THE SCIENTIFIC AMERICAN DIGEST

(*Continued from page* 50)

other feature of the disease is the fact that it takes the blood much longer to clot than is usual.

Dr. Birch reported that he and his associates had located a family of hemophiliacs in southern Illinois whose family records were traced back 125 years through six generations. There had been 16 bleeders in this family, seven of them now living.

Dr. Birch started his investigations on the theory that if the women of such a family can transmit the disease, they must potentially have it, but something in the female mechanism holds it in abeyance. The greatest difference between males and females is in the sex organs. He therefore treated two boys who were marked sufferers from the disease with ovarian extract and implanted ovarian tissue in one of them.

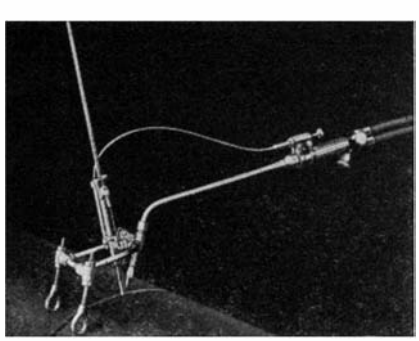
These boys had scarcely ever been free from hemorrhage for a month at a time before this treatment. After the treatment, the boy who had the extract from the female glands was free from bleeding for 11 months, and the one who had the ovarian transplant was free from bleeding for five and one half months.

Dr. Birch and associates are continuing their studies on this disease, as their present experiments are incomplete, he reported.—*Science Service.*

New Welding Blowpipe

A NEW oxy-acetylene welding blowpipe, revolutionary in design and accomplishment, has been introduced by The Linde Air Products Company of New York.

The Lindewelder, as the new device has been named, is a two-flame blowpipe with a rod holder which feeds the special welding rod automatically by gravity. A rod-lifting device controlled by a trigger on the blowpipe handle permits the operator to raise or lower the welding rod as required in starting and completing the weld, in passing over tack-welds and in



The gravity-fed welding blowpipe

changing rod. A carriage having two adjustable runners supports the blowpipe during the welding operation. This feature provides greater ease in manipulation and complete comfort for the operator, as only one hand is required to hold the blowpipe.

Two separate flames are utilized in the Lindewelder, one for preheating the welding rod and one for performing the actual welding operation. The upper or preheating flame is so adjusted that the inner cone impinges directly on the rod as it emerges from the lower end of the rod holder, preheating it nearly to the melting point. The lower flame is the welding flame, which is directed between the vee and the rod so that it prepares the base metal for proper fusion with the weld

The new oxy-acetylene welding torch, in use, is almost automatic

metal and simultaneously melts the end of the preheated welding rod in the welding puddle.

Through the use of the Lindewelder, the Lindeweld process becomes almost automatic. It is claimed that welds of superior strength and quality are produced at greatly increased speed. In the field of overland pipe line construction, the time required to make a weld has been reduced 40 to 60 percent as compared with older methods.

Chemist Improves on Nature in Producing Vitamin C

THE sensational discovery of the chemical formula of Vitamin C by a young Norwegian chemist, announced previously in these columns (page 313, May, 1932 issue), is undoubtedly one of the most significant scientific developments of the year. Ottar Rygh, the discoverer, has not only disclosed the chemical identity of this mysterious substance but he has also pointed out a simple way of producing the vitamin substance in large quantities from cheap raw materials. The details of his experiments, in which more than 15,000 oranges were consumed to provide material for his research, have now been made public in a publication of the Fridtjof Nansen Foundation.

As a result of Rygh's work narcotine has been shown to be the pro-vitamin C which, upon the ripening of the fruit, is chemically changed into vitamin C which is found to be the chemical known as orthodiphenol. Synthetic orthodiphenol, prepared in the chemical laboratory, has been shown to be active against scurvy in guinea pigs when 0.02 to 0.03 of a milligram is administered daily.

The investigations that led to this result were carried out in the following way: Raw juice, obtained from oranges by pressing, was centrifuged and gently evaporated in

vacuum to about one sixth of its original volume at a temperature not exceeding 25 degrees, Centigrade. The concentrated juice was shaken with ether to remove the small suspended oily particles; during this treatment the turbidity disappeared. A sodium hydroxide solution was then added in small portions with air excluded, until the reaction with litmus was very faintly alkaline. It was again extracted with ether and the extraction product evaporated to remove the ether, all operations being carried out in the absence of air.

The residue, which had a strong anti-scorbutic power, consisted of a yellow oil mixed with needle-shaped crystals, which were shown to be narcotine. Extensive experiments led to the conclusion that the unripe fruit is rich in narcotine and poor in vitamin C, while the ripe fruit is rich in vitamin, the narcotine disappearing during the ripening of the fruit.

The second part of the problem was to synthesize the vitamin from pure narcotine. Irradiation with ultra-violet rays was first tried, but only a slight change in the biological action of the substance was observed. Then an effort was made to change the narcotine by chemical treatment. After two hours' treatment of narcotine with strong hydrochloric acid, the monophenol is formed, and after six to seven days the orthodiphenol. The monophenol showed a slight anti-scorbutic action, whereas the orthodiphenol was found to be preventive of scurvy in guinea pigs when administered in doses of 0.02 of a milligram a day. When as much as 0.1 of a milligram a day was administered, symptoms of overdosage appeared.

Ottar Rygh was born in 1903 in Stavanger, Norway. In 1927, he received the degree of Mag. Art. at the University of Oslo and afterwards studied vitamin chemistry for two years with Professor Windaus at the University of Göttingen, Germany. During his work on vitamin C he has been assisted by his wife, Aagot Rygh, who is also a chemist, and by another young Norwegian chemist, Per Laland. The X-ray examinations of the research animals have been carried out by C. G. Sundberg of the University of Upsala, Sweden.—*A. E. B.*

Get Five Grams of Radium in 25,000 Platinum Tubes

A CONSIGNMENT of five grams of radium worth 350,000 dollars, packed in 25,000 tiny platinum tubes worth 50,000 dollars, has been received by Bellevue Hospital, New York, to be used in cancer treatment. This hospital now has 10 grams of radium, twice as much, it is said, as any other medical institution in the world.

As explained by Dr. Francis Carter Wood, head of the Crocker Institute of Cancer Research at Columbia University, radium is kept in platinum tubes during cancer treatment. The platinum absorbs the beta rays given off by the radium, and thus prevents burning the patient. The precious metal permits radium's gamma rays to pass into the body. The latter rays then produce the beta rays which do the work in the internal treatment of cancer.

The five grams were packed in 10 cases, each containing 25 lead cartons. In each carton were 100 platinum tubes filled with the precious substance. The consignment, lent to New York City by the Belgian Government Radium Foundation, was measured by the United States Bureau of Standards in Washington, and also checked there as to its strength.

Controlling the Radio Announcer

MORE than one person has expressed a desire for some sort of device which would automatically cut out the blatant advertising ballyhoo now so prevalent on the radio, and then turn on the set as soon as the entertainment resumes. This Utopian dream has not been realized, but the next best thing is available. It consists of a device which is manually operated as a remote control for all radio sets, so arranged that it may be placed anywhere desired. When the ballyhoo starts, press the button and tone it down to a whisper. When the program resumes, release the button, and the volume is restored to normal.


Four locations in which the new radio volume control may be used

The device, made by the Alden Manufacturing Company, of Brockton, Massachusetts, consists of a molded push-button, the button proper having a travel of half an inch. As the button is depressed, a resistance is slowly decreased until at the end of the stroke there is a virtual short circuit. The resistance is connected across the aerial and ground binding posts on the set, or, where an aerial is not used, it is connected to a special tube adapter. The push-button is obtainable either plain, with a clamp, or with a weighted tapestry strap for use on armchairs.

Aside from the desirable announcer control feature of this device, it may be placed near the telephone so that the radio volume may be reduced without going to the set. When placed on the floor, the push-button may be operated by the foot.

Domestic Goat Joins Wild Deer

A STRANGE sight in Rocky Mountain National Park, Colorado, is that of a goat of the cultivated variety, with a tinkling bell around his neck, grazing and migrating with a herd of deer.

Several years ago this goat escaped from a local ranch and took up his residence with the deer. He has been seen several times since with his adopted family.—*Science Service.*

Steel Made Super-Hard by Rapid Chromium Plate

AN intensely hard surface is put on steel tools to increase their usefulness many times by a process of rapid chromium plating at high temperatures reported recently to the Electrochemical Society by Lieutenant A. Willink of Frankford Arsenal, Philadelphia.

As an alloy, chromium made steel stainless; as an electroplate, it gave automobile parts an ever-shiny, non-rusting finish, and it hardened tools and parts of machinery subject to great wear. Now, by the new method, it imparts to tool steel a coat of super-hardness.

A certain die plated by the new method stood up for 85,000 impressions in the Frankford Arsenal. Protected by an ordinary chromium plate, it had a life of about 25,000 impressions, and without the chromium protection it was useless after a 4000 run.

The new method has the additional advantage of requiring much less time than the old. Plating is done in a bath at about 150 degrees instead of 65 degrees, Fahrenheit, and the current density is at least 1000 amperes per square foot of plating surface.—*Science Service.*

Individual Dry-Cleaning Machines

USE of trichlorethylene in the dry-cleaning industry has increased rapidly in England, says the London correspondent of *Chemical and Metallurgical Engineering.* This development is attributed to the recent introduction of a new type of machine for cleaning garments individually in a few minutes, as compared with the usual practice of putting 30 or 40 garments in a rotary washing machine for over an hour.

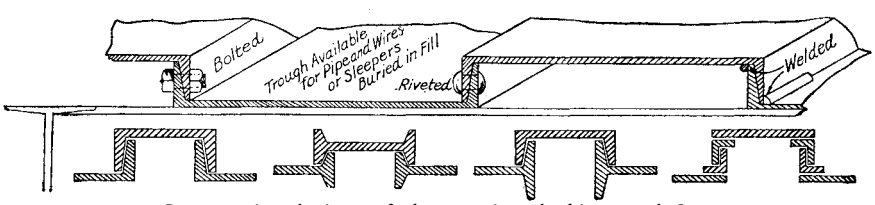
The apparatus combines a small rotary washer with a storage tank for the solvent above it, and a still below, from which cleaned solvent is returned to the storage tank. These machines, together with a hydro extractor and drying plant, attract much attention in retail shops, which report very good business. Other machines are using mixtures of carbon tetrachloride and benzene, and, where large enough, are combined with a solvent recovery plant. "There seems little doubt that the trichlorethylene individual method will be considerably extended," says the English writer.—*A. E. B.*

Interlocking Steel Floor

A NEW type of steel floor construction which can be shop fabricated and shop assembled in widths and lengths limited only by the limitations of transportation facilities has been worked out by the Belmont Iron Works of Philadelphia. This company's rolled structural steel interlocking floor is an important development in steel construction for fire-proof structures of all types and particularly for the typical American skyscraper.

The Belmont floor has been put into production in commercial widths and lengths, 7 feet by 20 feet, by the three usual methods of shop fabrication: bolting, riveting, and welding. The fact that the steel contractor can detail, fabricate, and erect it along with the structural steel skeleton framework is one of the outstanding features of the new floor. In addition, it at once furnishes not only to the steel erector but to the general contractor and every sub-contractor as well, a rugged, tight, fire-proof working floor at every floor level for all construction purposes.

The accompanying illustration shows clearly the simple method of laying the various kinds of interlocking steel floor structural members. Bolting, riveting, and welding practices are shown. The ends of these members rest upon spandrel girders and intermediate floor beams usually supported, in addition, by filling-in beams at their centers.



Cross-sectional views of the new interlocking steel floor

Rasorite Discovery Promises Better Glass

CALIFORNIA has disclosed an entirely new mineral, named "Rasorite" after its discoverer, C. M. Rasor, well-known as a borax engineer. It is tetrahydrate of borax, and 8,000,000 tons of it lie in Kern County. According to *Science Service,* it promises to cheapen borax, and greatly extend the use of unbreakable borax glass of the kind known as "Pyrex." Ordinary glass breaks because it has a high co-efficient of expansion. Glass made from quartz has a low co-efficient. Quartz is very refractory, however, melting only at very high temperature. When borax is used with quartz we get "borosilicate glass" or "Pyrex." This vast deposit, enough for 50 years, will give us more borax for glass, welding fluxes, enamels, and so forth. In glass, it should give us unbreakable fruit jars, milk bottles, tumblers, carafes, and a multitude of other everyday things.—*A. E. B.*

New Sources of Alcohol

THE United States Commissioner of industrial alcohol, Dr. James Doran, recently told the House of Representatives Appropriations Committee that "about 8,000,000 gallons of industrial alcohol are produced from crude oil" in the United States. The largest plant in the world for making alcohol out of petroleum is in Charleston, West Virginia. The crude oil is "cracked" to yield ethylene gas which is then converted to ethyl alcohol. The extent of this process for the manufacture of alcohol shows quite plainly that the old process of producing alcohol by fermentation from sugar solutions is rapidly giving place to the new catalytic method in this country.

Meanwhile, in Europe, where the high price of gasoline encourages the admixture of alcohol with gasoline for motor fuel, two processes for making alcohol from wood are being developed commercially—the Bergius process and the Scholler-Tornesch process. The latter involves the conversion of wood into sugar by treating the wood with weak acid. It is said that 50 pounds of sugar are obtained from 100 pounds of sawdust, and that 40 pounds of the sugar can be fermented into alcohol. If, through the use of this process only 5,000,000 tons of the previously worthless waste wood is treated, 2,000,000 tons of sugar can be produced. The total production of the en-

tire German beet-sugar industry is only 1,900,000 tons. The wood sugar would not compete with the edible variety, but rather would be used in animal feed and for the production of enough alcohol to make the country independent of foreign motor fuels. A valuable byproduct is lignin, a useful fuel, of which about 30 pounds remains after the treatment of 100 pounds of sawdust.—*A. E. B.*

Caffein Overdose May Cause Sterility

TOO much caffein, the substance that puts the "kick" in coffee, may have a bad effect on the male reproductive physiology, even causing partial or total sterility. Such at least is the indication of experiments by Prof. Hermann Stieve of the University of Halle, reported in the German scientific weekly, *Die Umschau.*

Prof. Stieve administered to male guinea pigs doses of caffein ranging from .018 to .09 gram per kilogram of body weight. They became partially or totally sterile, and anatomical examination showed degenerative changes in their reproductive glands.

However, undue alarm need not be taken by human beings, for a little calculation shows that to take in .09 gram of caffein per kilogram of body weight an average-sized man would have to swallow four or five gallons of the strongest coffee. Race suicide by the coffee route is therefore considered hardly a practical menace. But the danger that lurks in becoming habituated to caffein tablets, which some persons take freely in order to keep going under strain, is not to be minimized.—*Science Service.*

Rolling Electric Motor Frames

TO roll a cold strip of iron six inches thick, 30 inches wide, and 20 feet long, into a circle requires tremendous power. This is one of the operations involved in making frames for electric motors.

In the accompanying illustration, the camera was in a "pulpit" where the operator pulls levers that manipulate the machinery. The circular gage at the left tells him about the pressure and other facts. After the straight strip leaves the horizontal rollers, lower left, it passes between three vertical rollers so adjusted as to crimp it into a curve. On the far side the weight is carried on a small dolly which is guided by a long hook in the hands of the workman at the right. As the direction of the vertical rollers is reversed, the beam comes the other way, riding across the floor on another dolly each time the curve is increased until a complete circular frame is the final result.

New Technique of Organic Chemical Analysis

A NEW technique for peering inside complex molecules of living matter and discovering how they are put together was described at a recent organic chemistry symposium of the American Chemical Society in New Haven.

The historic method of determining the constitution of a substance has been to pull it to pieces and find out what the pieces are, which might be called the destructive method. The new process, the synthetic constructive, has been greatly developed in the last five years to take up discovery at the point where old-fashioned analysis becomes unproductive. It consists of constructing in the laboratory substances the constitution of which is not definitely known; finding out how they are created by creating them.

First the experimenter must produce a shrewd hypothesis, must make a guess as to what are the components of the substance and how they are arranged within the molecule. With this to go on, he proceeds by trial and error until he has laboriously built up that substance and made sure of its identity by elaborate checkings. Then he has solved his problem.

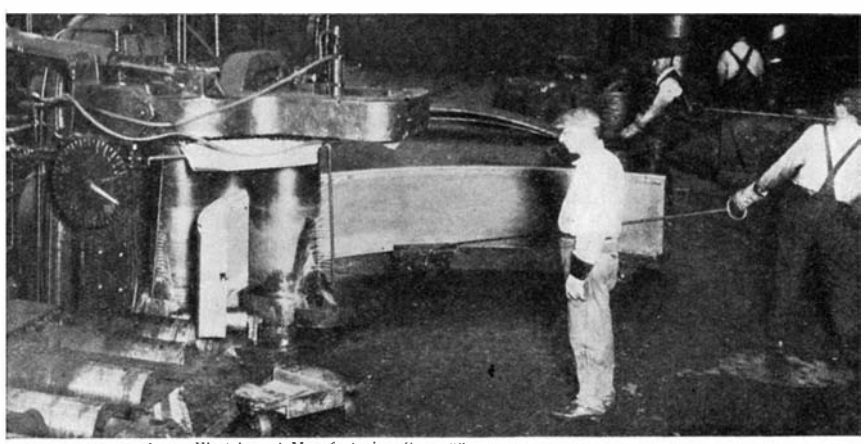
Examples of this new technique of building up substances were given by chemists before the scientists who crowded the auditorium of the Sterling chemistry laboratory of Yale.—*A. E. B.*

Farmers Finding New Uses for Electricity

NEW uses for electricity on the farm are being developed constantly as more and more farms are served by power lines, the United States Department of Agriculture says.

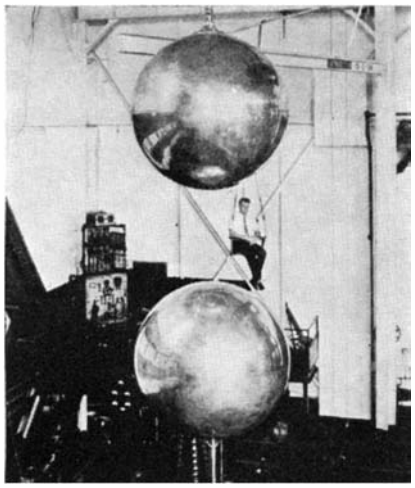
One of the newest developments is electrical heating of hotbeds. Several agricultural experiment stations have experimented with electric heaters and have found them practical. Electricity is also effective in dehydrating crops. In California it has been found practical in dehydrating for the preservation of nuts.

Farmers are finding that electric power



Courtesy Westinghouse Electric and Manufacturing Company

Rolling a cold strip of iron six inches thick by 30 inches wide



High voltages and artificial lightning cannot be measured by ordinary instruments. Therefore, huge sphere gaps such as this one have been constructed in the General Electric laboratories to measure accurately potentials ranging up to as high as three million volts

is more satisfactory than high-priced labor in many circumstances. Some of the applications of electricity on the farm are feed grinding, milking, threshing, filling silos, cooling milk and cream, driving cotton gins, and pumping water. Farm women use it for a variety of household uses.

Automatic control of electrical appliances is a desirable feature in several of their uses on the farm. Electricity was first used on farms for pumping water for irrigation, and this use still consumes more of this power each year than any other.

"Rock Wool" Insulating Material

AS a result of experimental work conducted by M. F. Goudge, mineral technologist to the Division of Mineral Resources, Ottawa, Canada, it has been found that rocks, or mixtures of rocks, from the Niagara Peninsula have definite possibilities as raw material for the manufacture of rock wool, one of the most effective insulating materials on the market today.

This rock wool is a furnace product made from self-fluxing dolomite rock. In the process of manufacture, the rock, with coke as fuel, is charged into a small cupola furnace where it is melted to a very fluid condition. The operating temperature is reported to range from 2800 degrees to 3300 degrees Fahrenheit. The molten rock, coming in a small stream from the furnace, is atomized by a blast of steam under a pressure of 80 to 100 pounds. Each small globule of molten rock, as it is hurtled through the air, trails behind it a very thin, pliable, glassy fiber. These fibers constitute the rock wool of commerce.

In appearance rock wool resembles sheep's wool, but it cannot be woven. Rock wool is sometimes sold in bulk, but more often is processed and sold in granulated form, in blankets, or treated with a binder and sold in the form of blocks and sheets under the name of "rock cork." Besides its use as an insulating material for the range up to 1000 degrees Fahrenheit—for which purpose it is rated as one of the most effectual materials available in commercial quantity—rock wool finds application as the main ingredient in acoustic tile, and as a corrosion resistant packing for acid carboys.—*A. E. B.*

Pure Honey Will Crystallize

HONEY is defined as a sweet, viscid fluid collected from the nectaries of flowers and elaborated for food by the honey bee. It may be produced as comb honey, which we all know, or it may be a liquid, a semi-solid, or a solid block of crystallized honey.

The old idea that crystals in either the semi-solid or solid honey indicate beyond doubt that the product was adulterated with sugar has been quite well dispelled. In fact, the presence of the crystals now tend to prove its purity, as an adulterated honey will seldom crystallize. There are some honeys, too, that crystallize very slowly, such as California sage, but most kinds crystallize rapidly after being extracted.

In color, honey may be water-white or it may grade through the yellow or ambers to the brown and on to the black. Some kinds may even be decidedly red or, like sweet clover, or mint honey, have a decided greenish tinge. But none of these colors indicate the addition of artificial colors by any means, but are due entirely to the source of the nectar.

Honey may also be as mild or as strong in flavor as you can imagine and possess all the fragrant aroma of perfumes in one case and have a nauseous odor in another. Yet it is all pure honey, and the aroma, too, as well as the color, comes from the flowers which were the basis of the nectar.

People are very apt to jump at conclusions as to the purity of the honeys, because of the many colors, flavors, and aromas. A person used to orange or sage honey would immediately say that the almond honey is not honey at all, or vice versa.

Honey belongs to the carbohydrates, or sugar foods. It is a solution of two kinds of sugars, dextrose and levulose, in varying amounts in water. The analysis of honey shows the following: Water, 15 percent; sucrose, 4 percent; ash, .5 percent; dextrins, 2 percent; undetermined, 3 percent; dextrose, 35 percent, and levulose, 40.5 percent. This is an average analysis, and the amount of levulose is always greater than that of the dextrose.

The higher the percentage of levulose—hence the lower the dextrose content—the slower the honey will crystallize, and vice versa.—H. M. Krebs in *The United States Daily.*

Paper from Southern Pines

A PROMINENT American chemist, Dr. Charles H. Herty, having successfully demonstrated on an experimental scale the feasibility of a pulp and paper project utilizing as raw material the several species of pine trees that grow in Atlantic and Gulf states, has acquired the support necessary for the construction and operation of a semi-commercial plant at Savannah, Georgia. Dr. Herty believes that a paper industry can be built up in the southern states, using as a raw material native woods, hitherto regarded as impractical for paper manufacture.—*A. E. B.*

COMMERCIAL PROPERTY NEWS

Conducted by SYLVESTER J. LIDDY

Member of the New York Bar

Patents and University Research

ARCHIE M. PALMER, associate secretary of the Association of American Colleges, has described the means in which various universities throughout the country have met the question of what they shall do with valuable and patentable discoveries made by faculty members in their research when backed by university funds or those of outside interests, in his recent report on "Some Problems Arising From Faculty and Institutional Research."

"How to develop these devices and inventions," declared Mr. Palmer, "so that the greatest possible benefit may accrue, is becoming a very pertinent question in college and university administration.

"Some discoveries are of such character that they should be made public and available to any one wishing to make use of them, the university merely retaining the patent title in order to prevent some person or organization from taking out a patent and monopolizing the discovery or invention. A fertilizer or medicine that any manufacturer could make is an illustration in point.

"There are cases, however, such as the carbonization of coal or the manufacture of vacuum tubes for radio transmission in which, because of the large amount of capital necessary or because the use of the new discoveries depends upon the utilization of materials or processes patented and owned by others, the article can be manufactured only by one or two establishments. In such a case, it is manifest that the public interests will be best served by giving a license, even a monopoly license, if necessary, to the manufacturer of the patent or discoverer on a royalty or cash basis.

"Among the problems involved are those which concern the obligations to the public, to the faculty member making the invention, to the institution itself, and to industry. In some cases where the device or process results from co-operative activity or as a result of a contractual relation there is an added responsibility to the employing or co-operating firm. An examination of the practices in several universities will throw light upon the handling of certain problems arising from faculty and institutional research.

"While working in one of the laboratories at Columbia University a member of the pathology department discovered a chemical product which was found to be a specific remedy for the disease of rickets. Desiring to assign to the university the patents issued to him to cover this invention, he raised with the administration the question of procedure. He wanted to assure to the university a share in the royalties which might be expected to accrue under the patents, and also to insure for the public a new and effective medical remedy made under the best possible conditions and sold at a reasonable price.

"In order to meet this situation and to handle similar patentable devices assigned voluntarily to the university, the board of trustees of the university in 1924 amended the university statutes to provide for the establishment of an administrative board of university patents, consisting of the president and the treasurer of the university, and not to exceed seven other persons to be appointed by the trustees for a term of three years, upon the nomination of the president. The amendment specified further that members of the administrative board shall be neither trustees of the university, administrative officers, members of the teaching staff, nor alumni.

"The Columbia administrative board of university patents has authority in its discretion, subject to the direction and control of the trustees, 'to accept for and on behalf of the university, by assignment or otherwise, either directly or through trustees or holding corporations, patents, patent applications, royalties, licenses or rights therein covering discoveries, inventions or processes, whether produced by members of the teaching staff of the university by use of university laboratories or otherwise.' This authority applies also to trademarks or proprietary names, and to copyrights of literary works owned or produced by members of the teaching staffs or others.

"The board is empowered to make arrangements on such terms and in such way as it may approve for 'the use, manufacture, sale or other disposition thereof, or of rights therein, with power, subject always to the approval of the trustees, to arrange for the use or division of the proceeds thereof.' The board is required to make an annual report to the president and may not authorize any charge or other obligation upon the funds of the university, or incur any liability, without previous authority of the trustees."

Perhaps the outstanding patent now held by any university is that by which the University of Toronto controls the manufacture of insulin, so useful in the treatment of diabetes. "So successful," said Mr. Palmer, "has been the administration of the patent rights with respect to this product that the income of the university for one year (1924) was 500,000 dollars."

The administrative procedure, he added, is quite similar to that of Columbia, already quoted. Actually no pressure is brought to bear on a faculty member to assign the university any patent, trademark or copyright that may have been issued to him, even though that discovery may have been made in the university laboratories. The opportunity is simply provided for the university to accept the assignment "if it is offered and if in the judgment of the governors it is considered advisable to accept it."

In treating the legal problems arising from the financing of research by industry the method employed by the University of Michigan is one workable solution.

"There the department of engineering research performs considerable experimental and research work in its laboratories under contractual arrangements with industrial concerns," Mr. Palmer's survey continues. "Under the terms of the contract every effort is employed by the university to prevent the disclosures of any facts or data furnished by the commercial agency. However, the university reserves the right to publish for the benefit of science such results of these research projects as are in the nature of fundamental or general principles.

"If, in the performance of such experimental or research work, patentable inventions or devices are discovered by the university's employees, the procedure to be followed in the procurement and administration of patents on these inventions is determined under a 'patent trust agreement' drawn up at the time the original contract is made. Provision is made under this agreement for the prompt reporting of all discoveries and inventions made during the prosecution of the research work and for the acquisition by the client either (1) of an irrevocable, non-exclusive, free license to make, have made, use, and sell the articles, machines, or devices (or right to practice the process, if a process invention) of any and all patents issued; or (2) of the entire or of limited rights, under certain conditions. If the client declines to make use of the invention the university may, under a trustee arrangement, exercise these same privileges."

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

Austrian War-Time Inventors to be Paid

UNEXPECTED good tidings recently came to German-Austrian inventors, when they were informed that after a lapse of from 12 to 16 years, they are to receive together a sum totaling one million dollars for their inventions.

Divided according to present-day frontiers, the money will not all come to present-day Austria, as it is for patents dating from the World War. The greater part comes to the modern Austrian Republic, Austrians receiving 912,000 dollars and Hungarians 35,000 dollars. From the date of the outbreak of the war until 13 years after its conclusion, all such patents in the United States were exploited under state license. Many inventors declined to accept official invitations to present claims, so hopeless were they of obtaining recognition for them. Austria has now been officially notified, however, that the above sums will

be paid out. One of the most highly paid patents is the invention of an Austrian to detect the approach of enemy submarines, which during the war was employed by the United States and the Allied Powers.

Owing to the Austrian financial restrictions, the actual inventors will not acquire dollars, as these will all be seized by the Austrian National Bank, and the inventors paid out at a rate in schillings fixed by the National Bank.

"Kisabel" Versus "Ise'bell" in Trademarks

IN a decision rendered recently in the case of Plough, Incorporated versus The Reed Laboratories, Incorporated, Assistant Commissioner Moore held that The Reed Laboratories, Incorporated, of Kew Gardens, New York, is not entitled to register, as a trademark for cosmetics, the term "Kisabel" in view of the prior use by Plough, Inc., of Memphis, Tennessee, of the notation "Mme. Ise'bell" or an equivalent name, for certain toilet preparations including rouge.

After referring to the record as to what was established and stating that the goods were of the same descriptive properties, the Assistant Commissioner said:

"The examiner of interferences was of the opinion that there is no confusing similarity between the applicant's mark 'Kisabel' and the opposer's trade name 'Ise'bell,' but with this opinion I am unable to agree. The two words are quite similar in appearance and sound. It is believed that there is such a similarity between the two as would be likely to cause confusion in the mind of purchasers when concurrently associated with the same article of trade; and that the rule repeatedly stated by the Court of Customs and Patent Appeals to the effect that the newcomer should select a mark so dissimilar to prior marks or prior trade names as to avoid any likelihood of confusion as to the origin or ownership of the goods, should be applied in this case."

Patent Office Nearly Hundred Years Old

THE United States Patent Office, which recently celebrated the opening of its beautiful new quarters has been operating in its present form for nearly a hundred years. The act of Congress establishing the office under a commissioner was passed on July 4, 1836.

Patents have been issued by the United States Government for a much longer period, however. They are provided for in the first article of the Constitution.

The first act of Congress specifying how patents were to be issued was passed on April 10, 1790. At that time the matter of granting patents was under authority of the Secretary of State, Secretary of War, and the Attorney-General. Since that time the office has been under the Department of the Interior and in 1925 it was transferred to the Department of Commerce.

It was in 1836 that the Patent Office started to number serially the patents issued. By the time the full century has passed, these serial numbers will be above two million. Two million patents granted in a single century! During the last fiscal year 44,317 patents were granted, or, if one counts design patents, trademarks, and so on, the grand total is 62,708. Applications for patents received during the year numbered 84,097, and the total number of applications filed in the office amounted to 106,893.—*Science Service.*

Copyright Infringement By Film Exhibitor

THE unlicensed exhibition of copyrighted motion picture films constitutes an infringement of a copyrighted dramatic composition, according to a recent ruling of the Court of Appeals for the First Circuit. "We hold," the court stated in its opinion, "that films which are founded upon copyrighted dramas or other dramatic compositions are protected under the provisions of section 1 (d) of the Copyright Act and their unlicensed exhibition is an infringement of the copyrighted dramatic composition."

This ruling was announced in cases in which the distributors of copyrighted motion picture films charged an exhibitor with infringement of their copyrights by the alleged showing of the films one day later than the date fixed in the license agreements relating to the leasing of the films between the distributors and the exhibitor.

The court did not pass upon the question of whether the distributors have rights of action for infringement of copyright or whether their actions should be confined to claims for breaches of the license contracts, the cases being remanded to the District Court for the District of Massachusetts for amendment of pleadings. This question, it was noted, can not satisfactorily be determined upon the pleadings then before the court.

The license agreements between the distributors and the exhibitor, it is explained in the opinion of Judge Morris, granted the exhibitor the right, under the respective copyrights of the motion pictures involved, to exhibit them publicly each for one day only at a specified theater. The distributors charged that the pictures, in each instance, were shown one day later than the date fixed in the agreements. Each exhibition was charged to constitute a separate infringement for which the distributors, in addition to seeking injunctive relief, asked for damages.

The District Court, according to the opinion, had dismissed the bills of complaint on the motion of the defendant exhibitor on the ground that the alleged exhibition complained of was not an infringement of the copyrights on the motion pictures. This ruling of the lower court was reversed by the appellate tribunal.

The Circuit Court of Appeals rejected the contention that the protection afforded to copyrighted films is limited to duplication or vending of the films and that motion pictures cannot be classed as a "dramatic work" as that phrase is used in section 1(d) of the Copyright Act of 1909, as amended in 1912, although agreeing that there is nothing in the law "which specifically affords protection from the exhibition of films used in motion picture machines."

Pointing out that through Congress, by the Act of 1909, copyright proprietors have been given control of devices serving to reproduce mechanically their musical works and that the Supreme Court of the United States has recently held that broadcasting musical productions for profit over a radio may constitute an infringement, the court declares that "no sound reason appears why publication through the sense of hearing is more damaging than publication through the sense of sight. If inhibition is applicable to the former, it should also apply to the latter.

"There appears to be an increasing tendency to liberalize the construction of the copyright statutes to meet new conditions which have rapidly developed within the last decade and which are continuing to develop, perhaps most strikingly illustrated by the application of copyright to radio."

"Dry-Ice" Case Review Sought

A PETITION seeking the determination that it and its licensees are entitled to the exclusive use of the trademark "Dry-Ice" applied to solid carbon dioxide, which is employed as a refrigerant, has been filed with the Supreme Court of the United States by the Dry-Ice Corporation of America.

An injunction is also sought restraining the use of the term for solid carbon dioxide in the corporate titles and advertising of competitors. The petition requests the court to review the decision of the Circuit Court of Appeals for the Fifth Circuit holding that the term was not subject to registration as a trademark for the product and refusing to grant the injunction sought. (See page 252, April 1932 SCIENTIFIC AMERICAN.)

The lower court ruled, it is explained in the petition, that "Dry-Ice" is descriptive of characteristics or qualities of solid carbon dioxide and therefore was not subject to trademark registration. The registration of the term was declared invalid. It also held that competitors can not be prevented from using the term in their corporate titles and advertising if their actions in so doing are unaccompanied by any wrongful conduct having the effect of falsely representing the source of their product or attempting to palm it off on the purchasing public as the product of the Dry-Ice Corporation or its licensees.

It was found as a fact by the lower courts, according to the petition, that the petitioners' use of the term "Dry-Ice" had established a secondary meaning in the minds of the public as denoting its product. "The use of a term to which a secondary meaning has attached in the corporate title of a competing corporation is in and of itself so likely to cause confusion," it is claimed, "as to be subject to injunction."

Relative to the right to register the term as a trademark, the petition states that "this case presents a situation where the lower courts have held descriptive two words in paradox which at the time when conceived were not descriptive of the goods, consequently could not be descriptive of the characteristics of the goods, and were in no sense a measure of quality."

The term "Dry-Ice" does not, it is contended, "state or describe the fact that solid carbon dioxide is or may be used as a refrigerant. 'Dry-Ice' does, however, suggest the function of the article in question." The fact of suggestion is not a sufficient ground, it is pointed out, for invalidating the registration of the term as a trademark.

Books SELECTED BY THE EDITORS

A HISTORY OF EXPERIMENTAL PHYSICS

By Carl Trueblood Chase, Asst. Prof. of Physics, N. Y. Univ.

THE word "history" usually connotes something dull. If it does, then the rather ponderous title of this book has done it an injustice, for it really is a most readable story of a great science, written in chronological order. About the easiest, most logical, way to learn about the science of physics is to begin where it began and trace its growth up to our own times. Thus the reader sees it unfold just as it actually did unfold, and gets a clearer picture of what it is all about than he would from a textbook which gives the ingredients out of chronological sequence. This "history" begins with the ancient Greeks and Galileo and the physicists of the 19th Century, but most of it pertains to physics since the reactivation of the science, which took place in 1895 with the discovery of the X ray and of all the things, unsuspected at the time, which were entrained by that epochal discovery. We follow the story down through the really big events—the discovery of radio-activity, the various atom concepts, the quantum theory, relativity, Michelson's velocity of light experiments, the electron, and the most recent theory of the wave atom. The account is in plain language, without mathematics, and centers around great experiments which are fully described, rather than abstract theory. There is a foreword by Millikan.—$2.40 postpaid.—*A. G. I.*

INTRODUCTORY GENERAL CHEMISTRY

By Stuart R. Brinkley, Asso. Prof. Chem. Yale

THE classification of the substances is based on the typical reactions which they exhibit, in preference to a classification based entirely on the elementary substances. The salts are grouped together according to type thus making it possible more clearly to develop the principles involved in their preparation and reactions. In the chapters dealing with the metals the classification is based on the principles involved in extracting the metals from their ores. In the discussion under each of the classes of substances, the most important members of the group are first considered, after which others of less importance are studied by analogy to these. A list of supplementary readings of different degrees of difficulty is placed at the end of each chapter—from the preface. A thoroughly sound and graspable presentation of much value for reference as well as study.—$3.20 postpaid.

MEET THE SCIENCES

By William Marias Masiloff

A BOOK which will interest some of the more serious, thoughtful readers, especially science teachers. It is called "a panoramic view of the sciences" and consists of discussions of the status of the sciences of mathematics, logic, physics, chemistry, and biology, and the near-sciences, psychology and sociology. It will help systematize and regiment the reader's point of view, if he already has a general background, regarding the divisions of science.—$2.65 postpaid.—*A. G. I.*

BLUEPRINT READING

By Fortman—McKinney

A PRACTICAL handbook for the machine trades on reading working drawings, assembly and scale drawings, manufacturing, tool and installation drawings. Prepared so that anyone can obtain drafting knowledge and practice in visualizing the finished products from plans, elevations, and sections. A careful study of this book will teach how to translate the ideas of the designer and thus show how a job should be executed to be accurate, efficient, and workmanlike.—$1.65 postpaid.

CHINA SPEAKS

By Chih Meng, Asso. Dir. China Inst. in America

IT must be said in all fairness that after reading "Japan Speaks" (reviewed in our June issue) this book impresses one as much the more sincere and appealing of the two. There is no studied attempt to rouse the emotions and no call upon sentiment—just the forceful presentation of facts as seen by a cultured, keen observer, one who is able to assimilate and assemble facts in an orderly and readable fashion. Whatever may be your sources of information about the Sino-Japanese disagreement you should not miss the opportunity of reading these two books.—$1.65 postpaid.

PRICING FOR PROFIT

By W. L. Churchill

IN co-operation with manufacturers' associations, 16 groups lent their aid to these researches in an endeavor to learn how to make business profitable—to stock-holders, management, employees, and thus to its customers. Certain economic laws are here developed as the result of 15 years of research and practice as business consultant to ailing industries. It is shown how these laws govern profits, how their application assures dividends to stockholders and proper returns to both management and labor. Every business man should know these laws and apply them.—$3.20 postpaid.

THE SCIENTIFIC AMERICAN ANNUALOG

CRAMMED full of useful and scientific information, this little book of 248 pages lists subjects of permanent value as well as the accomplishments of the year in science and industry. With the other six volumes of the series this makes a valuable reference library covering topics it would be difficult to locate in any other reference—many indeed, like the explanation of flotation and submergence, general formula for evaporation, ferry bridges, suspension railways, twinkling of stars, blue of the seas, Admiral Taylor's bow wave theory, etc., etc., were specially written to cover queries received from readers. It is a mine of odd information gleaned from myriad sources.—$1.50 postpaid. Volumes 1 to 7 inclusive $8.00 postpaid.

NEW INTERNATIONAL YEAR BOOK—1931

THE present volume is the 30th issue and like its predecessors has arranged in alphabetical order topics covering every conceivable phase of activity during 1931. A "chronology" of important events has been added and the number of illustrations has been doubled. The population of towns and cities as revealed by the 1930 census is given under "Census" and an enlarged "Necrology" has added value to this already most useful section. The orderly arrangement of material and the inclusive scope of this work make it in our opinion the best yearly record of which we know. It should be as valuable for any general library as it is essential for editorial reference.—$7.00 postpaid.

A RESEARCH IN MARRIAGE

By G. V. Hamilton, M.D.

SO many of our readers showed serious interest in the scientific (as opposed to the pseudo-scientific) side of sex problems by obtaining Lawrence and Beams' "One Thousand Marriages," reviewed last January, that we now place before them another noted advanced study of a cognate nature. The present volume of 556 text pages summarizes the data from the intimate and extensive self-revelations of 200 married persons who are serious-minded and well above the average as to intelligence and cultural attainment. It presents, in the words of the author, who is a psychiatrist of standing, "some of the more important things that happened to the 200 spouses of my study during their childhood, and their present beliefs, attitudes, predicaments, and characteristic modes of performance with regard to sex and marriage." Each of the 200 subjects answered the same lengthy list of questions, requiring for each a total of as much as 25 or 30 hours, and the book contains many tables giving their answers. Thus we get a fair average slice of humanity with the bars down—ordinary inhibitions off—and the findings are in harmony with those of the newer science of sex. They show that humanity's traditional "knowledge" of humanity with regard to such matters has been rather far from fact. Now we face fact, open up the truth to daylight and take a saner, more rational attitude toward things which too long have dwelt in realms of darkness and prudishness and ignorance.—$5.20 postpaid.—*A. G. I.*

THE ART OF BIRD-WATCHING

By E. M. Nicholson

A PRACTICAL guide to field observation by one who has written several books on birds and was the moving spirit of the Oxford University British Guiana Expedition. All the necessary equipment is indicated. How bird-watching is done, bird census work, contemporary fields and the scope and yield are most carefully outlined. Much has yet to be learned about even such common birds as house sparrows so it is a mistaken idea that there is not much work of this kind to be done.—$3.65 postpaid.

GOLDFISH VARIETIES AND TROPICAL AQUARIUM FISHES

By W. T. Innes

THIS is indeed the "ne plus ultra" of the goldfish, its feeding and care. It contains 300 illustrations of apparatus, full page plates of species, many in beautiful color work, and smaller illustrations showing the various individuals. One cannot praise too highly both the excellence of format and the wealth of information so clearly given. It is beyond a doubt the monumental work on this subject.—$4.20 postpaid.

POWER AND THE PUBLIC

E. M. Patterson, Prof. Economics, U. of P.

NINETEEN men of national standing have written monographs from sharply divergent points of view and these are presented in the hope that through a frank exchange of views and a comparison of data, light may be shed on mutual problems which the continued business depression has brought to public attention so fully. A continuation of The Annals of the American Academy of Political and Social Science which have proved of so much value in directing discussion along useful lines.—$2.65 postpaid.

RUSSIA: MARKET OR MENACE?

By Thomas D. Campbell, L.L.D., D.E.

WRITTEN by the famous "wheat king," agricultural-engineering expert, and mechanized farming originator and operator who has twice been called to Russia as agricultural expert by the Soviet Government, and has traveled extensively there on inspection tours.

This book describes his journeyings and what he saw, treating at length the wonderful economic developments made of late years, and showing how many of his own previously formed adverse opinions had to be materially modified. While absolutely opposed to Communism, Dr. Campbell acknowledges the possibility of Russia working out her own salvation along the lines of her present policy. His query "market or menace?" is not directly answered, but his opinion is readily deduced.

The reviewer's reaction decidedly favors "market," not "menace," and he is firmly convinced that the proper policy for our government to adopt is official recognition of the Soviet Republic and fostering to the utmost all lines of business between the two countries. —$2.15 postpaid.—*J. A. L. Waddell, D.Sc., L.L.D., D.E.*

AROUND THE WORLD SINGLE-HANDED

By Harry Pidgeon

BORN on an Iowa farm but tiring of his monotonous rustic environment, the author journeyed in an old spring wagon to Alaska where he then collected specimens for several American museums. Here he built his first boat, only a rowboat at that, but with it he gained invaluable experience on rivers and rapids. In the public library he studied navigation and boat-building and then constructed the 34-foot yawl *Islander*, in which he circumnavigated the world alone. This is the very readable story of his leisurely wanderings, just as fancy dictated. A tale replete with keen observations of places and men, and adventurous to a degree that seems almost improbable. Beautiful photographs abound for this "library navigator" was also a professional photographer.—$3.20 postpaid.

LIVES

By Gustav Eckstein

THIS is a curious collection of stories of the lives of men and of animals written from an intensely human viewpoint, amazing in its detail of observation and analysis but with a decidedly fatalistic trend. The author will be remembered as producing "Noguchi" which received considerable attention last fall, being among the non-fiction best sellers. As in that book, this volume seems to bring out the pathos and wonderment of just why life runs as it does.—$2.65 postpaid.

THE SOCIAL LIFE OF MONKEYS AND APES

By S. Zuckerman, Anatomist to the Zoological Society of London. Demonstrator of Anatomy, University College, London

THE author has had access to a rich collection of living monkeys and apes and has investigated their traits with thoroughness and in full scientific detail. The group and family life of the apes is very largely dominated by sexual motives and the chief value of this study, for those who are not primarily interested in apes as such or in sociology as such, is the background it provides for a fuller comprehension of the same factors in related human affairs. The account—316 pages—is very largely a simple exposition of events in a large colony of baboons but is not a story book, being thoroughly scientific. Some of the earlier chapters will seem a bit "slow" to many readers but—reversing the unfortunate tendency in some books—this gets better and better as it proceeds. There is a large bibliography on animal behavior.—$3.90 postpaid.—*A. G. I.*

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(From the Recommendation of the Committee on Unemployment Plans and Suggestions of the President's Organization on Unemployment Relief)