SCIENTIFIC AMERICAN

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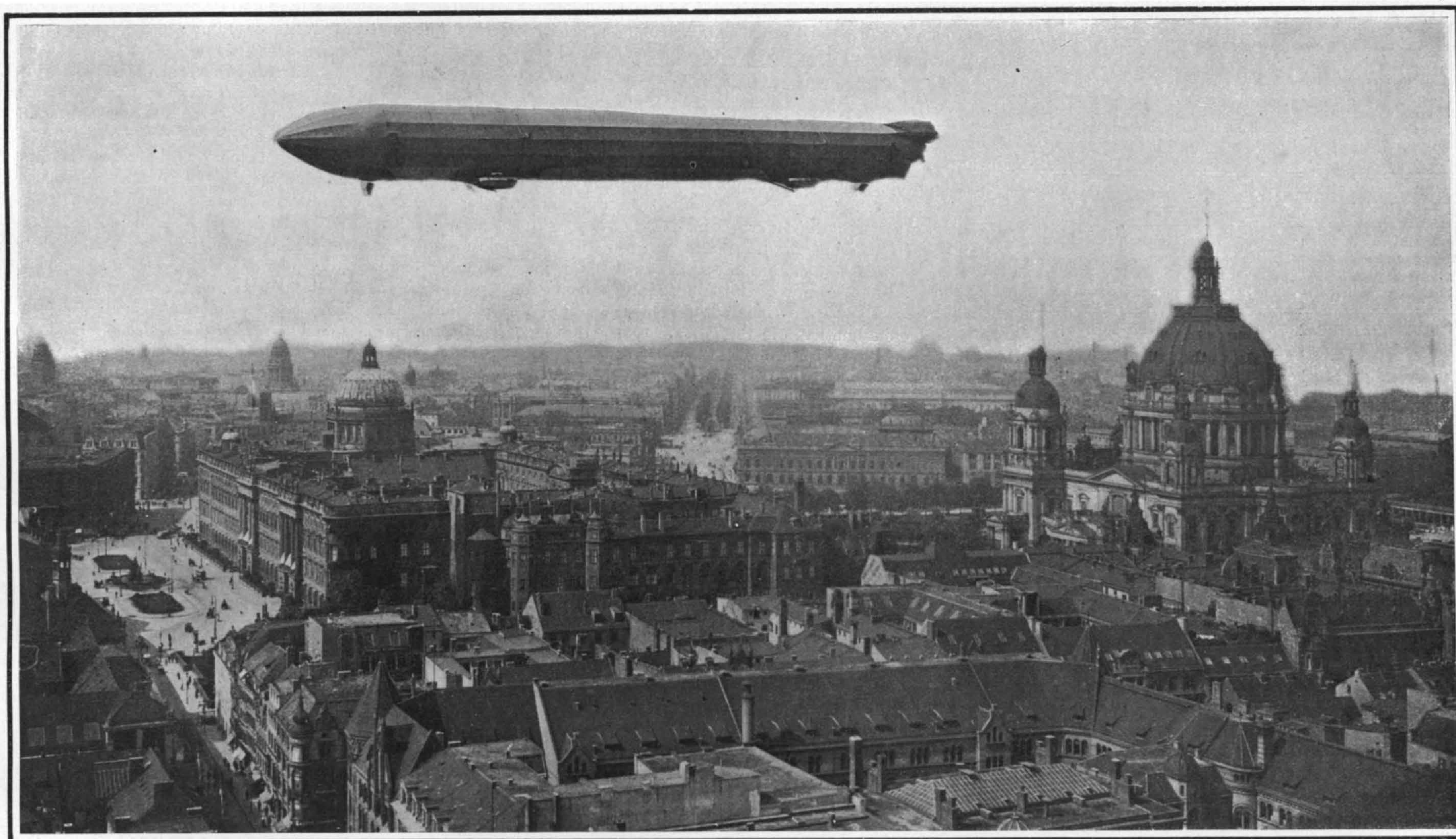
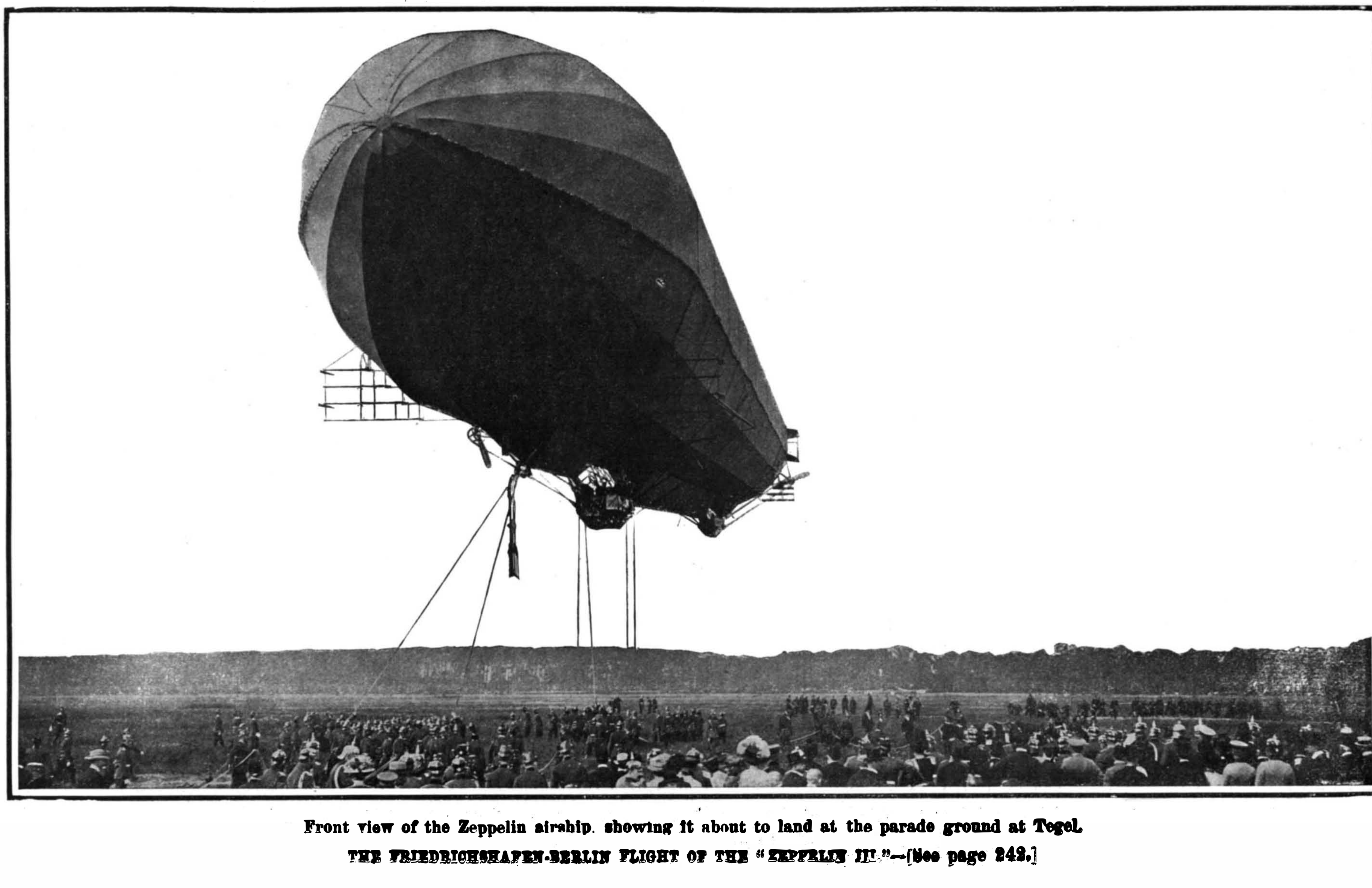


The "Zeppelin III." airship sailing over Berlin after its long-distance trip from Friedrichshafen.



Front view of the Zeppelin airship, showing it about to land at the parade ground at Tegel.

THE FRIEDRICHSHAFEN-BERLIN FLIGHT OF THE "ZEPPELIN III."—[See page 242.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, OCTOBER 2nd, 1909.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

TRUE SIGNIFICANCE OF THE HUDSON-FULTON FESTIVAL.

The splendor of the Hudson-Fulton festival stands for greater things than the mere exploitation of two individual men. Back of the music and the shouting, the blaze of color, the roar of saluting guns, and the blended laudation of press, pulpit, and platform—back, indeed, of the two men whose names are in every mouth and before every eye, are two cardinal facts of world-wide and age-long import and endurance, to which we must look for an explanation of the stupendous scale of this festival and the universal interest which it has awakened.

Why do we give Henry Hudson such pre-eminence over Gomez and Verazzano, and place Fulton above Fitch, Symington, and Stevens?

The transcendent importance of Hudson's voyage to New York Bay and up the river which bears his name, is due to the fact that he explored and opened up to the world the great highway of travel which nature had laid down from the Atlantic seaboard to the heart of the American continent. Gomez and Verazzano dropped into New York Bay as they did into many another inlet, and probably gave it value as one of several convenient watering places encountered on their coastal voyage.

Although Verazzano made mention of a great river, it is evident that he made no exploration to ascertain whether it was a river or an arm of the bay. Indeed, the fact that it was saline and tidal must rather have suggested a closed arm of the sea than a noble fresh-water river. Henry Hudson, on the other hand, not only sailed through the river for its whole navigable length, but he noted its flora and fauna, the appearance and habits of life of the inhabitants, and everywhere appears to have made free use of the sounding lead, not only throughout the river, but in his exploration of New York Bay.

And just here we venture the suggestion that, when so astute a man as Hudson had reached the head of navigation, he probably made such investigation as sign language and other means of intercourse with the Indians allowed, of the nature of the country which lay beyond. It is not unlikely that from the Indians he learned of the extensive Mohawk Valley beyond the Hudson; of the chain of lakes to the north; and of the westward route through which by canoe and portage, the travel and traffic of the Indian tribes were maintained from the Atlantic Ocean to the inland seas of fresh water that we now know as the Great Lakes.

Bitter, indeed, must have been Hudson's disappointment when the shoaling of the water just beyond Albany proved to him that his hope of finding a northwestern strait leading to the Pacific was merely a dream; but his regret was mitigated to no little degree if he realized that he had found a great natural highway into a vast continent, of whose extent the Indians probably were able to give him a not unworthy estimate.

But, setting all mere conjecture aside, it is certain that Hudson's careful and intelligent exploration of the Hudson River, as distinguished from the cursory and unappreciative glimpses obtained by Verazzano, and possibly by Gomez, produced immediate results among the enterprising Dutch traders, and led to the early founding of a city and colony destined to become the most famous and powerful on the whole of the new continent. To the *veni, vidi* of Gomez and Verazzano, Hudson added the *vici* of one of the most successful and, in its effects, momentous voyages of exploration that the world has ever known. Right worthily does Henry Hudson bear his honors.

The work of Robert Fulton, two hundred years later, was the natural complement of that of Henry Hudson. Because of the inadequate means of transportation the new colony was unable, for fully two centuries, to reap the full fruits of Hudson's discovery of this great highway to the West. It is difficult for us to realize the crude condition of travel prior to 1807. There were but few really good roads; the majority were not much better than cleared tracks through the primeval wilderness. Travel by road was laboriously slow, and sailing up or down the Hudson in the cumbersome sloops of those days was little, if any, better. But the beat of the paddle wheels of the "Clermont" ushered in an entirely new method of transportation, which was destined to do more for the development of the country in a few decades than had been achieved in the two centuries preceding. The success of the steamboat was one of the causes which led to the construction of the Erie Canal. The rapid opening up of the country which followed upon the superior means of transportation thus afforded was exceeded only by that even more swift and complete settlement and exploitation, which followed on the institution of steam railroad travel. This in turn followed the same great highway through the Hudson and Mohawk valleys to the Great Lakes and the far West.

Hudson in 1609, and Fulton two centuries later, may have had some glimpses of the ultimate outcome of their respective achievements; but in their wildest flights of imagination, did they dream that a thousand ships would join with a city of 4,500,000 souls to grace the scene of their early labors, and render them the present stupendous tribute?

ONE HUNDRED YEARS OF THE MARINE ENGINE.

Reminiscence and comparison will be rife during the week of the Hudson-Fulton Celebration, and never will they be more active, surely, than when that curious marine craft, the "Clermont," slowly creeps, under the impulse of her antique engine, over the waters of New York Bay and the Hudson River.

In the "Clermont" engine, as in all the Watt engines of that day, the low steam pressure of four or five pounds above the atmosphere, was made necessary by the weakness of the copper boilers. The pressure being low, the condenser was, necessarily, of vital importance; yet the vacuum could scarcely be called satisfactory, for during the trial trip of the replica of the "Clermont," we noticed that the vacuum stood at about 22½ inches. Wood was used for fuel; and probably the consumption per horse-power per hour was equivalent to not less than five or six pounds of coal.

The marine boiler and engine are greatly indebted to the activity of the Hudson River steamship builders for their early improvement. We know that compound engines were used on this river as early as 1824, and that they showed satisfactory results. Furthermore, steam pressures of as high as 50 pounds to the square inch were used on the Hudson River long before the middle of the last century.

The marine engine made slower progress in ocean navigation than on the rivers, and particularly on the Hudson. The earliest transatlantic steamers, say of the period from 1845 to 1855, used boiler pressures of from 10 to 20 pounds to the square inch, and the approximate consumption of fuel was from 4½ to 3½ pounds per horse-power per hour. From 1855 to 1865, when the paddle wheel gave place to the screw propeller, the approximate boiler pressures were from 20 to 35 pounds, and the consumption of fuel was reduced from 3½ to 3 pounds per horse-power per hour. In the ten years, from 1865 to 1875, of the development of the transatlantic marine engine, the compound took the place of the simple engine, and steam pressures rose from 35 to 60 pounds, while fuel consumption was reduced from 3 pounds to 2.2 pounds per horse-power per hour. With the introduction of triple-expansion engines during the period from 1875 to 1885, the boiler pressures were doubled from 60 pounds to 125 pounds, and the approximate consumption was reduced from 2.2 to 1.9 pounds per horse-power hour. Then, in that notable period from 1885 to 1895, came the twin-screw quadruple-expansion engine, with boilers using forced draft and carrying pressures of from 125 to 225 pounds per square inch. The resultant economies were remarkable, the fuel consumption per horse-power per hour falling from 1.9 to 1.4 pounds per horse-power per hour.

Then came the most radical improvement in the marine engine in all the hundred years since the days of Fulton, when Parsons introduced the steam turbine, whose advantages ultimately proved to lie not so much in a further reduction of fuel economy, as in economies of weight, engine room space, consumption of oil, the great reduction of the cost of repairs and general up-keep, and above all in a great increasing of speed. Strange to say, boiler pressures, which had been mounting steadily upward, fell from the maximum of 225 pounds, as used with multiple-expansion engines, to about 150 or 160 pounds, which was found to be the most economical pressure for a turbine. The fuel consumption in high-speed turbine vessels is approximately the same as that of the very best reciprocating engines using all the modern contrivances of forced draft, superheaters, etc. Such are the conditions which obtained during the period from 1895 to 1905.

The present decade is being devoted to the development of the marine turbine, by the removal of certain defects, which at present seriously limit its usefulness. As matters now stand, the turbine drive gives its best results only when applied to comparatively high-speed vessels, and when they are driven at their maximum power. As the speed decreases, there is a loss of efficiency. Furthermore, the economical speed for the propeller is an uneconomical speed for the turbine. The present development is in the direction of combining the reciprocating engine with the turbine, using the former for the higher ranges of expansion and the turbine for the lower ranges. This combination gives an engine which can run economically at a low or cruising speed; that can reverse; and that can show as good economy on a cargo steamer as an all-turbine engine on a high-speed vessel.

Figures have recently become available of the first ocean-going installation of this kind, which was placed in the cargo steamship "Otaki." Since her delivery in November, 1908, this ship has completed a voyage to New Zealand and back. She is a sister ship, except in her engines, to two other vessels, the "Orari" and "Opawa," fitted with reciprocating engines. The "Otaki" is driven by two sets of triple-expansion reciprocating engines, one on each wing propeller, and a low-pressure turbine driving a center propeller.

A comparison of the relative performance of the two ships shows that at the full-speed trial, the "Otaki" developed 5,880 horse-power, as against 5,350 horse-power shown by the "Orari." Her coal consumption between Liverpool and Teneriffe was 11 per cent less when steaming under similar conditions and at practically the same speed. A comparison of the coal consumption for the whole of the voyage shows a gain for the "Otaki" of 8 per cent, or 500 tons of coal. The engines made a non-stop run from Teneriffe to New Zealand of 11,669 miles. The coal consumption, on the run from the Clyde to Liverpool at about half the power, worked out at 1.387 pounds per horse-power for all purposes—a most satisfactory result.

In the steam turbine we have apparently reached the limit of efficiency in the history of the steam marine engine. The indications are that the developments of the future will be in the direction of an internal-combustion engine, using either oil or producer gas.

COMBATING INJURIOUS INSECTS WITH THE AID OF THEIR NATURAL ENEMIES.

An interesting instance of successful warfare waged against injurious insects with the aid of their natural enemies is reported from Hawaii, where the sugar plantations have in recent years been threatened with annihilation by the ravages of a small cicada, little more than ⅛ inch long. Prof. Kirkaldy, the director of the Honolulu entomological station, has described the little insect and named it *Parkinsiella saccharicida*. It pierces the stem of the sugar cane and extracts the sap, causing the plant to wither and die. The formidable character of this insect pest is due to the amazing rapidity with which it multiplies. Six generations are produced annually and, on the assumption that 20 females of each brood live to reproduce their kind, it is estimated that the progeny of one female, produced in the course of a single year, numbers 64 millions. The insect was undoubtedly introduced with the sugar cane from other countries into Hawaii, where it has multiplied enormously, as its natural enemies, which limit its numbers elsewhere, do not appear to have been imported with it. Entomologists were, therefore, sent abroad to discover the original home of the little cicada, to find its natural enemies, and to bring these to Hawaii. It was necessary to extend these laborious and costly investigations to every part of the world from which sugar cane plants had been imported. The home of the insect was finally located in Australia, where two of its most formidable enemies were also found. These are two species of ichneumon fly, of the genera *Paranargus* and *Ovetertastichus*, which lay their eggs in the eggs of the cicada. The first-named species destroys only the cicada eggs in which its own eggs are deposited, but the other species pierces only one egg of each cluster of cicada eggs and its larva destroys the entire cluster. Both species have been successfully colonized in Hawaii and the prodigious increase of the sugar cane cicada has thus been checked.

The first steel steamship ever built in the maritime provinces of Canada is under construction at Yarmouth, Nova Scotia. A great development is expected in this industry, which, in the days of wooden vessels, was such an important factor in the prosperity of the provinces bordering on the Atlantic coast.

ENGINEERING.

The Canadian government has decided to advise the board of engineers to call for tenders for the new Quebec bridge, to take the place of the ill-fated one which collapsed during construction. The span has been reduced from 1,800 to 1,715 feet, and plans are to be prepared for bridges of both cantilever and suspension type, the style adopted depending upon cost and speed of erection and general usefulness as compared with expenditure.

Two suction dredgers built by Messrs. William Simons & Co. for use in reclamation work by the Bombay Port Trust, which will add a square mile of land to Bombay, have given remarkable results in their acceptance trials. They are equipped with powerful spiral cutters at the end of their suction pipes, and eat their way into solid blue clay at the rate of 2,700 cubic yards an hour, discharging it 4,500 feet away through a pipe line half of which is floating. One of them has made a cut 300 feet wide at the bottom, 21 feet deep, and 1,000 feet long in 85 actual dredging hours.

Bids have been opened on the U. S. battleships "Arkansas" and "Wyoming," and announcement of the letting of the contracts is expected. These will be the largest battleships in the world, the plans calling for 26,000 tons displacement, 545 feet over-all length, 92 feet beam, 29 feet draft, and 33,000 horse-power engines, giving a speed of 21 knots. Since the British "Dreadnought" set the fashion in all-big-gun battleships, the size and gun capacity of each new ship of the U. S. navy have been steadily increased; but these will be the first two ships to exceed all records of foreign navies. The Cramps made the lowest bid of $4,450,000.

The steamship "Otaki," built by Messrs. Denny of Dumbarton, is the first merchant vessel to be fitted with "combination" engines, consisting of two sets of triple-expansion reciprocating engines driving wing propellers and a low-pressure turbine driven by their exhaust steam driving a central propeller. The act of reversing the reciprocating engines closes their connections with the turbine, which is not reversible, and diverts their exhaust to the condenser. Otherwise the "Otaki" is identical with the sister ships "Orari" and "Opawa" of the same company, fitted with reciprocating engines. On a recent round trip to New Zealand the "Otaki" made the same average speed as her sister vessels with a coal consumption of 11 per cent less than their mean, and a water consumption nearly 20 per cent less, their boilers being identical with hers. She also made a non-stop run of 11,669 miles, probably the longest continuous run yet made by a marine turbine.

Some interesting tests of timber under long-continued loads by Mr. H. D. Tiemann of the Yale Forest School were described by him in a paper read before the American Society for Testing Materials. The test specimens were continuously loaded in some cases for a year or more; and their deflections under load, recovery under partial release of load, and other behavior automatically recorded. As in the case of ductile metals a curious effect due to plasticity is noticed, which, while allowing the timber to be distorted and even to take a set, does not affect its ultimate strength. The deflections or recoveries due to immediate addition or removal of loads are independent of the deflections or recoveries due to time effect of dead loads. A remarkable relation between the moisture absorbed and the strength of the beam was also shown, increase of moisture in the atmosphere causing the test specimens to increase in deflection and decrease in strength to the point of failure.

Engineering and building construction for earthquake countries is discussed in an interesting and authoritative manner by Prof. W. H. Hobbs in the current Engineering Magazine. The article summarizes the results of a number of investigations resulting from the California, Italian, Japanese, and other earthquakes, showing the lessons learned from practice in localities especially subject to earthquakes as well as from laboratory experiments with materials. It has especial interest in reference to the suggested liability to damage by earthquake of the Gatun dam and locks at Panama. Whereas it is shown that alluvial filled and other unconsolidated formations, especially when marshy, afford more dangerous building sites than solid rock near the surface on account of the tendency of the latter to dissipate a shock, it appears that considerable displacement of underlying rock will hardly appear at the surface of overlying loose material if the latter is sufficiently deep. It is further shown that on such loose material rigid buildings, especially when supported upon massive monolithic foundations, are less liable to damage than more elastic structures. It would therefore appear that the deep alluvial deposit in the old river bed under the Gatun dam, much talked of as a danger spot in the construction, represents as safe a foundation as possible in an earthquake country for the massive monolithic structure of the locks and dam.

AERONAUTICS.

On September 21st, Hubert Latham attempted a flight with his "Antoinette" monoplane at Berlin. One wing touched the ground twice with considerable shock; then a wheel collapsed and the propeller was broken. After repairs had been effected, however, he succeeded, on September 24th, in making a splendid flight of 1 hour and 3 minutes' duration.

In addition to the World's $10,000 prize for the quickest flight by an aeroplane or dirigible from New York to Albany, the American has offered a prize of $1,000 for a circuit of Manhattan Island by an aeroplane. Three airships are ready to start in the first-mentioned contest, these being the dirigibles of Capt. Baldwin, John Roeder, and George L. Tomlinson. The start will be made from 119th Street and the Hudson River.

The flights of Wilbur Wright and Glenn H. Curtiss above New York Bay and the Hudson River during the present week are to be the leading feature of the Hudson-Fulton Celebration. The flights will be announced by flag signals displayed from the Singer and Metropolitan towers, and by bombs, as follows: White flag with red center—weather favorable, flight will probably take place in the afternoon. Black flag with white center—weather unfavorable; no flight to-day. White flag with red center over red flag with white center—flight will probably take place within the hour. Red flag with white center over white flag with red center—flight will take place within 15 minutes. The same with black flag with white center below both—flight has started.

At Morris Park late in the afternoon of September 23rd, Charles Crout made a short flight of 60 feet at an elevation of about eight feet with a new biplane built by François Raiche, a member of the Aeronautic Society. This is the first aeroplane built by a member to succeed in getting off the ground. It was run along the track at a speed of 15 to 18 miles an hour against a 12 to 15-mile wind when the flight was accomplished. The balancing planes were not operative, and the aeroplane tipped in alighting and damaged one end of the lower plane. Exhibition flights will be made soon with this machine throughout the country. The aeroplane has been acquired by the Scientific Aeroplane and Airship Company, which will conduct the exhibitions with it and also with several monoplanes which the company has produced.

In the course of his exhibition flights recently at Berlin, Orville Wright made several new records. On September 18th, with Capt. Englehardt as passenger, he flew 1 hour, 35 minutes, and 47 seconds, thus beating by 23 minutes and 11 seconds his previous record with a passenger. During this flight he sent his machine beyond the limits of the Tempelhof parade ground and soared over the railroad tracks and houses in the vicinity. In a subsequent attempt during the same day to beat the speed record, the water circulation of the motor gave out, and he was obliged to descend after a flight of 1 hour and 24 minutes. A few days before Orville Wright flew at an estimated height of 50 meters above a balloon anchored at a height of 175 meters, thus making the altitude he reached probably over 750 feet. Rougier, on the 20th ultimo, attempted to break this record at Brescia, Italy, with his Voisin biplane. He succeeded in making an official record of over 198 meters (650 feet). Mr. Wright will probably fly at the aviation meeting at Berlin during the present week, after which he will go to England, in order to test the first Wright aeroplanes built there for the British government.

The day following his arrival from Europe, Glenn H. Curtiss, the winner of the Bennett aviation trophy and the present holder of the SCIENTIFIC AMERICAN Trophy as well, was given a luncheon at the Lawyers' Club by the Aero Club of America. Among the distinguished guests present were William Marconi, the inventor of wireless telegraphy, and St. Clair McKelway, editor of the Brooklyn Eagle. The latter told of a trip to Goshen, N. Y., back in 1867 in Andrew's dirigible, an account of which was subsequently published in the SCIENTIFIC AMERICAN. This airship (which was made to travel in any desired direction by means of long inclined planes between the triple, parallel, cigar-shaped gas bags, the planes causing the balloon, as it rose from the buoyancy of the gas, to ascend upon a long incline) on this occasion traveled as far as Goshen, N. Y. (50 miles), whence it was blown back by the wind across Long Island Sound to the eastern end of Long Island, where a successful landing was accomplished. In view of his exploit 42 years ago in this, the first dirigible balloon, Mr. McKelway believed himself to be the oldest aeronaut present. The mayor of Baltimore, Md., read a telegram announcing the flight of Lincoln Beachy from that city to a point in the Blue Ridge Mountains, 125 miles away—a flight which is probably the longest ever made in America with a dirigible balloon. The aeroplane with which Mr. Curtiss won the Bennett trophy will be exhibited at Wanamaker's store in New York this and the coming week.

SCIENCE.

The record of altitude in aeronautics has been attained by Sig. Placenza and Lieut. Mina, in an ascension made from Milan on August 10th, 1909. Their great spherical balloon, the "Albatross," carried 2,600 pounds of ballast at the start and reached an elevation of 38,700 feet, or more than 7 miles. The aeronauts experienced a temperature of —25.6 deg. F. and landed near Milan 3½ hours after they started.

The great tidal waves observed at Marseilles on June 15th, 1909, appear to have been caused by the unusually high electric charge of the atmosphere which is known to have existed during the period of the earthquakes which devastated the south of France. The powerful attraction exerted on the surface of the earth by this electric charge caused earthquakes on land and tidal waves in the Mediterranean.

Prof. Percival Lowell has noted at his Flagstaff Observatory that the antarctic canals of Mars are disappearing. This waning of the much-discussed canals seems to be a well-recognized phenomenon. Long ago Prof. Pickering suggested that we see not really the canals, but rather the vegetation which fringes their banks. The waxing of the canals in spring and summer and their waning in autumn and winter is not unreasonably attributed to the growth and decay of this vegetation.

In accordance with the resolutions of the last International Congress of Mining and Metallurgy, Applied Mechanics, and Practical Geology held at Liége in 1905, it has been arranged that the next Congress shall meet at Düsseldorf during the last week of June, 1910, under the auspices of the Rhenish-Westphalian Mining Industry. An influential committee of organization has been formed, which is charged with the making of the arrangements for the reading and discussion of papers, visits to places of technical interest, and social entertainments.

A letter has been received at Harvard Observatory from Prof. E. B. Frost, director of the Yerkes Observatory, stating that Halley's comet was observed visually by Prof. S. W. Burnham with the 40-inch telescope, on September 15th, 21 h. 39 m. G. M. T., in app. R. A. 6 h. 18 m. 51.1 s. and app. Dec. +17 deg. 9 min. 44 sec. The comet followed B. D. +17 deg. 1232 by 12.7 min., north 4 min. 12.1 sec. The comet was also photographed with the 2-foot reflector on September 15th and 16th by Mr. Oliver J. Lee. A second letter received at this observatory from Prof. Frost states that the comet was also observed visually by Prof. E. E. Barnard on September 17 d. 21 h. 1 m. 30 s. G. M. T., in app. R. A. 6 h. 19 m. 0.9 s. and app. Dec. +17 deg. 9 min. 0.8 sec. The comet followed A. G. 2122 (= +17 deg. 1232) by 0 min. 22.55 s., north 3 min. 28.9 s. Description: 15½ mag. 12 s. diameter, with possibly a faint nucleus or indefinite fleck of light in it. The comet was also photographed by Mr. Lee at the same time.

The astronomers of Lick Observatory have been making some spectroscopic studies of Mars from the top of Mount Whitney. This peak is the highest in the United States, its altitude being 14,501 feet above sea level. The instrument taken by the observers was a 16-inch horizontal reflecting telescope, to which a suitable spectroscope was attached. Of the seven nights spent by the men on the summit, only two were clear enough for observation. The spectrum of Mars was compared with the spectrum of the moon. It is known that there is no water vapor on the moon, certainly in no appreciable quantity. If no difference can be detected between the spectrum of Mars and the spectrum of the moon under these most favorable conditions, it can be said with safety that water exists on Mars in negligibly small quantities. The results of this expedition have not as yet been published. Readers of this column of science notes will doubtless remember that Mr. Slipher of Prof. Lowell's staff claims to have obtained spectroscopic evidence of the existence of water vapor on Mars.

On July 26th, 1909, the Singles coal mine, in the French district of Puy de Dome, was the scene of an accident similar to that which occurred some time ago in the Gard mines. At the Singles mine an interior shaft was being sunk for the purpose of determining the depth of the deposit. This shaft was sunk from a horizontal gallery which led from the foot of a shaft, 1,000 feet deep. The explosion of a powerful blast shattered the rock and caused the disengagement of great volumes of carbon dioxide, which filled the gallery and both shafts before all the miners could take refuge in the safety chamber. This mine possessed no oxygen life-saving apparatus and the manager was absent at the time of the accident. The life-saving corps of several mines in the vicinity responded promptly to appeals by telephone, but no effective work could be accomplished until several hours had elapsed. Of twelve miners who had been entrapped, seven had passed the day in terror in the safety shelter, but the remaining five were found suffocated in the gallery.

HOW WE GET STANDARD TIME.

BY HARLAN T. STETSON.

Although it may be generally known that the determination of time is the work of the astronomer, yet doubtless few people stop to investigate the precise methods employed in the correction and distribution of standard time. It is a system in itself quite indispensable to the success of the industrial world.

The great universal timekeeper is the earth itself. So uniform is the earth's rotation on its axis, that the length of the day according to Newcomb has not altered the 1/100th, and probably not the 1/1000th part of a second since the beginning of the Christian era. The direct effect of this rotation is the apparent revolution of the celestial sphere, or the daily motion of the sun, stars, and planets across the sky. As places on the earth are determined by latitude and longitude, so stars are located by right ascension and declination. Every conspicuous star has its position carefully determined, and from a star catalogue the astronomer knows at once the instant of culmination or meridian passage of any given star. If then with a suitable instrument an observation of a star's transit across the meridian can be obtained, and the time of its occurrence be noted by a clock or chronometer, a comparison with the catalogue will disclose the amount by which the clock or chronometer is fast or slow. Such an operation of finding the clock error is always what astronomers understand by the expression "obtaining time." The instrument used for making these observations is known as the transit instrument, and consists essentially of a telescope so mounted as to be capable of swinging about a horizontal axis in the plane of the meridian. The accompanying illustration shows such an instrument ready for the observation. In the eye-piece of the telescope is placed the reticle, comprising a number of spider webs, of which the attached diagram shows five to be stretched vertically and two horizontally across the field of view. The instrument is so adjusted that the middle one of the vertical threads coincides as nearly as possible with the imaginary circle in the sky called the meridian.

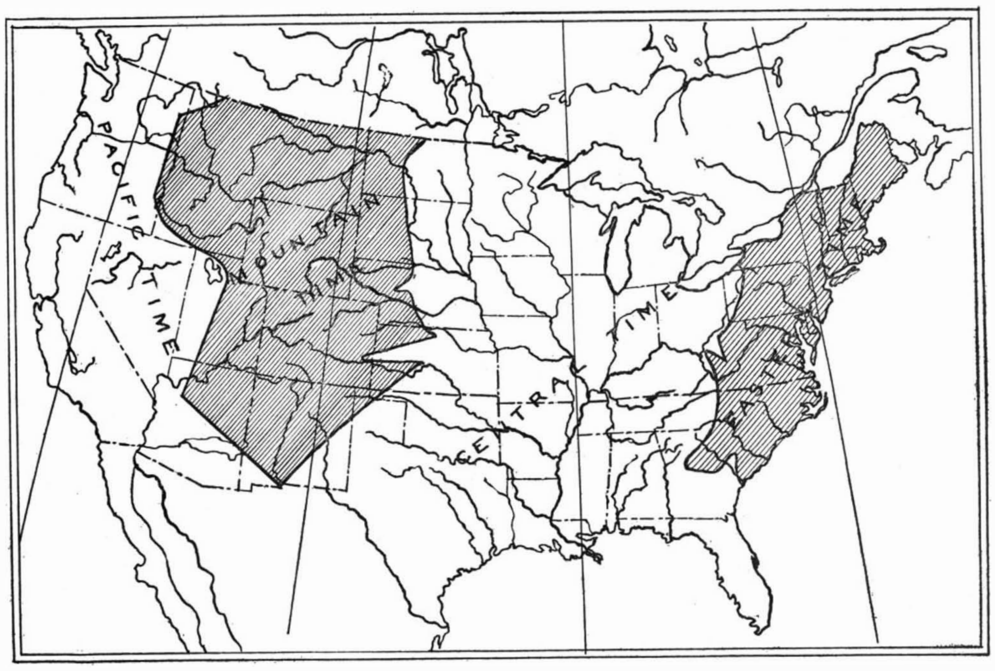
When observations are to be made for determining time, the astronomer first turns to the Ephemeris or some catalogue of stars, and selects a star which is soon to culminate, then from the declination he mentally calculates the altitude at which the star will transit. By means of a reading circle attached to the instrument he sets the telescope at the proper angle, so that the star will pass through the field of view. Either of two methods may now be employed in making the observations. The first and older of the two is known as the "eye and ear" method. This consists of watching the star pass through the field, and while listening to the half-second beats of the chronometer, estimating to the nearest tenth of a second the time at which the star crossed each thread of the reticle. In the "chronographic method," now much used, the mind has less to do, and hence more accurate results can be obtained. Here as before the astronomer watches the passage of the star across the threads of the reticle, but instead of esstimating the time of transit, he presses a telegraphic key at the proper instant. The key is in electrical connection with an instrument called a chronograph, and an automatic record is made of each observation. Either method will leave a record for the five threads similar to the following, the Roman numerals designating the number of each thread in order of observation:

I.			16.7
II.			25.5
III.			34.3
IV.			43.0
V.	7h.	9m.	51.7s.
Mean	7h.	9m.	34.24s.

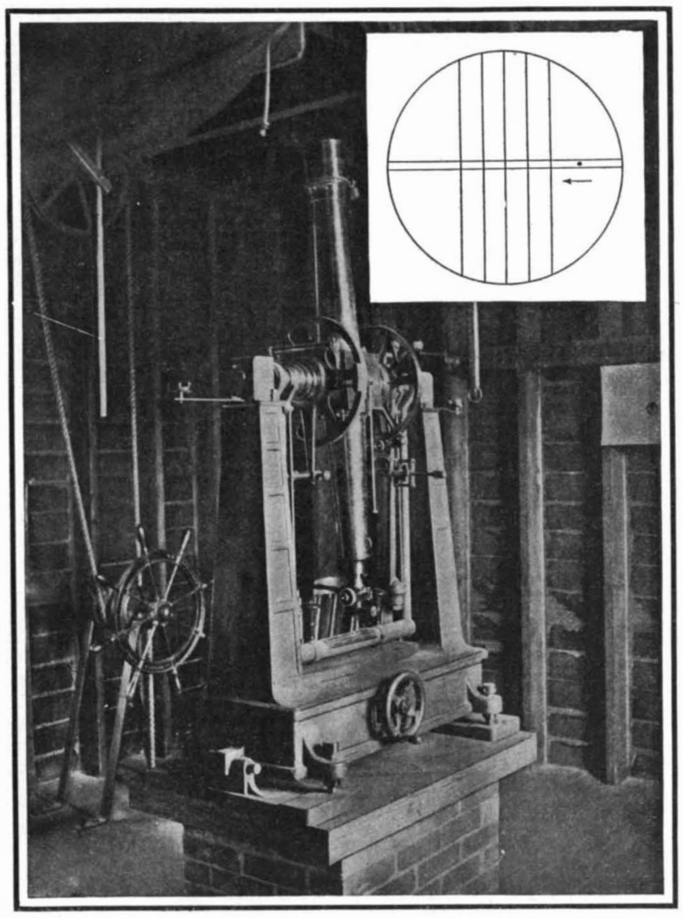
The above is the actual result of a set of observations made by the writer, using the eye and ear method. The figures in the "seconds" column were written immediately after the transit of each thread; the hour and minute were filled in at leisure after the last observation.

The mean of these observations will give a more precise result for the transit over the middle thread than a single observation could afford. The exact right ascension of the star we will suppose to have been known as 6h. 58m. 35.95s., which equaled the correct time of the star's transit. The chronometer, however, recorded the time of transit as 7h. 9m. 34.24s., and was therefore fast by the amount of 10m. 58.29s.

Were the instrument in perfect adjustment, and were there no personal element to enter into the result, such a set of observations would be quite sufficient. As a matter of fact, however, there are always small errors in the instrument, which must be determined and applied as a correction to the final result. The astronomer therefore does not rely wholly upon a single record like the above, but will usually repeat the observation with a number of different stars on the same night. From these numerous records he is able to deduce the necessary corrections, and thus obtain a more accurate value for the chronometer error. Time thus determined, ordinarily correct to within one-tenth of a second, is *sidereal* time; and though very useful to the astronomer, is quite unsuited to the use of the world in general, whose activities are governed by the rising and setting of the sun, and not the stars. Sidereal time must therefore be converted into *solar* time. This is easily effected by a simple calculation constantly employed by the astronomer. Having then obtained solar time, there remains only to distribute it to the outside world.



STANDARD TIME BELTS OF THE UNITED STATES.



AN OBSERVATORY TRANSIT INSTRUMENT FOR DETERMINATION OF STANDARD TIME. DIAGRAM SHOWS RETICLE OF TRANSIT.

Until within the last twenty-five years each community used its own local time, but as travel became more extensive it was found quite inconvenient to alter one's watch and system of time reckoning for every few miles of traveling east or west. Accordingly, in the year 1883 the United States adopted the present system of standard time. The whole country from the Atlantic to the Pacific was divided into time belts of approximately fifteen degrees in width. The "Eastern" belt, extending as far west as Buffalo, uses the time of the 75th meridian, which is very nearly that of Philadelphia, and is five hours slower than Greenwich time. Crossing into the "Central" belt, watches are set one hour earlier, as the time employed is that of the 90th meridian, six hours behind Greenwich time. Similarly, "Mountain" time uses the 105th meridian, seven hours behind; and the "Pacific" belt adopts the 120th meridian time, just eight hours slower than that of Greenwich. Such a system is quite indispensable to railroad lines, and hence standard time is sometimes called "railroad time." At present almost every civilized country is using some system of standard time, usually under the control of its own government.

The chief source for standard time in the United States is the Naval Observatory at Washington, D. C. Here high-grade clocks are carefully regulated by observations of the stars at night, and all necessary corrections applied. For the five minutes preceding noon of each day, eastern time, the Western Union and Postal Telegraphic companies suspend all ordinary business, and throw their lines into connection with the Washington Observatory. It is so arranged that the sounders all over the lines make a stroke each second during the five minutes until noon, except the twenty-ninth of each minute, the last five seconds of each of the first four minutes, and the last ten seconds of the fifth minute; then follows the final stroke at exact noon. This affords many opportunities for the correction and setting of timepieces throughout the country. The Western Union Company also operates a system of some 30,000 clocks, which automatically set themselves by the noon signal each day.

In addition to the Washington signals, many smaller observatories determine and distribute time in a similar way to jewelers and local railroad lines. In most of the larger seaports, time balls are dropped at noon, and give mariners an opportunity to correct their chronometers. Fire-alarm companies aid in the distribution of time in many localities by sounding bells at certain specified times each day, thus affording the public a convenient source of "correct time" with a reasonable degree of accuracy.

The Destruction of Rats with Carbon Disulphide.

M. de Kruyff, of the agricultural bureau of the Dutch Indies at Buitenzorg, Java, has published an interesting article on the destruction of rats. The various contagious diseases which have been recommended for this purpose have been found useless in the tropics and have not always proved effective, even in the temperate zone. Hence De Kruyff's experiments will be of general interest. After working four years with numerous viruses without succeeding in creating an epidemic or even killing a single rat, De Kruyff obtained more encouraging results by employing carbon disulphide in the following manner: All visible ratholes were first stopped with earth for the purpose of ascertaining which holes were inhabited, for the inhabited holes were found reopened on the following day. Half a teaspoonful, or less, of carbon disulphide was poured into each of these holes and, after waiting a few seconds to allow the liquid to evaporate, the mixture of vapor and air was ignited. The result was a small explosion which filled the hole with poisonous gases and killed all the rats almost instantly. A pound of disulphide, costing about 10 cents, is sufficient for more than 200 ratholes; 131 dead rats were found in 43 holes which were opened after the operation. In two cases, 10 rats were found in a single hole.

The process is, therefore, very cheap and its results are immediate and absolutely certain.

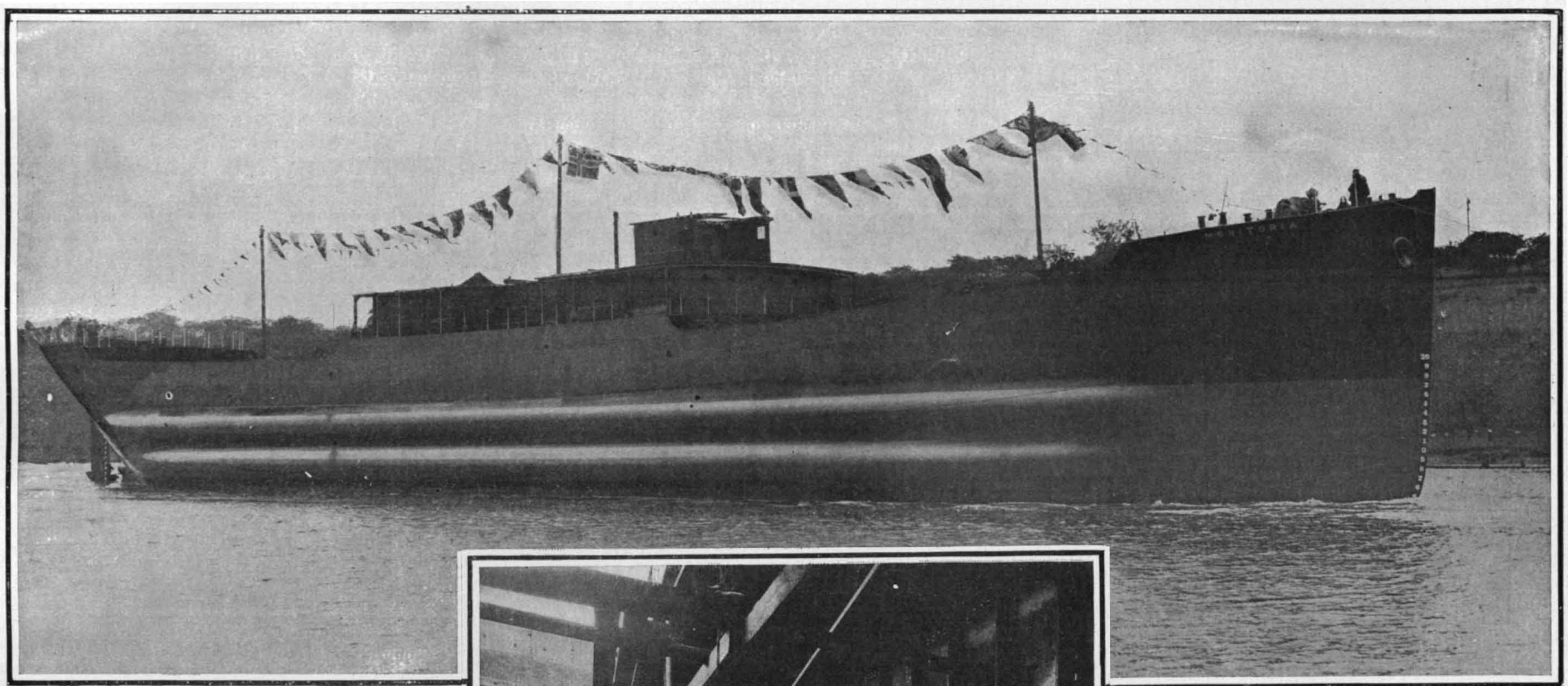
It is calculated, states a contemporary, that the United States is producing the following per week for fifty-two weeks in the year for every man, woman, and child of the population of ninety millions: Three-quarters of a pound of wire, more than three-quarters of a pound of rails, half a pound of structural shapes, three-quarters of a pound of plates, one-third of a pound of sheets, three-quarters of a square foot of tin-plate, two and a half pounds of bars, hoops, etc., four pounds of iron castings. These and other finished iron and steel products make a total of twelve to thirteen pounds each week per head.

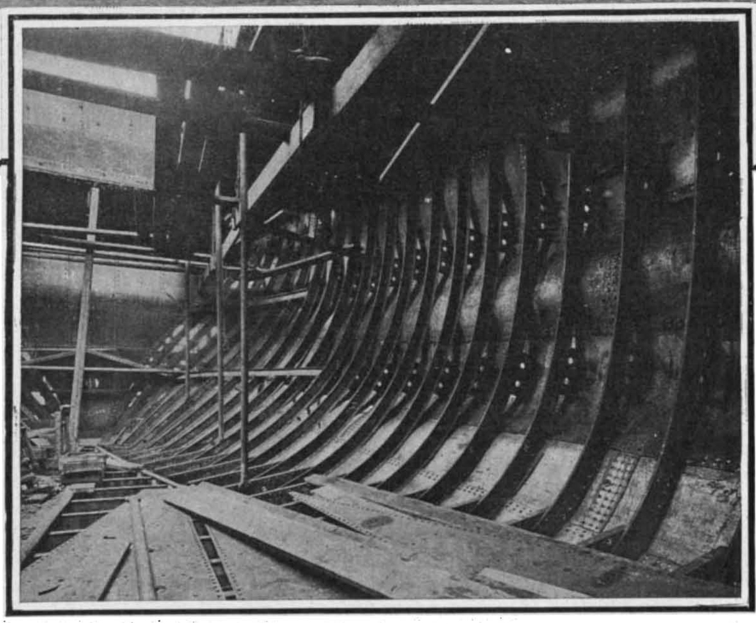
CORRUGATED SYSTEM OF SHIP CONSTRUCTION.

The interest of the shipping world has been aroused by a new departure from the ordinary lines of ship construction, as exemplified in the steamship "Monitoria," which recently left the Hylton shipyards of Messrs. Osbourne Graham & Company of Sunderland. This vessel of 3,300 tons marks a new development in shipbuilding design, being built upon what is known as the Monitor or corrugated system. For several years past experiments have been carried out by the Monitor Shipping Corporation of Newcastle-on-Tyne, to determine the best method of increasing the longitudinal strength of a ship without any corresponding increase of weight. To this end the underwater part of the hull between the light and load lines was corrugated for almost the entire length of the vessel. Continued investigation and experiment resulted in ascertaining the definite form of this corrugation, and at last it was resolved to test the system practically in a full-sized vessel. The Ericsson Shipping Company, of Newcastle-on-Tyne, undertook to build a craft on these lines, and the "Monitoria," now on her first trip, was the outcome. The vessel measures 279 feet in length by 40 feet 1½ inches normal extreme breadth, increased by the Monitor projection to 42 feet, with a molded depth of 20 feet 7½ inches.

In the accompanying illustrations the forms of construction of the corrugation are clearly shown. The shell plating is swelled out in two places on either side longitudinally, the curve being somewhat flat, and the upper and lower edges curving gradually into the flat side of the normal vessel. The main frames measure 8 inches by 3 inches, and the depth of the corrugation is 11½ inches at the crown. Plain angles are attached to each main frame and a corrugation gusset plate at each frame. There are no side stringers.

The very important result is obtained in this design that the projections give considerable increase in the hogging and sagging strength, so that the stress on the material is reduced at both keel and gunwale. The construction of the sides of the ship with these corrugations is rather an addition than a vital alteration of the main structural system, and it can be applied to any type of steamship. The builders claim that the extra cost is slight; and the dead weight carrying capacity is increased from three to four per cent. The coal bill is reduced from 12 to 15 per cent for the same speed; or, if the coal consumption is maintained as before, the speed of the ship with the extra dead weight is increased from 0.25 to 0.5 knot according to the size and class of the ship.





These corrugations increase the stiffness and longitudinal strength of the vessel.

THE "MONITORIA"—A CORRUGATED SYSTEM OF SHIP CONSTRUCTION

THE GABET WIRELESSLY-CONTROLLED AUTOMATIC TORPEDO.

On Wednesday, June 23rd, experiments were made with the wirelessly-controlled torpedo of Gabet, to which reference has already been made in these columns. In the experiments on the banks of the Seine endeavors have been made to control the torpedoes from a small boat about 100 meters (328 feet) distant from them, containing a plant for producing Hertzian waves.

The torpedo motor was started and stopped at will, and the rudder turned in every direction at the will of the man in the boat.

The improved Gabet torpedo consists mainly of a large cylinder terminating in two cones and forming the lower part of the apparatus. Some distance above, about 1.5 meters (5 feet), there is another similar cylinder, only smaller and intended to float. The lower shell is 9.5 meters long (31 feet).

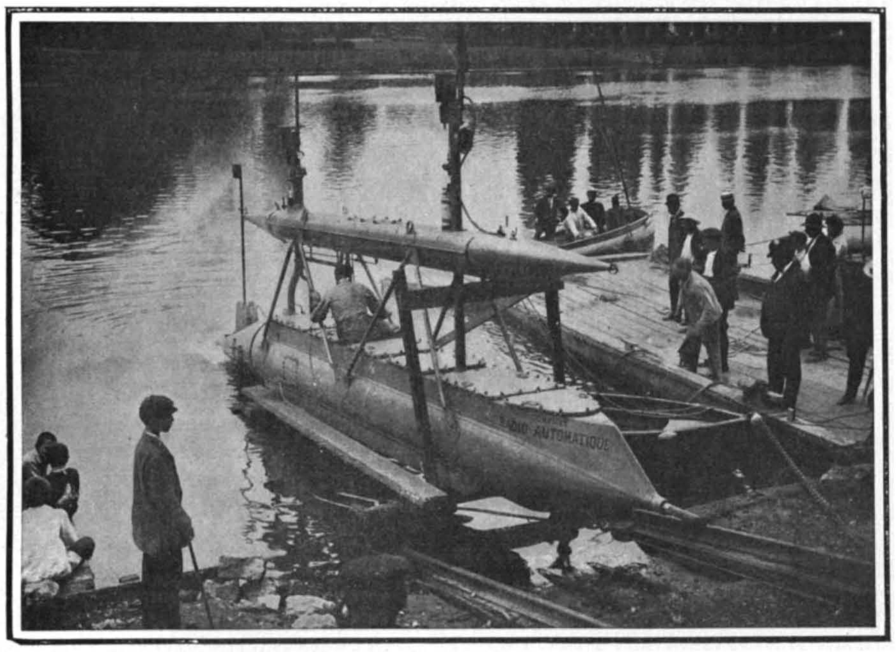
The two tubes are fastened together by a series of very strong steel tube frames. Besides these two other shafts, rather large in diameter, start from the lower body, extend beyond the float, and form two rather short, vertical masts. Each one of these carries an acetylene light. They are connected by a copper wire.

Let us now examine the parts composing the lower shell, which is the most important. It is divided into several compartments, having each its particular use.

The first compartment is situated in the fore part of the lower shell. It contains the explosive charge and controls a warhead similar to the warheads of all present-day torpedoes, which produce the explosion of the charge instantly on contact with a hard body, such as the hull of a vessel.

While all ordinary torpedoes carry only 70 to 100 kilos of explosive (154 to 220 pounds), the Gabet can take 900 kilos (1,980 pounds) with correspondingly greater destructive effect.

The Gabet torpedo contains an internal-combustion motor operated by gasoline, a decided novelty. Compressed air as now used in torpedo motors may supply powerful engines, but the radius of action is very



Launching the improved Gabet wirelessly-controlled torpedo.

The wave-transmitting apparatus set up in a small boat.

THE GABET WIRELESSLY-CONTROLLED AUTOMATIC TORPEDO.

limited. The speed of torpedoes thus operated reaches 30 knots, or about 50 kilometers an hour.

It is manifestly very dangerous to shut in a gasoline motor in a confined space or nearly so, as is the case here, where communication with the outer atmosphere takes place only through the upper part of the foremast.

Ventilation is effected by means of a large blower, situated aft, between the motor and the chamber containing the storage batteries. The precautions taken seem sufficient to dispel all fear of serious accidents.

The motor is located in the compartment aft of the torpedo. It is therefore entirely separated from the explosive charge, with which it cannot communicate by any manner whatever.

The torpedo used for the present experiments develops 30 horse-power. It has a motor with eight cylinders arranged in V shape. But the compartment is large enough for a 300-horse-power multiple-cylinder motor, which is necessary to impart to the torpedo the estimated speed of 20 knots, or about 36 kilometers an hour.

Regarding weight, every necessary margin is allowed, since the torpedo can carry 1,800 kilos (3,960 pounds) of ballast under present conditions, that is to say, with a 30-horse-power motor. This ballast represents the difference between the weight of an electric motor with its storage batteries and the weight of the internal-combustion motor developing this power.

Gabet expects to attain a 10-knot speed with the 30-horse-power motor which he will use in his preliminary trials, before putting in the 200-horse-power motor, on which he relies to obtain the 20 knots that he considers sufficient speed.

Endeavors have been made to obtain for this dirigible torpedo all the advantages that could be had on a real vessel. In particular, it was sought to fit it with the means for maneuvering and altering the speed. This problem seems strangely difficult of solution. The trouble has been overcome by using a reversible screw, with which it is only necessary to turn the blades so as to diminish their effectiveness on the water: this promptly reduces the speed. By this means a propeller is obtained that acts as well moving forward as backward when given the same speed of rotation.

There was another great difficulty to surmount before this screw could be used. The power exacted from the motor varied considerably with the speed. It became necessary, therefore, to find a way of reducing the power developed by the motor and of providing against its running away as the resistance of the propeller tended to diminish.

To attain this end the spark is retarded as the speed of the torpedo is reduced. The motor speed is thus gradually changed by the variation of the pitch of the screw. This variation of pitch of the propeller has been availed of to act upon the timer of the motor.

For that purpose the pitch-controlling mechanism has been connected with the timer by a jointed rod, so that the spark advance is at its maximum when traveling full speed forward or backward. The pitch-controlling mechanism is also connected to the throttle valve, in order to simultaneously diminish, in certain proportions, the volume of gas admitted.

The third compartment of the torpedo contains a small storage battery. This is not intended to drive the torpedo, but to operate a relay that helps maneuver the boat under the influence of the Hertzian waves acting on special devices.

The compartment back of the explosive charge contains the Hertzian controlling instruments. They are sufficiently effective to act even at as great a distance as 8 to 10 kilometers (5 to 6 miles) from the transmitting station. This distance is a convenient one at the present time, for warships get into action at least at 7 or 8 kilometers (about 4 miles) away.

We have said that the two masts of the torpedo carried acetylene lights. These serve to show the position of the torpedo at every moment, and indicate clearly every change in its course.

It is absolutely necessary to know what is going on inside the torpedo and what influences may act upon it. For although the receiving instruments of the Hertzian waves have been made as perfect as possible, they may come under the influence of other waves than those sent from the transmitting station. In this case, the torpedo would obey other agencies and would deviate from its course.

To remedy this serious objection lanterns have been disposed about to flash signals in such a manner that the operator, placed on shore or on a ship, may recognize the nature of the directions received by the torpedo. In short, every time the torpedo receives waves registered by its instruments, the lanterns show signals to indicate the direction of the torpedo. If these signals lead the operator to believe that the waves come from the enemy, he does what is necessary to rectify the course of the torpedo, and he nullifies the disturbing waves.

We presume that the wireless control of the torpedo remains as we have previously described it. The reader interested in that phase of the construction is referred to Scientific American Supplement No. 1650.

THE "ZEPPELIN III." AIRSHIP AND ITS TRIP TO BERLIN.

The large photographs of the latest Zeppelin dirigible reproduced on our frontispiece this week give an excellent idea of this new leviathan of the air, which made its first long-distance flight from Friedrichshafen to Berlin a little more than a month ago.

The start of this memorable journey occurred at 4:35 A. M. on August 27th. The airship started against a light northeast wind. Besides Engineer Durr and young Count Zeppelin (the nephew of the inventor), only three mechanics were carried. The crew was reduced to but five men because of the uncertain weather and in order to reduce the weight carried as much as possible. The airship arrived at Ulm at 6:45 A. M., having made the 80 kilometers (49.7 miles) in two hours and eight minutes, at an average speed of about 23.3 miles an hour. This speed was maintained up to Heidenheim, a place located on the frontier of Wurtemburg and Bavaria, which was passed at 7:30 A. M. Soon after Gingen was reached. The airship remained here about an hour and described circles, while all the time it was fighting against the contrary wind blowing from the direction of Wurtemburg. Soon after Engineer Dürr sent a telegram stating that the airship would be forced to land at Nuremberg, on account of a cracked cylinder in one of the forward motors in the forward car. On account of this mishap, the speed was reduced considerably, the airship finally arriving at Ostheim, near Gunzenhausen, 21¾ miles from Nuremberg, at 11:45 A. M. At this point a broken propeller—which was immediately replaced by an old one that was carried on board—made it necessary to land. Advantage was taken of the landing to renew the water ballast. After a delay of 2½ hours, the airship started again at 2:10 P. M. for Nuremberg, which was reached at 4:45 P. M. A landing was effected against a strong wind. Before landing the dirigible described several circles, in order to give the 120 soldiers of the Fourteenth infantry regiment time to make preparations for anchoring it. When the airship alighted, the crowd broke bounds, and it was feared that they would damage it. Fortunately, however, this fear was not realized.

The start from Nuremberg was made the following day at 2:15 A. M. At 4 A. M. it passed above Bayreuth, where it was buffeted by the wind for three hours. Engineer Durr dropped a card at 7 o'clock stating that all was well on board. At 8 o'clock the airship, still battling against the wind, returned to Bayreuth. It then resumed its journey, but was able to make a mean speed of only 14 kilometers (8.7 miles) an hour. It passed Munchberg at 9:40, Hof at 10 o'clock, and Plauen at 12:10 P. M. It was making only 30 kilometers (18.64 miles) an hour. Werdau was passed at 1:45 P. M., and although the wind had completely died out, the speed of the airship grew less and less. It was hoped that it would reach Leipzig by 10 P. M., when another accident occurred. One of the blades of the propellers broke, and it was only with the greatest difficulty that the airship was able to reach Bitterfeld. It arrived at this place at 6:45 P. M., having been driven from Eilemburg by a single motor. A successful landing was effected.

Repairs were made during the night, and the next morning at 7:30 A. M. the airship left Bitterfeld in a heavy fog. The fog dissipated rapidly, however, and when the airship arrived above the Tempelhof parade ground at Berlin at 12:30 P. M., the weather was clear. The Emperor and the other members of the royal family were on hand to receive Count Zeppelin, who had gone aboard his airship at Bitterfeld. Emperor William introduced him to Orville Wright, and this meeting of the two champions of the heavier-than-air and the lighter-than-air type of flying machine was decidedly novel. The landing of the airship occurred above the parade ground at Tegel, after it had first performed evolutions above the Tempelhof parade ground and afterward flown over the city of Berlin. One of our photographs shows the airship above the city, and the other shows it just before alighting.

The return voyage was started at 11:30 P. M. the same day. The airship followed the Wittenberg-Juerbog railway line for a considerable distance, when it again met with another accident, due to the breaking of a propeller. The blade tore through the envelope of the airship, and punctured one of the balloons. The accident happened near Bulzig, about 60 miles from Berlin, and with the aid of some farmers, the airship was immediately brought to land in a field near the railroad track. The speed up to the time of the accident was extremely slow, and barely reached 20 kilometers (12.43 miles) an hour. Count Zeppelin was not on board at the time of this accident, he having returned to Friedrichshafen by rail. The airship was obliged to remain at Bulzig for nearly three days. It was not until 10:53 A. M. on the morning of September 5th that another start was made. Ulm was passed at 7:45 P. M., and Biberach at 8:25 P. M. The airship finally arrived at Friedrichshafen at 9:30 the following morning after a continuous voyage of 22 hours and 37 minutes. The average speed maintained from Bulzig therefore was only 14.3 miles per hour.

After the "Zeppelin III." had been repaired, an effort was made to sail it to Hergentheim, 120 miles from Friedrichshafen, to take part in the maneuvers; but the repairs were not finished in time, and the airship was unable to reach its place until the maneuvers were over. Considerable excellent work was done, however, by the "Gross II." military dirigible at these maneuvers. This dirigible was able to reconnoiter from a great height and to send messages to the rear. Emperor William was greatly pleased at the work done by this airship at the maneuvers.

The "Zeppelin III." is the largest and most powerful airship which Count Zeppelin has yet built. It has two 150-horse-power motors, each of which drives, by means of belts, two two-bladed propellers. These are located one on each side of the airship about a third of the way up from the bottom. They are held upon brackets projecting out from the rigid frame. The driving of the propellers by belts is a new arrangement, as heretofore they have been driven by shafts and bevel gears. The stabilizing fins near the rear end are somewhat different from before, there being two upon each side placed above the center horizontal line of the airship. The up and down steering is accomplished by quadruple horizontal rudders on each side of the airship at the front and at the rear. Besides this, water ballast is carried in a long tank connecting the two cars.

It is planned to use this airship for carrying passengers in different cities in Germany in the near future.

The Current Supplement.

The opening article of the current Supplement, No. 1761, discusses the San Salvatore mountain railway of Italy. Beautiful views of this picturesque road are published. The classification of chemical elements, in the light of Mendelejeff's great generalization, and in the light of the electronic theory, is considered by Prof. H. E. Armstrong in a thoughtful paper. A critical *résumé* of Prof. Wood's experiments with rotating liquids used as mirrors is presented. A perpetual clock is described by Charles E. Benham. A new system for the electrical transmission of pictures is described by Dr. Robert Schoenhoefer. Prof. Albert F. Ganz's paper on recent electrical progress in the artificial lighting field is concluded. The great rise which is announced in the price of India rubber tires directs attention once more to the various and conflicting problems presented by the wheels of motor cars. These are critically considered. Prof. William H. Pickering presents his view of the origin of meteorites, and advances the theory that meteorites are of terrestrial origin. The disappearance of the Bosgoslav Islands is described. Sir Norman Lockyer, the well-known English astronomer, has made a special study of the astronomical value of ancient temples. The result of his researches is presented in an article entitled "The Uses and Dates of Ancient Temples."

The Death of Robert Hoe.

Robert Hoe, senior member of the well-known firm of R. Hoe & Co., printing-press manufacturers, of New York city, died in London on September 22nd, at the age of seventy. Mr. Hoe was for years the head and front of the extensive business founded by Robert Hoe in 1803. His devotion to the enormous enterprise with which his name was connected, was exhibited not only in an administrative capacity, but also in the suggestion of many improvements in printing presses. His invention of the rotary multi-color and half-tone web presses, now found in every newspaper and job printing plant, is perhaps his most important contribution to the printing art. Mr. Hoe was the author of several books, most of them dealing with printing. Among them is a history of the development of the printing press from the time of Gutenberg down to the present day.

The railway from the Piræus to the Turkish frontier (246 miles) may be said to be practically completed, the section from Bralo to Larissa having been opened to traffic since October last, and trains now run in twelve hours from Athens to Larissa. The construction of the final section of 28 miles to the frontier is in an advanced state. There remains, then, in order to release Greece from the isolation which she is the last of European States to suffer, but 70 miles between the frontier and the nearest station on the Ottoman railway system. There appears no indication, however, of any disposition on the part of the Ottoman government to facilitate the construction of the junction line, and it will be regrettable if the reformed government of Turkey continues to oppose a project so evidently appertaining to an era of civilization and progress.

On Waterproofing Concrete.

On account of the number of inquiries received from correspondents as to methods of waterproofing cement blocks or monolithic concrete, the SCIENTIFIC AMERICAN has been investigating what is being done in the way of improvement of existing methods.

The Concrete Association of America has conducted a valuable series of experiments and distributes its findings free of charge in a public-spirited manner, but the results obtained are largely negative.

Some preparations are found to be effective under certain conditions, but none hitherto has been found to be equally reliable with all mixtures and under all circumstances.

The need and requirements of external paint for concrete, if only to counteract the variable porosity which cannot be avoided unless the personal equation in concrete mixing is eliminated, is so well put in a paper read before the recent convention of the American Society for Testing Materials, by Mr. G. D. White, that we quote a part of it by permission.

"Unless extreme care is exercised in the preparation, mixing, and workmanship of concrete for solid or reinforced work, which is not always commercially possible, the resultant concrete is not impermeable, or at least not uniformly impermeable to water or moisture. Where perfect materials have been used with perfect workmanship, we have another difficulty, another problem to solve. Concrete is a non-conductor of heat. It is, naturally, a cold-blooded animal. The difference in temperature between the concrete wall and the atmosphere (the warmer the day the greater the difference in temperature) causes a condensation of moisture on the surface. This is annoying, and a detriment to health in living and office rooms; a loss of room or loss by damage in storerooms and warehouses; an objection in any building, no matter what its nature or purpose.

"Hollow concrete blocks, tiles, brick, etc., have various defects. They are not only porous but capillary positive, and thus absorb moisture from 5 to 40 per cent of their own weight. Due to rain and snow, walls built of these materials become water-soaked, and remain soaked for varying lengths of time. During certain seasons of the year, and especially in some sections of our country, they remain soaked for months.

"The fact that dry walls are essential to health and comfort is generally known, and so well appreciated that the question of dampness has been a restraining agent to a much larger and more extensive use of concrete by the building trades of this and other countries.

"The tendency to stain, the frequence of efflorescence, and difference in color due to difference in materials and to intermissions in concrete, are defects of a less serious nature.

"A drawback that includes concrete in all forms is the uninviting, unattractive color. Replace our buildings of marble, of terra cotta, of granite, of wood handsomely decorated, with buildings of concrete, and note the contrast. The dirty gray of ordinary cement or concrete becomes monotonous to the observer even where there is but a sprinkling of concrete among buildings of more pleasing construction.

"If to the strength, cheapness, durability, and fire-resisting properties of concrete can be added impermeability to moisture and decoration, we will have a building material as nearly perfect as the world has ever seen, and this within the means of every builder.

"In recognition of this fact, various concerns and individuals have placed on the market and recommend as a solution to the problem, various treatments and coatings.

"For the sake of convenience, I will divide these into four classes. In my investigation of the various treatments and materials included in these classes, I have endeavored to be unprejudiced, and to give to each its true worth and full value.

"I. WATERPROOFING COMPOUNDS IN LIQUID OR POWDERED FORM, MIXED WITH THE CONCRETE IN ITS PREPARATION.

"This is a help in that it lessens and retards, in a measure, the moisture-absorbing tendency of concrete. It fails in the desired attainment for the following reasons:

"Improper distribution, which is difficult of regulation.

"When properly distributed, it does not render concrete entirely impervious to moisture.

"It has a tendency to weaken the tensile strength of concrete.

"It does not decorate.

"The increase in value is not proportionate with the increase in cost.

"It deteriorates with age, that is, a concrete block containing the waterproofing compound, on the first application of water will absorb certain varying quantities. On subsequent applications, allowing the block to dry in each instance, larger quantities are absorbed.

"II. TREATMENTS PREPARATORY TO THE USE OF LINSEED-OIL PAINTS.

"Treatments in various forms have been advanced and recommended by some of our leading master painters, and indorsed by most able research chemists. For the sake of brevity, I have included in my paper but three of these treatments:

"(a) Hydrochloric or muriatic-acid wash.

"(b) A wash consisting of a solution of zinc sulphate and water.

"(c) A wash consisting of ammonium carbonate and water.

"From a chemical standpoint, muriatic acid, no matter in what strength, nor what the character of the concrete, is not only useless as a remedy, but detrimental in its action. Master painters who have endeavored to put it in practice have discovered to their sorrow a confirmation or a demonstration of the chemical theory.

"Theory favors and practical tests confirm as the best adapted to the purpose, the former of the two latter methods."

The author proceeds to give the chemical reactions of these various washes with the concrete ingredients, and shows in a convincing manner the reasons why they fail in their desired object. He adds:

"The treatment with zinc sulphate or ammonium carbonate, even though successful, does not offer a solution to the problem, because a linseed-oil paint is unsuited for either exterior or interior painting of concrete. The gloss robs the surface of the appearance of stone or masonry. Linseed oil has water-absorbing and lacks water-resisting properties. It cannot be applied over a damp or wet surface, which means that following a rainstorm or rainy season, a painter must wait weeks and perhaps months before he can commence work on or complete a contract already begun.

"III. COLORLESS LIQUID COATINGS.

"Certain of these may be of some value or service in retarding moisture absorption and efflorescence, but they are all alike found lacking in the following respects:

"They serve to emphasize any defects in, or difference in color of, concrete construction.

"They impart to concrete a soggy, water-soaked appearance.

"They do not render impermeable to moisture for any length of time.

"They do not decorate."

Under his fourth heading Mr. White summarizes paints for concrete, with the practical conclusion that there are none which fulfill all the requirements of a severe list which he gives. The principal of these are that it must be applicable to a wet surface and at the same time waterproof when set: it must be applicable to the concrete without previous treatment of the latter, durable, economical, and pleasing to the eye, must act as a bond between concrete and a plaster coat, and remain hard in the presence of water, in addition to possessing all the qualifications of ordinary paint such as working well under the brush, filling voids and leveling up irregularities of surface.

Although Mr. White did not say in his paper that he knew of any satisfactory paint, we have reason to believe that he has been instrumental in the production of one, or at least that it has been developed with a special view to fulfilling the requirements outlined in his paper.

We have recently seen tests, and the results of long-continued tests, of a paint called Cementhide, which seems to fulfill all the exacting conditions above referred to.

At a cement-block factory in Newark, N. J., a part of the process consists of the curing of the newly-made blocks by subjecting them to steam for thirty-six hours, accelerating their setting and providing a much more constant and uniform supply of moisture to the cement than can be obtained by spraying.

For this purpose two curing rooms are used, each of which is opened to be emptied and refilled on alternate days, the steam being turned off in the morning and on again at night. The steam is therefore continuously applied to the interior of the walls for 36 hours out of every 48. The rooms themselves are built of concrete blocks, and were formerly constantly saturated with moisture. It was evident from the outside which room was filled with steam from a thin film of moisture trickling down the exterior of the walls, which had to be drained away. Six months ago the interior was painted with two coats of Cementhide, and now there is no evidence of moisture on the outside of the walls, while the interior has a smooth, hard surface differing little from that of well-finished cement except in its pleasant color.

Blocks made as identically as possible from one batch of concrete have been tested under varying conditions, one plain and the other painted. The unpainted block was found to vary in weight with the water, absorbing it according to the amount present in the atmosphere or from the ground, while the weight of the painted block varied not at all. Blocks painted in a variety of pleasing colors have been left exposed to sun, rain, and wind for months without being apparently affected. Concrete painted with this material takes a plaster coat better than natural concrete, both concrete and plaster adhering to the paint more firmly than they do to each other. It has even been shown that the rise of moisture by capillarity in monolithic concrete set in moist ground is stopped by a coat of Cementhide between the top of the underground concrete and the masonry or other concrete continuation upward of the wall. The paint has a dull finish not unlike the concrete itself, but smoother and of any color desired, and appears to remain hard and to preserve the surface of the concrete indefinitely. One cannot imagine a more severe test in any ordinary building than that imposed at the block factory above mentioned, and it would seem that this paint should have widespread possibilities when it is sufficiently introduced on the market.

THE MODERN ICARUS.

BY JOHN ELFRETH WATKINS.

Tradition asserts that the first to sacrifice himself to the problem of flying was Wang Tu, a Chinese mandarin of about 2,000 years B. C. who, having had constructed a pair of large, parallel and horizontal kites, seated himself in a chair fixed between them while forty-seven attendants each with a candle ignited forty-seven rockets placed beneath the apparatus. But the rocket under the chair exploded, burnt the mandarin and so angered the Emperor that he ordered a severe paddling for Wang.

Then there is left in stone a partial account of experiments by Man-U, an Assyrian priest who attempted to fly from the temple of Baal. The next victims of aviation whom we find are certain criminals whose arms and legs the ancient Leucadians annually fitted with wings of various design and who were then hurled from the "Rock of Sappho's Leap," a boat awaiting them in the sea below to give them liberty should they succeed in solving the problem.

The first fatality of the kind in our era seems to have been a Roman who during the reign of Nero attempted to fly high in the air over the Eternal City. During the Dark Ages one Dante while trying to fly with a pair of wings, at Perouse, fell upon the top of St. Mary's Church and broke his leg. The Prior of Tongland in 1510, before the Court of Stirling donned feathered wings and, leaping from a tower of the castle, fell into the "mydding" (dunghill). Allard, a tight-rope performer, was crippled by a fall while trying to fly before Louis the Grand, at Paris, about 1660.

Thus far all such accidents were results of attempted aviation, for the balloon was not invented until 1783, when this new vehicle of the air met with an accident in Philadelphia during some experiments by Rittenhouse and Hopkins who, after sending up dogs and cats in a cage carried by a captive bunch of 47 hydrogen balloons, persuaded James Wilcox, a carpenter, to trust himself in the cage. After floating over the city he found himself drifting toward the Schuylkill River and, becoming terrified lest he should descend into it, punctured some of the balloons. Coming to earth with a thump he broke his wrist.

The next victims, Pilatre de Rozier and M. Romain, set out from Boulogne in 1785 in a car supported by a fire balloon underneath a hydrogen balloon with which compound arrangement they expected to cross the English Channel. In a quarter hour, when at a height of 3,000 feet, the apparatus took fire and the scattered fragments were found upon the seashore along with the awfully mangled bodies of the aeronauts. Next Olivari, ascending from Orleans, in November, 1802, also met death by his balloon catching fire.

In April, 1808, M. Mosment ascended at Lisle waving a flag decorated with the imperial eagle of France and the assembled spectators shouted with delight. He dropped an animal attached to a parachute and it came safely to the ground. Later a murmur of horror rolled over the crowd which learned that in one of the ditches outside the city M. Mosment had been found, lifeless and covered with blood. The same day the balloon came down seventy miles away.

In July, four years later, the corpse of Bittorff, after his balloon had caught fire, was found stiff and cold upon the roof of a house outside Mannheim. Shortly afterward Count François Zambeccari tried, like Rozier and Romain, to combine the fire and gas balloon but after adding flame to powder he crashed down from the heavens, his body, charred and mutilated, being picked up near Boulogne.

Mme. Sophie Blanchard, widow of a French aeronaut, made an ascent July, 1819, in the presence of a vast crowd, from the Tivoli Garden, Paris, setting off fireworks as she rose. Suddenly a great flash was seen above her basket and the crowd, thinking this to be a part of the display, shouted: "Bravo!" But the flames were seen to spread and the balloon to come down. Her basket caught against the projection of a roof and spilled her out upon the pavement, where she was picked up dead.

The first military martyr was Lieut. Harris, of the British navy, who, in May, 1824, while studying the strategic value of balloons attached to warships, was dashed to earth and killed by the breaking of a valve in his balloon. And in September of the same year, Windham Sadler, going up frcm Blackburn, England, was dropped to his death near Bolton, his balloon having collided with a chimney.

When John Wise, greatest of all American balloonists, abandoned his muslin balloon, in 1836, for the "Meteor," wrought of silk, he went up in it from Lancaster, Pa., on a showery day in May. He sailed to the southward and was soon lost in a big black cloud. That night he descended near Port Deposit, Md., and, mooring his ballccn near a farmhouse, aroused the family. It was drizzling and he was discharging the gas from the upper valve when someone brought a light, exploding the gas in the heavy atmosphere. Wise was thrown back ten feet, severely scorched, and some of those gathered round were badly burned. Wise was taken to Philadelphia, where he recovered.

In July, 1837, an immense crowd gathered in Vauxhall Gardens, London, to see an aged savant, Robert Cocking, test his new parachute. It was of Irish linen, had a circumference of 107 feet and was fastened below the basket of a balloon, wherein two aeronauts were stationed. Mr. Cocking got into the smaller basket of the parachute and the big balloon, after taking him slowly up, drifted gracefully away. But a rider following on horseback, arrived at a field near Lee, in Kent, just in time to find the dead body of Cocking, who had fallen through the air a mile in the collapsed parachute.

Another victim of the parachute was Leturr, killed in 1854 while attempting a descent, and soon afterward Arban, of France, while rising in a balloon from Barcelona was blown into the Mediterrancan and lost. Then in 1850 Gale made a fatal flight, while in 1863 Chambers was suffocated by balloon gas, in England.

In 1873 at Ionia, Mich., the populace cheered as the brave aeronaut, Mountain, rose from their midst in his big balloon. He floated gaily aloft at first but suddenly the fastenings of his basket gave way and he fell from such a height that his body penetrated the earth for some distance.

And next came the first recorded fatality from winged flight since the Dark Ages. Vincent de Groof, renowned as the "flying man," while giving an exhibition at London, in July, 1874, fell suddenly to earth where his corpse was picked up with the stilled wings attached.

In 1875 J. Croce-Spinelli and Spivel, two French savants, while attempting to break the record for altitude in their balloon "Zenith" rose so high above France that the intense cold deprived them of power to descend. When the "Zenith" came down they were found frozen to death in the basket. During the siege of Paris two balloons with escaping passengers drifted off to sea never to be heard of, and in 1888 the corpse of Simmons, who had ascended from Olympia, came to earth near Malden.

Hiram Maxim, a few years later, spent $100,000 on two immense heavier-than-air flying machines, the last —which weighed 8,000 pounds—making a false start, in July, 1894, when the machine ran off the guard rails. Maxim gave up in disgust and turned to other problems.

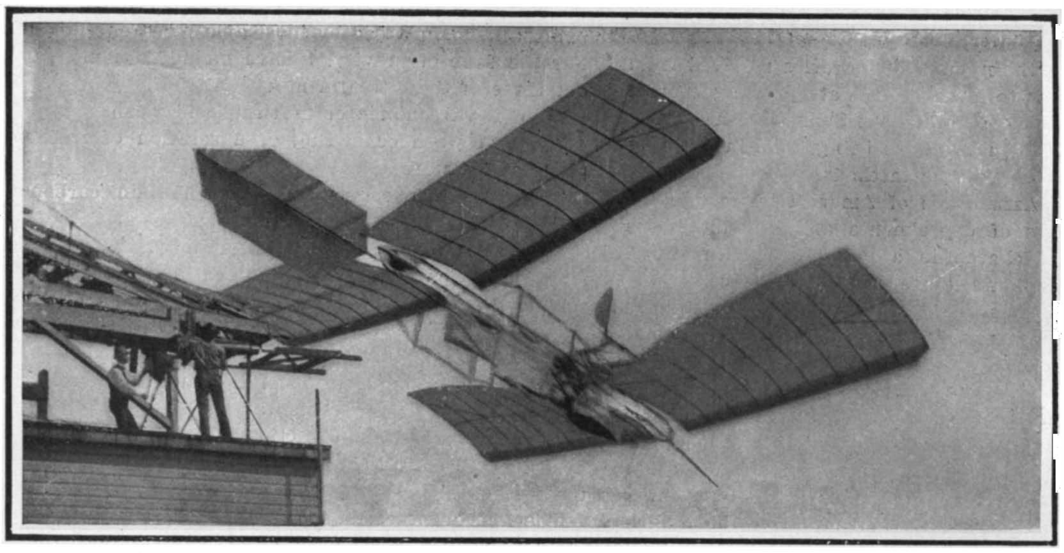
Then, in 1896, Otto Lilienthal, of Berlin, after a quarter century of tedious experimenting, brought forth a double-decked aeroplane in which he soared through the air at race-horse speed, sixty or seventy feet above ground. Prof. Robert W. Wood, of Johns Hopkins University, went over to Berlin to test the apparatus and made the snapshot used herewith. A few days after this picture was taken Lilienthal fell from the same apparatus, in the same spot, and was picked up dead. Shortly afterward the experimenter Pilcher, who had been continuing Lilienthal's methods in England, met death in much the same way.

The same year S. A. Andree of Sweden, accompanied by Nils Strindberg and Dr. Eckholm, two other adventurous Swedes, started in his balloon from Spitzbergen in search of the North Pole; and no trace of them has since been found.

In 1896 the hope of science was renewed by Langley, our great astronomer and physicist, who after a decade of the most careful experimentation, flew a steam aerodrome three quarters of a mile over the Potomac. This not being large enough to carry its engineer the army allowed the inventor $50,000 with which to perfect a man-carrying machine. The quarter-size model of the latter also steamed successfully over the Potomac in the face of the wind; but when the full-size aerodrome was about to leave the launching track a defective part of the launching apparatus caught it and precipitated it—engineer and all—into the water. Although the big aerodrome never had a chance to try its wings, the press so ridiculed the enterprise that appropriation for repair was refused and Langley, despite his other great contributions to science, died a disappointed man.

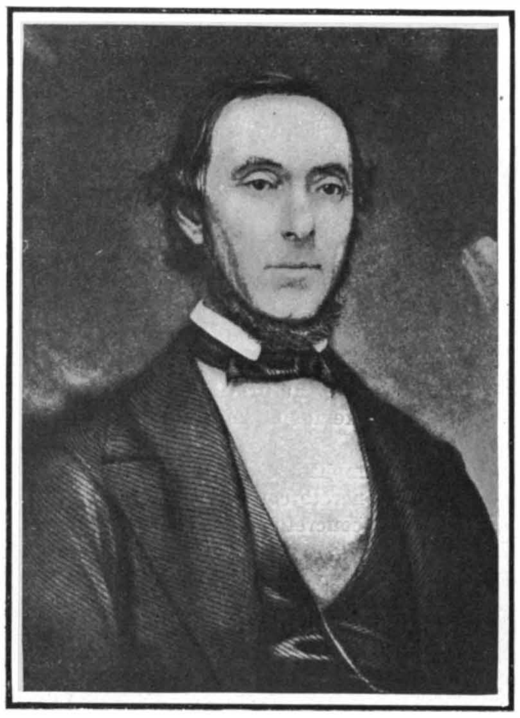
Count Zeppelin's new craft, 443 feet long, was making a long official test splendidly in August, 1908, when the balloon caught fire.

And finally comes Orville Wright, riding to victory in his heavier-than-air machine, which is scarcely inside the goal when it dumps him out with a broken thigh and several fractured ribs; and with him spills



False start of Langley "aerodrome," 1908.

Otto Lilienthal

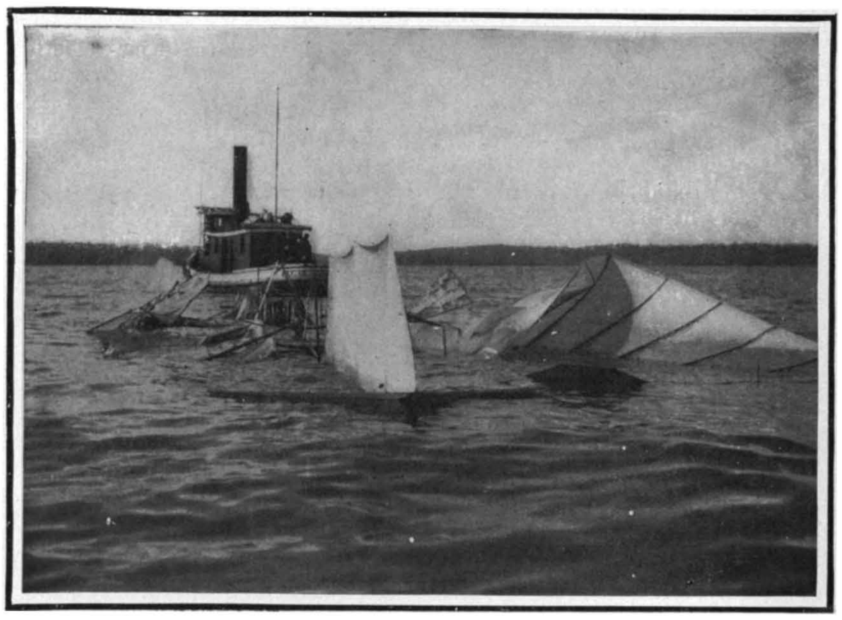


John Wise.

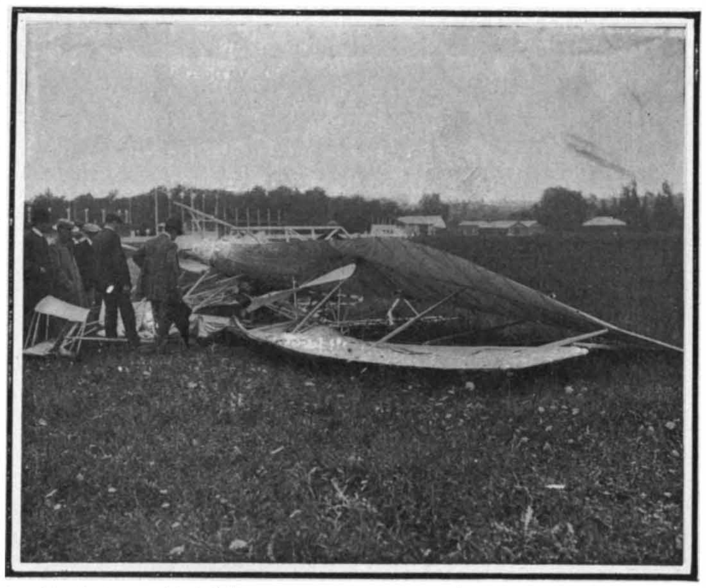
Otto Lilienthal.

S. A.

Lieut Thomas E. Selfridge.

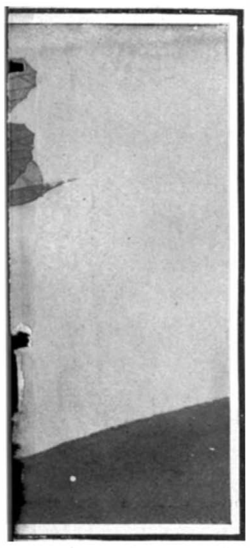


Towing wreck of Langley "aerodrome" back to houseboat, 1908.

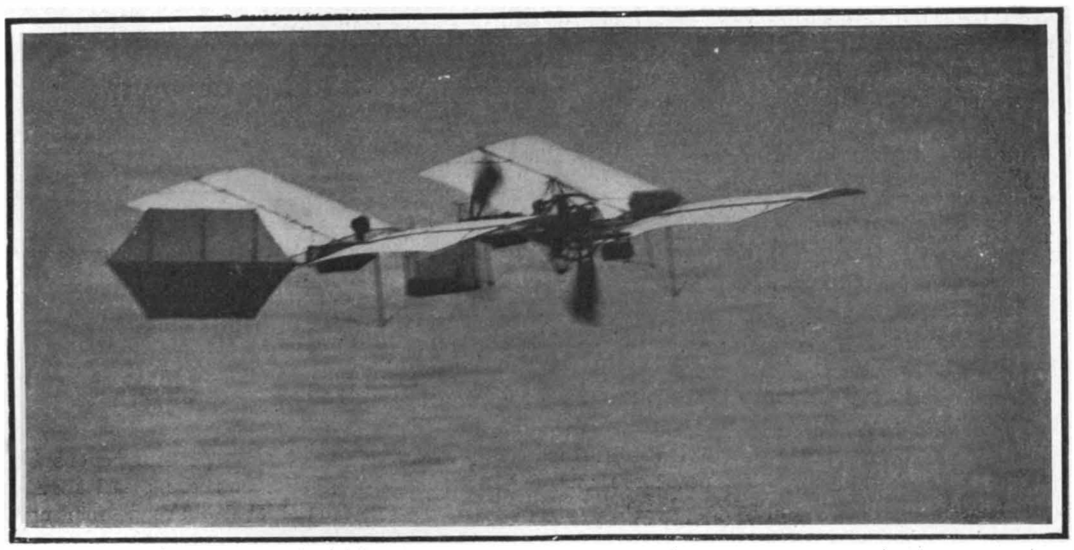


Lefebvre's machine after the accident.

Lefebvre, who was killed in France.



s fatal flight.



Langley's last model. Telephoto snapshot of it in flight

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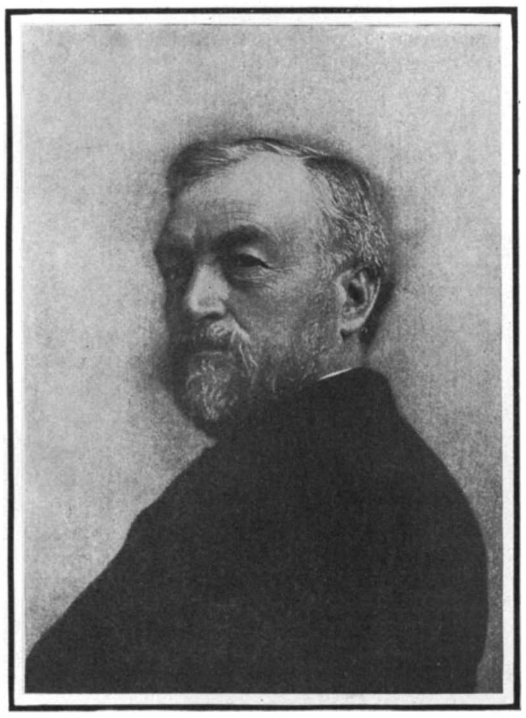
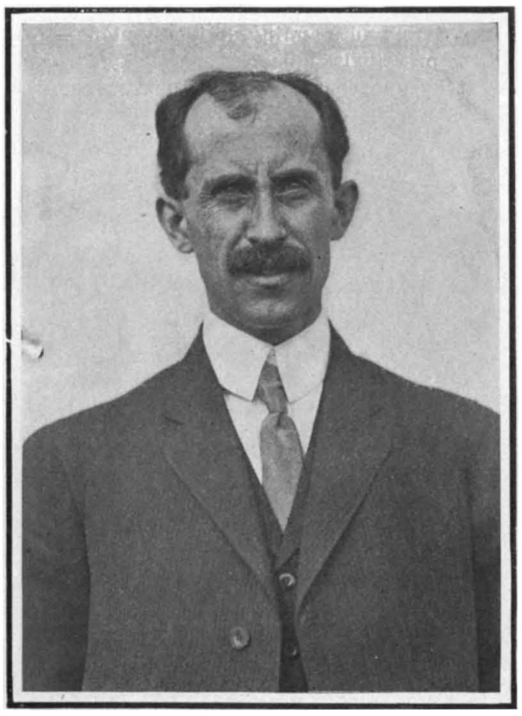
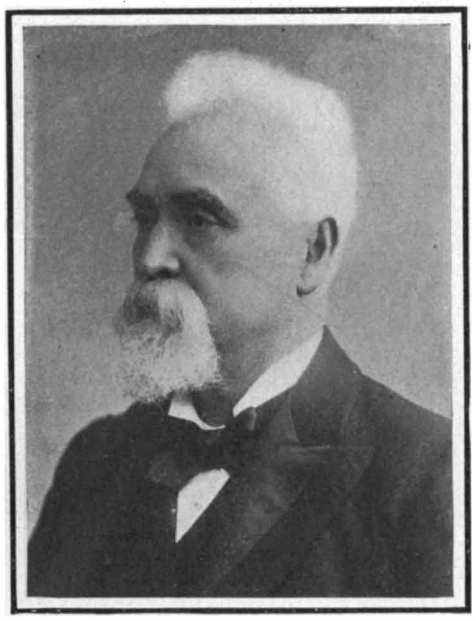


Samuel Pierpont Langley.

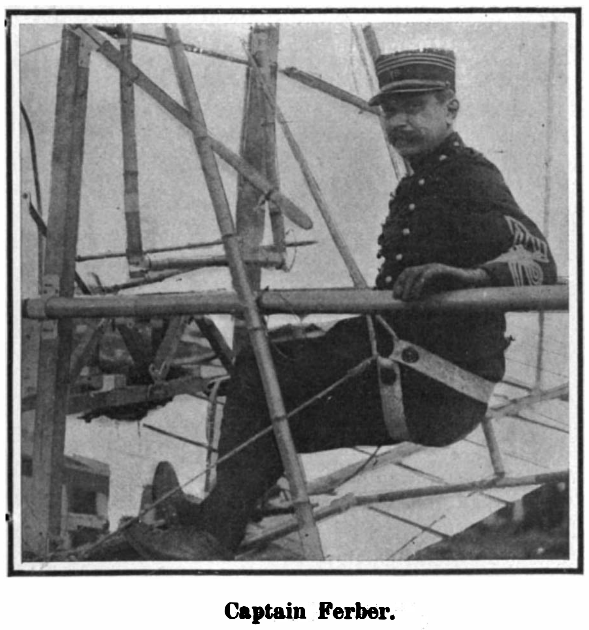


Orville Wright.

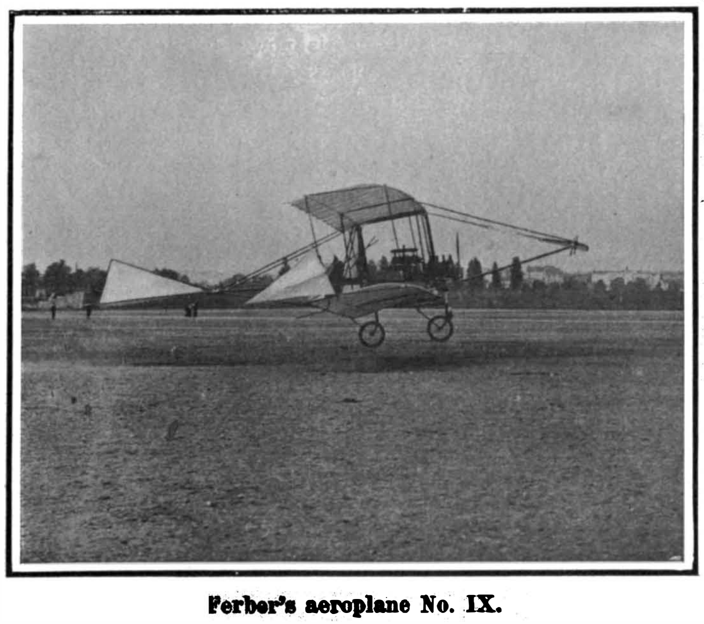
Langley aeroplane in the Potomac River.



Sir Hiram Maxim.



Captain Ferber.



Ferber's aeroplane No. IX.

N ICARUS.

to earth young Lieut. Selfridge, whom soldiers solemnly bear on a litter to the military hospital where occurs, three hours later, one of the more recent of the many fatalities of our chronicle of tragedy.

The two fatal accidents which have occurred in France with the motor-driven aeroplane within the last few weeks, have further dampened the enthusiasm of many would-be aviators. The first of these, which happened on September 7th, resulted in the death almost instantly of Lefebvre, who was one of the newest and probably the most daring of all the French aviators. The second one, which occurred only last week (September 22nd), snuffed out the life of Capt. Ferber, who was probably the best-known theorist and practician in the art of aviation in France. Both of these accidents occurred while the men were trying out new machines. In the case of Lefebvre, he was making his first flight with a new Wright biplane. The machine rose in the air without difficulty, and flew for some distance in a straight line. Lefebvre made an excellent turn, and was flying back again in a straight line when suddenly the machine dived to the ground, striking its head on with terrific force. The motor fell upon the aviator, who was crushed and had his skull fractured.

Capt. Ferber, on the other hand, was experimenting with a new Voisin aeroplane. He had flown half a mile at a height of about 25 feet and was making a turn when the machine tipped a great deal, and also dropped on the turn, so that the end of the lower plane struck the ground. The machine reared on its nose, and Ferber was thrown to the ground, the motor falling upon him. He managed to extricate himself, and was able to walk to the grandstand with the aid of some spectators. He said that he had flown too low, and that he had been bothered by the wind in making the turn. He was not seriously injured to all appearances, but in a few minutes a hemorrhage set in, and he died before a doctor arrived. The machine was badly damaged, and it was a wonder that the aviator was not instantly killed. Capt. Ferber probably did more than any other man to bring the art of aviation to its present advanced point. He was much of a theorist, and only lately he published an article in which he deplored the weight of the present-day machines, and gave it as his opinion that no progress had been made in perfecting these during the past six months. The fatal accident, which occurred at Boulogne, was preceded by another bad smash less than a week before. In this instance the machine broke a rudder and one of the planes.

Rate of Helium Production.

In a recent issue of Nature Mr. R. J. Strutt contributes a communication on "Rate of Helium Production from the Complete Series of Uranium Products."

A knowledge of this constant is essential to the estimation of the ages of minerals from their helium content. In a paper published in Proc. Roy. Soc., July 28th, 1908, Mr. Strutt gives the ages of some minerals provisionally on the assumption that the rate was 9.13×10^{-8} cubic centimeters per gramme U_3O_8 per annum. This rate was calculated from Rutherford's indirect data. It has received much support from Sir J. Dewar's determination of the rate of production by radium with its immediate products. Mr. Strutt is now in a position to confirm it further by an experiment on the rate of growth of helium in a solution of pitchblende. He speaks of *a* solution, but it has been found impracticable to take up all the constituents by one solvent. Two solutions were necessary.

The pitchblende solutions contained 115 grammes of U_3O_8, and yielded in sixty-one days a quantity of helium, which was measured as 2×10^{-6} cubic centimeters in the capillary of a McLeod gage. This gives the rate as 10.4×10^{-8} cubic centimeters per gramme U_3O_8 per annum. No stress can be laid on the close agreement with Rutherford's estimate in view of the very small gas volume measured. The experiment proves, however, that that estimate is of the right order of magnitude. Larger scale experiments are in progress, and these, in conjunction with similar experiments on thorianite, will, it is hoped, enable data on the quantity of helium in minerals to be translated into estimates of time with full confidence.

Railway Tree Planting.

The Pennsylvania Railway is planning to set out more than 1,000,000 trees. This will make a total of 3,430,000 trees planted in the last three years to provide for some of the company's future requirements in timber and sleepers. This constitutes the largest forestry plan yet undertaken by any private corporation. Heretofore the company's forestry operations have been confined to a limited area between Philadelphia and Altoona. This year, however, 65,000 trees are being set out on tracts of land near Metuchen and New Brunswick, N. J. In addition there are to be planted within the next month 207,000 trees near Conewago, Pa., 186,000 in the vicinity of Van Dyke, 334,000 at Lewistown Junction, 7,000 at Pomeroy, and 205,000 at Denholm.

THE HEAVENS IN OCTOBER.

BY HENRY NORRIS RUSSELL, PH.D.

WHAT astronomical problem has been so much before the public during the past month as this: How can a man determine when he is at the north pole?

As many incomplete or misleading answers have come to the writer's notice, it may be appropriate to give a brief review of the matter here.

An observer standing at the earth's north pole would have the celestial pole (not the pole star, which is 1¼ deg. distant) in his zenith. The stars, during the long night, would appear to circle round the sky from left to right always at the same altitude ab ve the horizon; the sun to circle similarly, rising slowly from the horizon to its maximum altitude of 23½ deg. between March and June, and sinking again until its disappearance in September. The change in the sun's altitude from day to day (which equals that in its declination) is accurately known, and can be taken from a small and easily portable table.

For an observer near but not at the pole, the celestial pole would be displaced from his zenith—toward that point of the horizon where the earth's pole lay—by one degree for every 60 nautical miles of distance. The stars—or the sun after allowance is made for its change of declination—w o u l d still appear to circle round the heavens, but would be lowest when due north—i. e., toward the pole—and highest when due south. The whole change in their altitude would equal twice the observer's distance from the pole. For latitudes up to 80 deg. or more (that is, more than five or six hundred miles from the pole) this change in altitude is very conspicuous, and observations can easily be made when the sun is highest (at local noon) in the manner familiar to mariners. But for an observer within a few miles of the pole, these changes in altitude would no longer be perceptible to the eye, and it would not be obvious in which direction the pole really was. To make quite sure, it would be necessary to observe the sun's altitude at intervals during the day, and also its compass bearing. (The compass, of course, which points toward the earth's magnetic pole, 2,000 miles away, would be as good a guide there as here, but of no service at all in finding the geographical pole.) It would then be necessary to march toward that compass bearing in which the sun had the lowest altitude (corrected of course for changes in declination). The distance to the pole in sea miles would be half the difference of the greatest and least altitude in minutes of arc; so that it would then be easy to advance to the right spot—in theory at least!

This discussion tacitly assumes that the observer is on firm land. On the drifting p lar ice, the change in his position during the day would complicate matters. But by making observations for a second day, the amount and direction of the drift could be determined; for the sun's altitude (still corrected for changes of declination) would be greater in the direction of the drift, and less in the opposite direction, than on the previous day, by the amount of the drift. The explorer would then have all the information necessary for his purpose.

One other point may be mentioned. The sun's altitude must of course always be corrected for refraction in the usual way. But since the sun's altitude is practically the same all day long, the refraction will be constant (except changes due to weather conditions, which would probably be very small). The observer's position and drift, which are determined from differences of the observed altitudes, will therefore be practically independent of the refraction corrections, and also of any "constant errors" of the instrument.

If the conditions of observation were as good as regards temperature and comfort as lower latitudes, an observer of moderate capacity, with portable instruments (sextant, artificial horizon, and chronometer) should be able from two days' observations to find both his position and rate of drift with an uncertainty of only a few hundred feet. Under the actual conditions at the north pole, everything would depend on the experience and skill of the observer; but in any case, he could fix his position with an error which would be quite imperceptible on even the largest-scale maps of the polar regions.

THE HEAVENS.

Our map shows the aspect of the evening skies; and shows, too, at a glance how dull the southern and eastern skies would be, were not Mars and Saturn there to brighten them.

The most prominent constellation there is Pegasus, which lies high up, south and east of the zenith. It may be instantly recognized by the Great Square—about 15 deg. on a side, composed of second-magnitude stars, and standing decidedly alone—which is one of the principal landmarks of the sky for the beginner, as it has no counterpart in the heavens. One of its four corners now belongs to Andromeda; but it was once grouped with the other three, and evidence of this still remains, for the letter Delta, which it bore as a member of the constellation, is now lacking from the list of the stars of Pegasus. The rest of the constellation, extending westward from the Great Square, contains some remarkable double stars (observable only with great telescopes), but nothing to detain us. Our initial letter shows how this constellation, large as it is, is supposed to represent but a part of the winged steed of classic mythology. Any actual resemblance would indeed be difficult to trace.

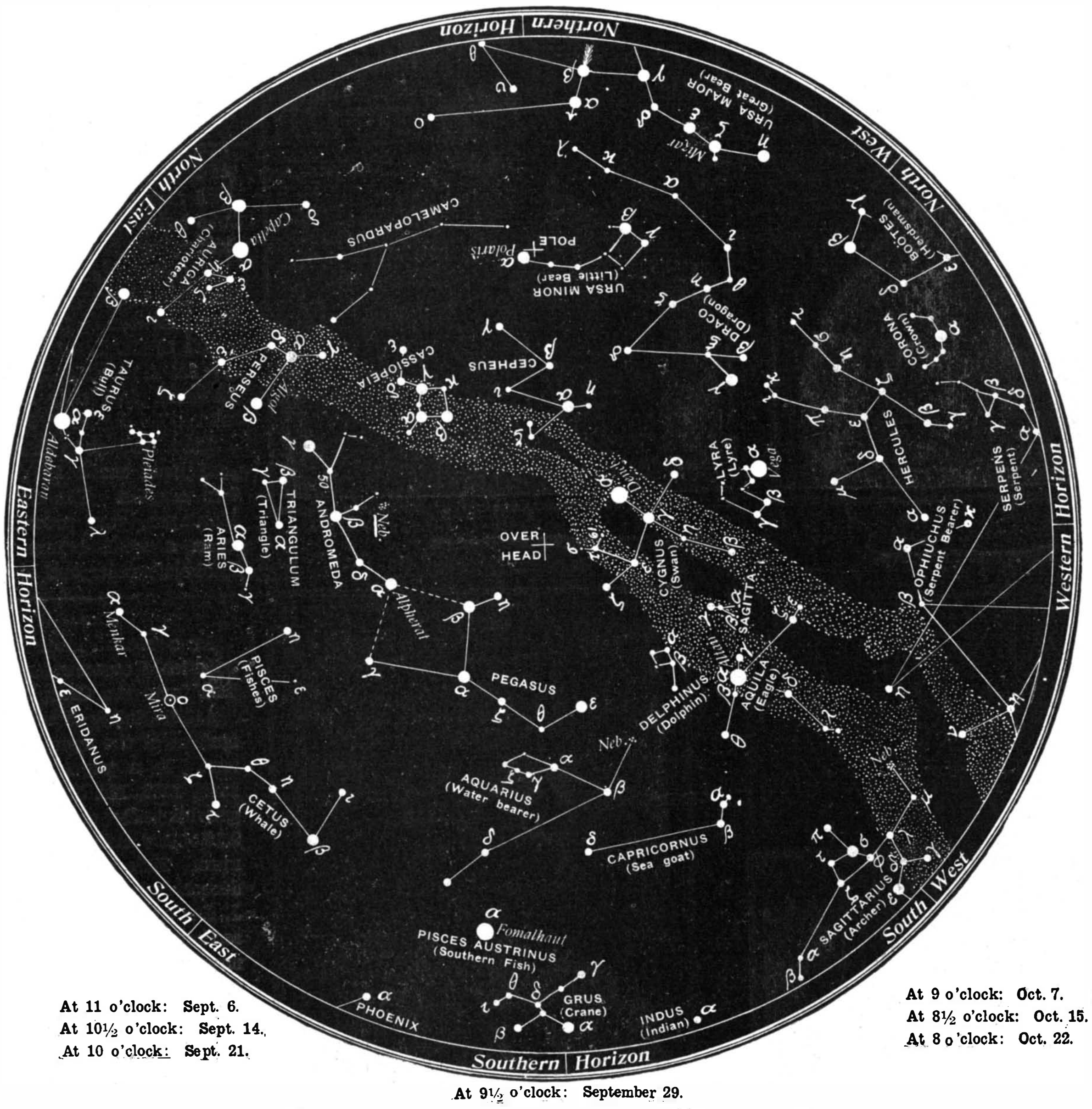
The western edge of the square, continued far southward, points out the isolated bright star Fomalhaut. The remaining stars of the Southern Fish, though too faint to be shown on the map, are easily visible on a clear night, forming a horizontal line just below the bright one.

The equally lonely star some distance east of Fomalhaut is Beta Ceti. The rest of the constellation follows this to the eastward. First comes a quadrilateral, of which the southernmost star τ is one of our nearest neighbors. Then comes the notable variable Mira—also not far from us in space, and now brightening up, and visible to the naked eye; and lastly a group, only the brightest two of which appear on the map. The whole constellation extends over more than 40 deg. and is one of the largest, though not the most conspicuous, in the sky. Above these constellations are the dullest of the zodiacal ones—Capricornus, Aquarius, and Pisces. The second of these, however, now contains the splendid Mars, and the last the less brilliant but still conspicuous Saturn, which both far outshine any stars within a long distance.

The line of stars running to the left from Pegasus, beginning at the northeast corner of the great square, contains the principal stars of Andromeda. Above the middle one of the three, near the second of two small stars, is the Great Nebula, the brightest in the heavens, concerning whose constellation, and the problems which it still presents, we spoke a few months ago.

Below this is the inconspicuous but ancient group of Triangulum, and the smaller and brighter one of Aries. The Pleiades are visible north of east, and Aldebaran is just rising.

Auriga in the northeast is a little higher up. Above it, in the Milky Way, we come in succession to Perseus, Cassiopeia, and Cepheus; then passing the zenith, to Cygnus, Aquila, and Sagittarius (just setting). Ophiuchus and Serpens are also disappearing, due west. A little to the right is the Northern Crown, with the "keystone" of Hercules above it, and the steel-blue Vega still higher. The Great Bear swings low on the northern horizon, and the Little Bear, enfolded by the Dragon, is higher up.



At 11 o'clock: Sept. 6.
At 10½ o'clock: Sept. 14.
At 10 o'clock: Sept. 21.

At 9 o'clock: Oct. 7.
At 8½ o'clock: Oct. 15.
At 8 o'clock: Oct. 22.

At 9½ o'clock: September 29.

NIGHT SKY: SEPTEMBER AND OCTOBER

THE PLANETS.

Mercury is evening star until the 12th, when he passes on this side of the sun, and becomes a morning star. He reaches his greatest elongation west of the sun on the 27th, about which date he rises a little before 5 A. M., and is easily visible before daybreak; being situated in Virgo, a few degrees above the bright star Spica, which however is not as bright as he is.

Venus is evening star, and is very bright, but not very conspicuous, because she is so far south. During the month she passes from Libra through Scorpio into Sagittarius, and at its end she is 26 deg. south of the celestial equator. In one latitude she sets a little after 7 P. M.; but for observers in the southern hemisphere she remains in sight three hours longer, and is remarkably prominent.

Mars is on the borders of Aquarius and Pisces, rising before sunset, and visible almost the whole night. He moves westward among the stars, ever slower and slower, until the 26th, when he begins the eastward march, which will take him over more than a whole round of the zodiac before another opposition.

Jupiter is morning star in Virgo, rising about 5:15 A. M. on the 1st, and 3:40 on the 31st; that is, about an hour earlier than Mercury at the time the latter is best seen.

Saturn is in opposition on the 13th, and is well observable all through the month. His wings are by this time pretty widely opened out, and he is a very beautiful telescopic object.

Uranus is in quadrature, east of the sun, on the 10th, and south at 6 P. M. Neptune, in almost the opposite quarter of the sky, is in quadrature, west of the sun, on the 13th, and crosses the meridian at 6 A. M.

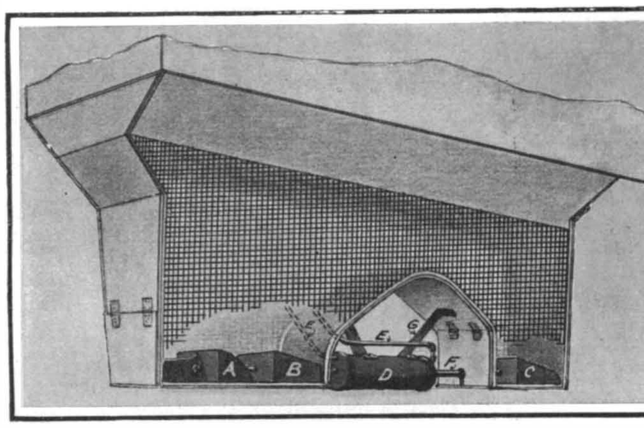
THE MOON.

The moon is nearest us on the 27th, and farthest off on the 13th. She is in conjunction with Neptune on the 6th, Jupiter on the 12th, Mercury on the 13th, Venus on the 17th, Uranus on the 21st, Mars on the 26th (early in the morning), and Saturn on the 27th. On the evening of the 20th she occults the bright star Sigma Sagittarii (in the Milk Dipper). As seen from Washington, the star disappears behind the moon's dark limb at 7:01 P. M. and reappears on the bright side exactly at 8 o'clock.

Patent Department

SELF-CLEANING ASHPANS FOR LOCOMOTIVES.

A patent has been recently granted on an ashpan for locomotives, which is provided with novel means for cleaning out the ashes. Our illustration shows a locomotive ashpan fitted with the improved apparatus, and partly broken away to show the details. There are, in reality, two ashpans, one placed before the other, and each provided with hoes attached to a piston, which may be operated to hoe the ashes out of the pans. The forward pan is provided with two hoes, *A* and *B*, while the rear pan has but one, *C*. Between the two ashpans is a cylinder, *D*, which is fed with steam through two pipes *E*, that enter at opposite ends of the cylinder. The piston in the cylinder is provided with a rod *F* at each end, to which the hoes are attached. The cylinder *D* is supported between the pans by means of a pair of brackets *G*. The forward end of each pan is provided with an outlet, normally closed by a damper. The rear of each pan is also provided with an opening, through which the ashes may be discharged, and the rear ends of the hoes *B* and *C* are of such form as to enter and close these openings, when they are forced back to the position shown in the illustration. When the hoes are moved forward, the dampers above referred to are opened by means of forwardly-projecting blades on the hoes *A* and *C*. The bottom plate of the forward ashpan is also provided with a discharge opening, which is intermittently opened and closed as the hoe *A* passes over it. The steam pipe *E* leads up to a three-way valve, located at the boiler head in a convenient position for operation by either the engineer or the fireman, who may by this means reciprocate the hoes in the ashpan, and thus cause the discharge of the ashes. The inventor of this improved locomotive ashpan is Mr. James S. Downing of 185 Cooper Street, Atlanta, Ga.



SELF-CLEANING ASHPANS FOR LOCOMOTIVES.

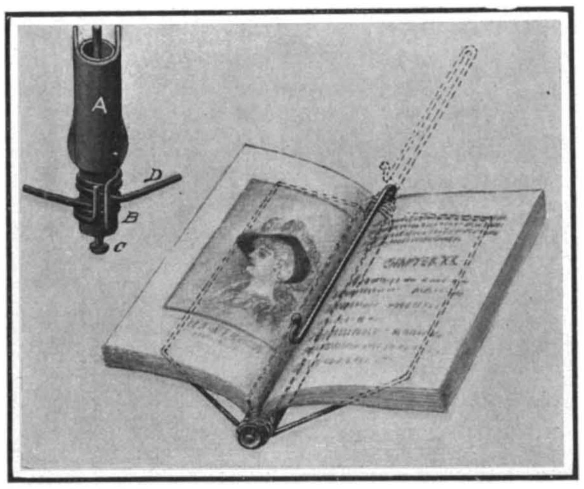
SANITARY REFUSE RECEPTACLE.

The ordinary refuse receptacles used in public places are merely open cans in which garbage, ashes, or other waste material is placed. The fact that these cans are open is a serious objection, because it permits the breeding of germs which may be infectious. Furthermore, it is a temptation to throw lighted matches or cigar or cigarette stumps into the can, and set fire to the contents. To obviate these difficulties, a new type of refuse receptacle has recently been devised, which is illustrated in the accompanying engraving. It is so arranged that the opening through which the refuse is introduced automatically closes; and in addition to this, the can is provided with a receiver for disinfecting material, which will keep the contents in as nearly a sanitary condition as possible. Fig. 1 shows the receptacle closed. The top or lid of the receptacle may be swung open, as indicated in Fig. 2, to permit of dumping the contents of the can. The cup of disinfecting material will be observed at the center of this lid. Fig. 3 shows the receptacle, with the inlet door open to permit of introducing refuse. A spring is attached to the door at the inside, and serves to draw the door shut as soon as it is released. When the top of the can is open, as in Fig. 2, the lid is fastened to a catch at the front of the receptacle, and this prevents the inlet door from being swung open while the receptacle is being inverted to remove the contents. The inventor of this refuse receptacle is Mr. Vincent Azzara, 24 Washington Street, Morristown, N. J.

SANITARY REFUSE RECEPTACLE.

CONVENIENT BOOK HOLDER.

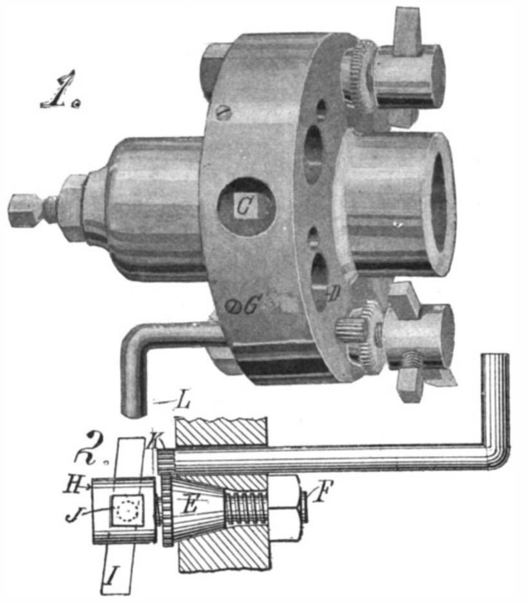
Pictured in the accompanying engraving is a holder for magazines and other books, designed to hold the book open at any desired point and support the book at each side. The cover supports of the holder are adjustable to support the book either fully open or closed, or to support the separated portions of the book in an intermediate position. The construction of the device is shown in the fragmentary detail view. It consists of a spring clip or gripping device *A*, in the form of a relatively long trough-like member of sheet metal, which grips the bound edge of the magazine or book. Within the clip is a tube *B*, which extends beyond the ends of the clip *A*. At the upper end of the tube *B* a plug is fitted to snugly engage a rod *C*. This rod is provided with a head at the lower end, as shown in the detail view, which is adapted to contact with the inner end of the plug, and prevent the rod from being withdrawn entirely from the tube *B*. The rod *C* is bent upon itself into a U form, while the outer extremity is turned up to prevent it from digging into the book. The cover supports *D* consist of wire wings hinged to the extremities of the tube *B*. A wire clip is bent over the hinged ends of the wings, and acts as a stop to prevent them from being opened too far. In application the clip *A* is passed endwise over the bound edge of the book, and the wings are slightly separated, to admit the book between them. The book is opened to the desired point, moving the wings outwardly on their hinges, and then the rod *C* is withdrawn from its tube, to the position shown by dotted lines slipped over the open book, and pressed back to its normal position, as indicated by full lines. In this position the two portions of the book are pressed against the wings, and the book may be conveniently held with one hand, by grasping the clip *A*, which serves as a handle. The hinges of the wings are sufficiently stiff to hold them in any position in which they are set. Mr. Albert F. Stone, Jr., of Callahan, Cal., is the inventor of this improved book holder.



CONVENIENT BOOK HOLDER.

IMPROVED CUTTER HEAD.

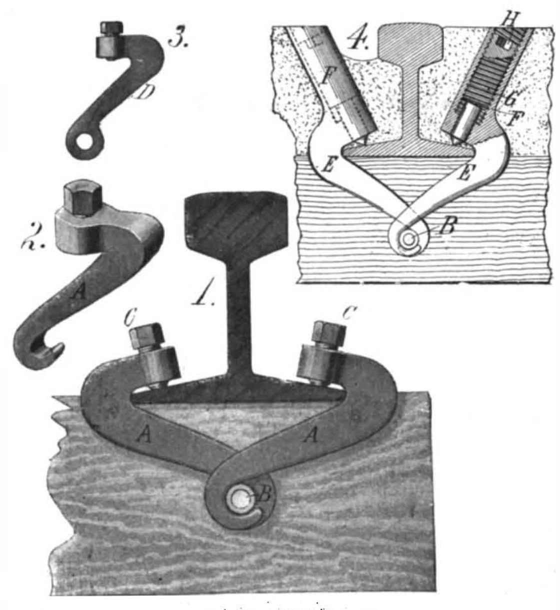
The cutter head which is illustrated in the accompanying engraving is so designed that the cutting tools may be readily attached or detached at will, and may be adjusted as desired, without removing them from the cutter head. The body of the device, which is indicated at *A*, consists of a cylindrical barrel having substantially the form of a cup, with a flange formed thereon. The driving spindle is adapted to enter the barrel, and the cutter head is adjusted thereon by turning the end screw. A set screw *C* serves to hold the cutter head to the shaft. A series of conical apertures *D* are formed in the flange. They are adapted to receive the split nuts *E*, through which the screws *F* are threaded. The screws *F* are prevented from turning by means of set screws *G*, which enter keyways therein; but by means of nuts on the end of the screws, the conical nuts *E* may be snugly seated in the openings *D*. The upper end of each screw *F* is provided with a tool holder *H*, adapted to receive a tool or bit *I*, which is held in place by means of a set screw *J*. Each conical nut is formed with teeth at its outer end adapted to engage a pinion *K* on the end of the key *L*. By inserting this key through the apertures from the rear of the cutter, the bits may be adjusted at will, without removing the cutter head, and then the screws *F* are made fast by tightening up the nuts at the rear. The bits may be cut from air-hardening steel of any shape. The inventor of this cutter head is Mr. John F. Stedman of Newberg, Ore.



IMPROVED CUTTER HEAD.

RAIL FASTENER.

The usual method of fastening a rail to the ties, has this disadvantage, that the base flange of the rail acts like the claws of a hammer under a nail head, to pry the spike out of the wood. A better construction would seem to be one in which the axis of the spike lay at right angles to the pull of the rail base. With a view to providing such a construction, a new type of rail fastener has just been invented, which is shown in the accompanying engraving. The fasteners may be applied or removed without the use of a hammer, and are adjustable to compensate for shrinkage in the ties. Fig. 1 shows a cross section of a rail fastened to a tie by means of two of the improved rail fasteners *A*. The rail fasteners, as indicated in Fig. 2, are formed with hooks at the lower end, adapted to engage a pipe *B*, preferably of cast metal, which is fitted into a hole in the tie. The upper end of each fastener is provided with a threaded aperture, in which a bolt *C* is fitted. The bolt is adapted to be screwed down on the base flange of the rail. Fig. 3 shows a slightly modified form of the fastener. For street railways a different construction is required, as indicated in Fig. 4. Here the fasteners *E* are formed with threaded sleeves *F*. Screw plugs *G* are adapted to be screwed into the sleeves *F*, so as to bring their lower points into contact with the base flange of the rail. The rail and fasteners are imbedded in concrete, or the street paving material, with only the upper ends of the sleeves exposed. It is merely necessary to tighten the screw plugs *G* once in a while by inserting a key wrench in the sockets *H*. The inventor of this rail fastener is Mr. George Dorffel, Fruitvale, Cal.



RAIL FASTENER.

RECENTLY PATENTED INVENTIONS.

Of General Interest.

SWIVEL AND EXTENSION CONNECTION FOR SUCTION-PIPES OR HYDRAULIC DREDGES.—J. W. Sackett, Jacksonville, Fla. This connection is to take the place of the ordinary suction hose and the ball and socket joint now used, and arranged to permit the drag to readily accommodate itself to irregularities in the bottom of the waterway to be dredged, and to change its relative position with respect to the dredge as the demands of the practical work require, and without causing any undue stresses on the suction pipe or the hull of the dredge.

HEAD-REST.—E. C. Leahy, Sydney, Nova Scotia, Canada. When used in connection with reclining chairs the invention consists of a head-block supported on a universal joint and having head-supports, with means for locking the joint and supports in adjustable positions; and as a pillow, the same general construction is employed, and is supported on the top of a casing vertically adjustable relatively to the casing body. It is for use by barbers, parlor-cars, dentists, etc., and as a pillow for campers, patients, etc.

HOLDER FOR ABSORBENT COTTON.—W. J. Durant, Spencer, Iowa. The invention relates to a holder adapted to receive a roll of cotton, and which is adapted to enable the cotton to be withdrawn as desired, while at the same time it is fully protected from dust and dirt. It is especially useful in the offices of surgeons and pharmacists, and in dispensaries and hospitals.

NON-REFILLABLE BOTTLE.—J. Burnstein, St. John's, Newfoundland. The object here is to provide a bottle arranged to effectively close the bottle when not in use, to allow convenient pouring of the contents of the bottle into a glass or other receptacle, and to prevent unauthorized persons from refilling the bottle with spurious goods.

PAVING-BLOCK.—D. Atherton, Philipsburg, Pa. The aim in this case is to provide a block, of which a series can be conveniently assembled to interlock with each other and to form transverse interlocking courses or rows, with a view to prevent transverse shifting of the blocks in the roadway even if the roadway is without curbs.

COLORATION PROCESS.—B. D. Avis, Jr., Wallace, W. Va. In the present patent the invention has reference to coloration process, the inventor's more particular purpose being the provision of a simple and inexpensive method of producing iridescent tints and colorations upon glass or upon opaque surfaces requiring comparatively little preparation.

Hardware.

ICE-SHAVER.—A. M. Preston, Broxton, Ga. The invention consists of a body formed to receive the shaved ice, and carrying a shaving blade and a movable member constituting a lid for the body and operable to force the shaved ice from the body, the latter having preferably a plurality of compartments which are simultaneously filled with the ice.

SHOE-POLISHER.—F. Vaughn, San Francisco, Cal. The invention relates particularly to that type of polishers adapted to hold and inclose the polishing fabric. An object is to provide a device which will hold the fabric tightly, and the stronger the pull on the fabric the tighter will the device grip it.

Heating and Lighting.

GAS-IGNITING DEVICE.—W. Grix, Schöneberg, near Berlin, Germany. The device consists of an igniter proper, such as a platinum pilule, an electric spark former or an incandescent wire, which is carried directly or through the agency of suitable parts by a compensation rod, so that, after the gas is ignited, the said rod is bent by the heat and moves the igniter out of the zone of hot gases.

Household Utilities.

REFRIGERATOR.—O. M. Campbell, Van Buren, Ark. The purpose here is to provide details of construction of a refrigerator that will render it very convenient, insure proper circulation of cold, dry air throughout the interior of the refrigerator, prevent sweaty deposits of moisture on the walls within the refrigerating chamber, and afford perfect drainage for water formed by melting of ice.

RENOVATOR.—J. H. Brown, New York, N. Y. This invention has in view a manually-operated device for household use in which the dust and dirt are removed by suction. It consists of two upright wheel-supported frames rigidly connected together at the bottom by a platform, and at suitable points thereabove; a receptacle seated on the platform; a nozzle applied to the part to be cleaned; a rotary pump having its inlet connected with the nozzle and discharging into the receptacle, and a driving mechanism for the pump, journaled on the frame.

EGG-TESTER.—Evelyn Leiss, Bronxville, N. Y. The invention belongs to that class of testers which consists of a box having openings in the top in which eggs are adapted to be seated, in combination with a mirror in the box under the openings, for reflecting such light as passes through the eggs, the same being observable through a sight-opening located at a point convenient above the mirror.

Machines and Mechanical Devices.

PULP-REFINING ENGINE.—F. W. Quantz, Vincennes, Ind. The main object of the inventor is to provide a shell filling which has the corrugated surface necessary for the reduction of the pulp, but which obviates a former objection, in that all of the pulp is forced into repeated and intimate contact with the revolving plug, thereby rendering the product of uniform texture.

ATTACHMENT FOR LINOTYPE-MACHINES.—A. F. Welling, New York, N. Y. More particularly the invention relates to devices for determining the number of quads to be allowed for a cut, so that the operator will be enabled to assemble the proper number of matrices having intelligible characters to fill the space at one side of the irregular outline of a picture or design and then insert the proper number of quads or blanks to fill the remainder of the line.

NURSERY-CHAIR.—P. S. Chandler, Mountpleasant, Tenn. When the chair is set up and the frame is placed in position encircling the chair, the rear ends of the arms are depressed so that the pins engage the enlarged portions of the slots, thus preventing disengagement of the tray from the undercut notches, until the rear ends of the arm are again lifted to disengage the pins.

FRICTION-CLUTCH.—M. S. Slagt and T. J. Kelly, Everett, Wash. One purpose here is to provide details for a clutch, which are simple and quick in operation, not liable to slip, and that will positively lock together two parts of a machine they are connected with, so that said parts will co-operate or release them instantly when this is essential for the proper operation of the parts connected by the clutch.

GANG-EDGER.—D. C. Leonard, Columbia, S. C. The main object of this improvement is to provide a machine which has movable members constituting part of the frame of the device, which can be swung up out of the way to permit easy access to the saws and thereby enable the operator to file them while they are on the arbor.

CALCULATING-MACHINE.—C. L. Nelson, Seattle, Wash. This invention relates to improvements in machines of that type in which the keys are operated in accordance with the number to be listed, and more particularly to that type disclosed in a previous patent granted to Mr. Nelson, although various features of the present invention might be employed in other calculating machines than that shown in said patent.

PAPER-CUTTING MACHINE.—G. M. Farnham, South Brewer, Me. This invention refers to certain improvements in machines for cutting paper into diagonal strips, and more particularly to that type of machine in which there is employed a cutter disposed at an angle to the roll of paper to be cut, and adjustable to vary the angle at will.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Legal Notices

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending September 14, 1909,

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Adhesive fluids, device for supplying, Windle & Ollerenshaw ... 933,938
Adjustable trap, J. H. Brady ... 934,035
Air-brake mechanism, supplemental, A. Doan ... 934,293
Air compressor governor, Kloer & Leavell ... 934,323
Alarm or time check, R. Turck ... 934,241
Album, post card, H. P. Morris ... 934,333
Alkali chlorids, apparatus for the electrolysis of, J. Billitzer ... 934,385
Amusement device, Liebling & Schmidt ... 933,788
Amusement device, H. A. Shaules ... 933,790
Armature, knockdown, E. W. Presbrey ... 934,212
Armatures of dynamo electric machines, winding for, B. G. Lamme ... 933,765
Attaching device, D. Hoyt ... 933,757
Auger, post hole, H. E. West ... 934,029
Automobiles and other machinery, transmission gear for, L. T. Rhoades ... 934,016
Automobiles, suspension spring system for, C. A. Lieb ... 933,997
Axle connection for vehicles, front, A. J. Goyette ... 934,067
Axle coupling, reversible car, M. Markarian ... 934,033
Axle skeins for vehicles, construction, J. E. Wilcoxen ... 933,806
Bait, artificial fish, N. W. Moran ... 934,087
Bait holder, J. F. Beatty ... 933,818
Barrel, J. W. Denmead ... 934,051
Basins, etc., stopper for wash, C. Meldau ... 934,330
Bearing, foot step ball, M. Goheke ... 933,974
Bearing for grain drills, etc., Davis & Bozard ... 934,291
Bearing, roller, L. J. Aldridge ... 933,735
Bed, J. W. Fuller ... 933,971
Bed rail notching machine, A. McLean ... 934,090
Bedstead, W. Wokurka ... 933,810
Beer pasteurizing and cooling apparatus, W. Wenzel ... 934,377
Bell, signal, H. W. Eden ... 934,396
Belt attachment, Dalmar & Wander ... 934,290
Belt fastener, J. W. Kidwell ... 934,321
Belt tightener, Wallace & Dow ... 934,248
Bicycle spring fork, H. C. Preston, Jr. ... 934,013
Bilge water discharger, C. A. Curry ... 933,891
Billiard cue, I. A. Gormon ... 934,162
Billiard cue tip, I. A. Gormon ... 934,163
Block forming machine, C. R. Walter ... 934,112
Block machine, W. L. Keller ... 934,320
Boat, F. M. Thompson ... 934,373
Boat and vessel, P. Igatz ... 933,905
Boiler cleaner and feed water heater, A. N. Jones ... 934,314
Boiler furnace, locomotive, F. F. Gaines ... 934,157
Boiler hanger, C. E. Lingenfelter ... 933,909
Boilers, system of washing and filing locomotive, W. White ... 933,937
Book, blank, scrap and similar, E. F. Hoberg ... 934,311
Book, loose leaf, T. C. Bruhn ... 933,882
Book rest, D. Duff ... 934,148
Boot or shoe, C. Pease ... 933,848
Bottle, S. Rolfson-Schmidt ... 934,358, 934,359
Bottle cap, G. E. Stahl ... 933,795
Bottle cap lifter and cigar cutter, E. C. Hunt ... 933,988
Bottle holder, J. F. Parker ... 934,344
Bottle mat, milk, C. A. Steinman ... 934,230
Bottles, jars, and the like receptacles, closure for, A. F. White ... 934,252
Bow separator, C. E. Titchener ... 933,933
Bracket, F. J. Moran ... 934,414
Brake. See Load brake.
Brake system, fluid pressure, W. H. Sauvage ... 934,019
Bridle irons or stirrup or joist hangers, machine for shaping, W. Hansen ... 934,168
Brooder, A. Noble ... 934,206
Brush, bottle and like cleaning, G. A. & C. C. Farrar ... 934,058
Brush hook and ax, combined, C. E. Olson ... 934,008
Bucket for concrete building material, N. C. Newerf ... 934,092
Buckle, cross line, A. F. Carlson ... 933,745
Burglar alarm, electric, M. Trautmann ... 934,108
Bust reducing attachment, J. M. Bodensiek ... 933,739
Calcium silicid, producing, Wilson & Haff ... 934,379
Calculating machines, setting device for, J. Graber ... 934,401
Calk, removable, G. S. Meyer ... 934,197
Calks on horseshoes, machine for forming and sharpening, Snover & Palmer ... 933,995
Camera mechanism, photographic, W. Verbeck ... 933,801
Can closing machine, C. M. Symonds ... 934,371
Can covers, apparatus for cleansing, sterilizing, and drying milk, C. H. Hood ... 934,404
Can feeding and righting machine, M. D. Blakeslee ... 934,134
Can heading machine, single, Adriance & Calleson ... 933,872
Candle gathering implement, C. B. Manbeck ... 934,196
Candy making machine, Hudson & Camp ... 933,987
Candy mold, E. J. Hedrick ... 934,310
Car, G. G. Fryer ... 934,398
Car body, J. M. Hopkins ... 933,903
Car chock, railway, J. Kezon ... 933,760
Car coupling, W. L. Wright ... 933,941
Car coupling, R. B. Chalmers ... 933,959
Car, drop bottom dump, H. C. Brunker ... 934,279
Car, dumping, A. Becker ... 934,267, 934,268
Car fender, E. Barrett ... 933,950
Car fender, C. Gardiner ... 933,973
Car, passenger, Curwen & Smith ... 934,142
Car, passenger, C. K. Pickles ... 934,350
Car safety stop, W. Gunter ... 934,166
Car seat, H. White ... 934,121
Car underframe, A. Becker ... 934,382, 934,383
Cars, drop door fastening for, Furgeson & Wheland ... 934,299
Cars, drop door operating mechanism for hopper bottom, A. Becker ... 934,269
Carbureter, M. Steel, Jr. ... 934,367
Cards, electrical pattern for the manufacture of jacquard, P. Weissenborn ... 933,805
Carpet sweeper, G. B. Deacon ... 933,893
Caster attaching bearing box, V. C. Luppert ... 933,999
Caster, furniture, G. E. Neuberth ... 934,004
Caster, leg mount, G. E. Neuberth ... 934,005
Casting rolls, J. L. Lewis ... 933,996
Casting rolls, mold for, J. L. Lewis ... 934,410
Cement block, W. L. Keller ... 934,319
Cement blocks, waterproof, J. A. Fincke ... 934,061
Cement clinker, process and apparatus for making, C. Ellis ... 934,056
Centrifugal machine, H. Schmitz ... 934,221
Chain tightener, C. H. Peterson ... 934,348
Chain tightener and lock, F. A. Fox ... 934,154
Chair. See Nursery chair.
Chair, W. M. Clark ... 934,285
Check bit, T. Tippit ... 933,864
Cheese cutter, O. O. Ozias ... 934,208
China, etc., apparatus for casting hollow and other ware of, W. Stubbs ... 934,231
Chlorin, separating and concentrating, Goldschmidt & Spitzer ... 934,400
Chuck, W. G. Sanborn ... 933,923
Chuck drill, J. Bradley ... 933,471
Churn, J. T. Armstrong ... 933,948
Churns, lever construction for, R. M. Rowe ... 934,217
Chute package, Perpignan & Riebelman ... 934,347
Cigar lighter, F. J. Wildemann ... 934,119
Clasp, G. N. Hall ... 933,752
Cleaning apparatus, F. J. Seeley ... 933,926
Clock, electrically operated, H. Gillette ... 933,899
Clover huller, J. C. Kistler ... 934,406
Clutch driving mechanism, controlling means for electrical, A. P. Steckel ... 934,104
Clutch mechanism for automobiles and for other applications, friction, A. Balloca ... 934,264
Coal washer, F. R. Wilson, Jr. ... 933,808
Coat, G. W. Davis ... 934,049
Cock, quick acting bib, L. J. Sommer, Jr. ... 933,859
Cocks, locking air, J. S. Sheafe ... 934,099
Coffee percolator bag, I. Norwood ... 933,917
Coffee roaster, L. Breyer ... 934,137
Coil winding apparatus, H. B. Smith ... 933,792
Coil winding machine, F. Mueller ... 933,778
Coke drawing apparatus, E. D. Ratliff ... 934,215
Colander, M. A. Bailiff ... 933,949
Column, wooden, C. A. Nickerson ... 933,915
Comb, E. Jennison ... 934,181
Composing machines, means for justifying tabular matter in typographical, Holbourns & Longhurst ... 933,835, 934,403
Composition of matter, G. W. Boggs ... 933,875
Composition of matter, C. J. & F. G. Marius ... 934,412
Concrete bridge, D. B. Luten ... 933,771
Concrete building and holding mechanism, A. N. Doud ... 934,294
Concrete chimney construction, G. Maschino ... 933,774
Concrete-mixers, power charging device for, E. B. Symons ... 934,234
Concrete reinforce, H. E. White ... 934,378
Concrete structure, reinforced, E. McCullough ... 934,089
Condenser, G. B. Petsche ... 933,849
Condenser, metallurgical, W. M. Johnson ... 933,843
Containing can, C. M. Symonds ... 934,370
Controller handle, E. W. Stull ... 934,232, 934,233
Coop or crate, folding, J. P. Carnefix ... 934,282
Copper refining apparatus, F. L. Antisell, reissue ... 13,020
Corn thinner and weeder, hand, G. M. Hanger ... 933,753
Corset, G. H. Cooley ... 934,044
Corsets, hip reducing attachment for, J. M. Bodensiek ... 934,272
Counter skiving machine, M. Canty ... 934,039
Coupling, Sarrazin & Perreault ... 933,924
Coupling, J. L. Walker ... 934,028
Cover retainer, J. E. Brown ... 934,277
Crate, H. D. Gokop ... 933,876
Crate, J. E. Mahoney ... 933,911
Crate, C. B. Burwell ... 934,280
Crate, folding, R. H. Goddard ... 934,156
Crate, shipping, J. E. Neeb ... 934,337
Cream ripener, T. L. Valerius ... 933,934
Cross head, A. Dubuque ... 934,147
Cuff holder, W. J. Neefs ... 934,091
Cultivator, N. Tripp ... 934,238
Cultivator, cotton, J. J. Green ... 933,977
Cultivator, gravity hand, J. E. Hosmer ... 933,986
Current transformer regulator, alternating, A. C. Lasher ... 933,767
Currents machinery, safety device for polyphase, J. M. S. Fontecha ... 934,063
Curtain frame, W. Sieckmann ... 934,364
Cut off, automatic, C. M. Brown ... 933,880
Cycles and like vehicles, toe clip for the pedals of, H. Frankenburg ... 934,064
Cylinder head, F. L. Sessions ... 933,789
Cylinder nurling apparatus, Nahm & O'Brien ... 934,335
Decoy, Oliver & Westcott ... 934,342
Delivery apparatus, H. B. Murray, Jr. ... 934,202
Deposit and collection receptacle, C. F. Bryant ... 933,883
Die stock, R. H. Burke ... 933,884
Dipping tank, Viktor & John ... 933,935
Dish washing machine, A. L. Pearce ... 934,346
Dispensing receptacle, K. C. Jopling ... 934,182
Display case and valise, combined, C. Billburg ... 933,874
Display rack, J. Romshe ... 933,851
Door adjusting device, A. Hollmann ... 933,985
Door check and closer, O. Anschutz ... 934,261
Door opening device, A. S. Flowers ... 934,153
Door stop, S. P. Croswell ... 934,392
Dough dividing machine, T. W. Kaiser ... 934,183
Draw bar carrier, C. H. Tomlison ... 934,375
Drawer pull, C. B. Adams ... 934,258
Dress suit cases, traveling bags, and the like, handle cap for, F. Waldschmitt, Jr. ... 933,936
Drill steel coupling, C. C. Hansen ... 934,069
Drills or other apparatus, carriage for portable pneumatic, R. H. Robinson ... 934,418
Driving mechanism, N. Smelansky ... 934,224
Dropper. See Trellis wire dropper.
Dye, azo, Jansen & Neelmeier ... 933,841, 933,842
Dye, brown sulfur, Gley & Dieterle ... 934,302
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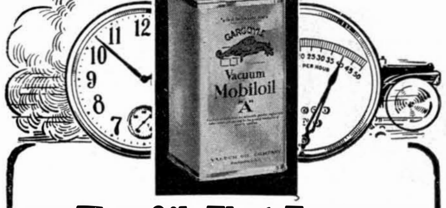

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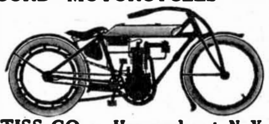

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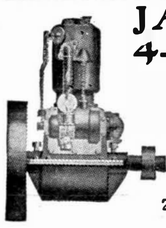

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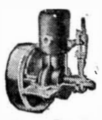

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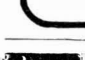

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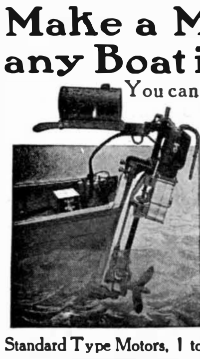

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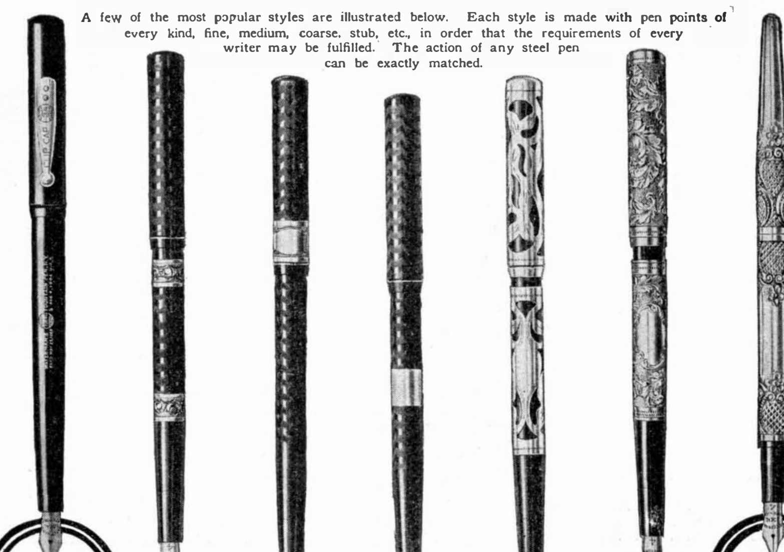

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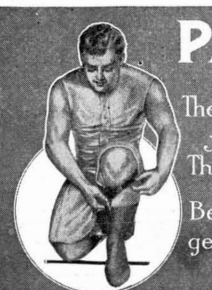

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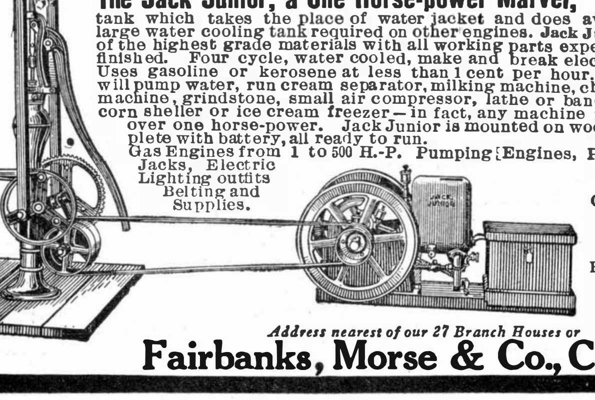

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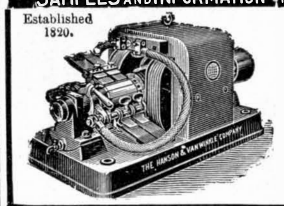

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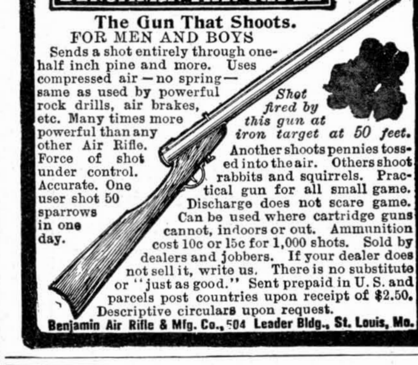

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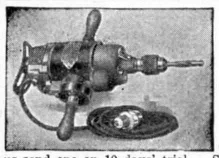

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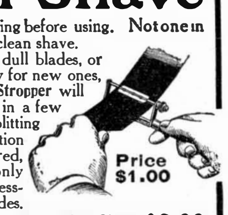

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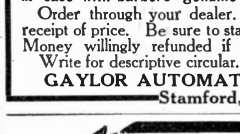

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