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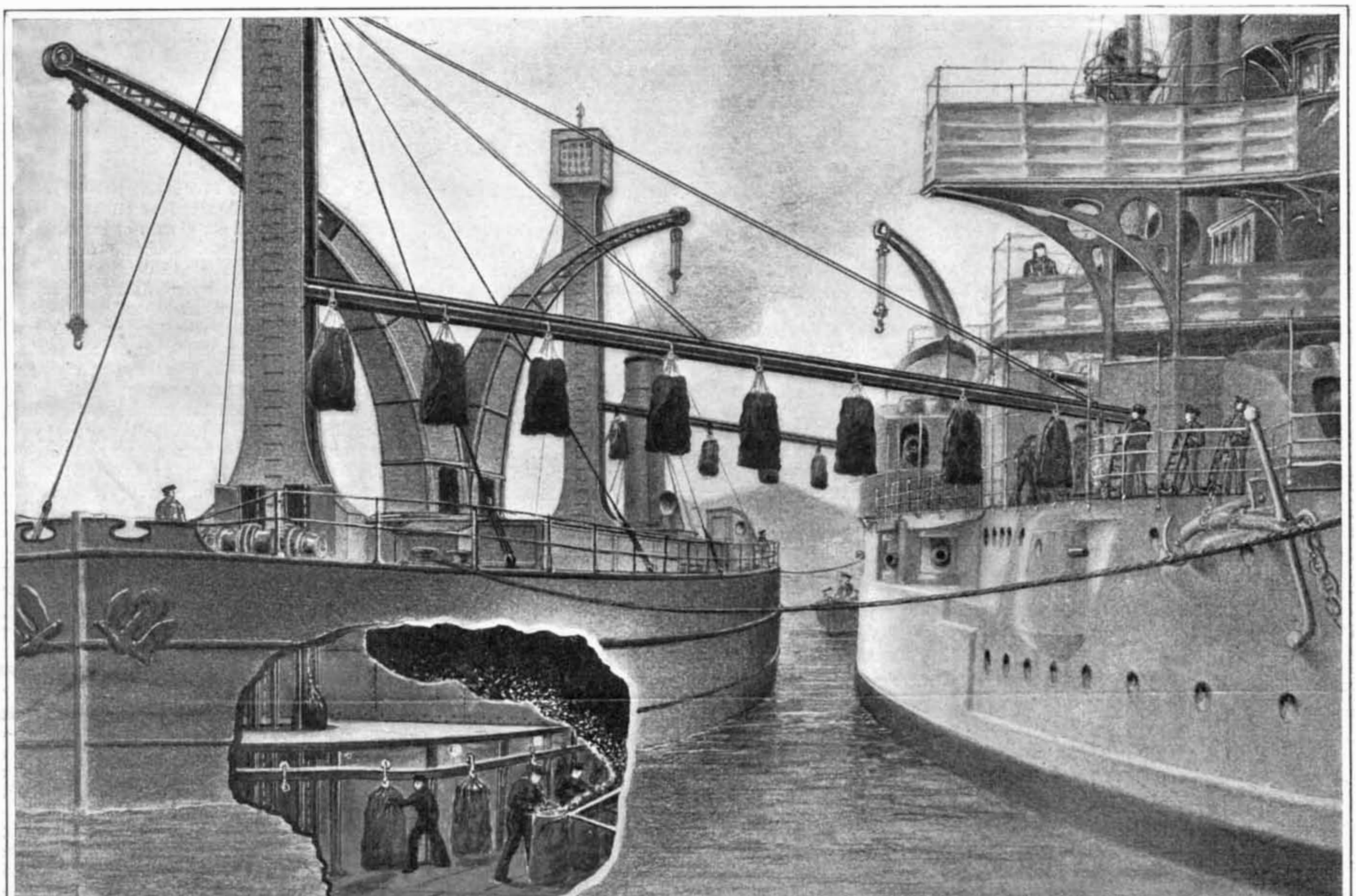

A COAL-BAGGING LIGHTER FOR COALING WAR VESSELS.—[See page 110.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, FEBRUARY 2, 1907.

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.

THE ENGLISH CHANNEL TUNNEL SCHEME.

When the British Parliament, a quarter of a century ago, voted down with a ringing "no" the scheme for building a tunnel beneath the channel from Dover to Calais, it was thought that the question had been settled for all time. Some pertinacious promoter, however, undiscouraged by the outspoken sentiment of that day, has now laid another bill before the House of Commons, in which the franchise then denied is again prayed for. Whether this latest Channel bill will meet with more favor, it is impossible to foretell. Although sentiment against the plan is not lacking, we fancy that the British public is this time disposed to lend a more willing ear to arguments in favor of the tunnel.

The question is undoubtedly one of grave political importance to Englishmen. A Channel tunnel will impair, if it will not destroy, a splendid isolation enforced by geographical situation. Accordingly, we find that the objections which were urged one-quarter of a century ago against an artificial union of France and England are again raised. A scientific committee, to which the matter of properly guarding the British terminal was referred in 1882, was decidedly pessimistic in its report. They questioned the possibility of preventing the capture of the British end of the tunnel by a bold company of French adventurers. Even the most elaborate and diabolically ingenious devices for checking an onslaught, devices which seem almost ridiculously romantic, were considered inadequate, for the reason that at the last moment the hand which was to set them in motion might fail. Among other things, the committee advised that the tunnel should not emerge within any fortification, but that its exit, as well as the airshafts and pumping apparatus, should be commanded by the advance works of a fortress, besides being within effective range from the sea. Means of closing the tunnel by a portcullis, and still more wonderful, of discharging poisonous gases into it, were recommended. Temporary demolition of the land portion of the tunnel by means of mining was still another conception. Sluices that should allow the tunnel to be temporarily flooded, and mines which should tear open the walls, were other defenses seriously contemplated. Finally, after having considered every possible safeguard, the committee concluded that "it would be presumptuous to place absolute reliance upon even the most comprehensive and complete arrangements which can be devised with the view of rendering the tunnel absolutely useless to an enemy in every imaginable contingency."

The naval view of the matter was saner, although likewise discouraging. Admiral Sir John Hay thought it not unlikely that the tunnel might be seized by surprise in the absence of the Channel fleet, and that a force of 16,000 men could be thrown very quickly upon the English coasts at a time when it would not be likely to find a sufficiently well-trained, well-equipped army to oppose it.

Englishmen are prone to regard the building of the tunnel as an enterprise which would redound largely to the benefit of their hereditary enemy. France is a great land power, an armed nation with nothing whatever to fear from invasion from over the sea. The addition of another railway terminating within her borders endangers by no appreciable extent her present position. Even assuming that an English expedition might capture Calais, and that 150,000 British soldiers were projected into France, it is a question if they could vanquish a standing army composed of trained soldiers.

Dismissing these political considerations, and passing for a moment to the engineering features of the contemplated work, it must be urged that the configuration of the bottom of the strait is most felicitous for the execution of the enterprise. The course selected presents a relatively plane surface, or at all events very gentle slopes. The depth of the Channel nowhere reaches 200 feet upon the selected line from England to France. For several miles out from the English coast it is not 100 feet deep; and the greatest depth is, roughly speaking, about two-thirds of the way across to France, and there its maximum is 186 feet.

Of the various plans which have been proposed for connecting England and France, that which was advanced some twelve years ago by Sir Edward J. Reed ought to commend itself strongly to civil engineers. He proposed a double tube of steel plate, to be constructed in sections of 300 feet, and to be hermetically sealed at the ends, and towed to the place of submersion. Each section was to be attached by one of its extremities to a huge caisson designed to form at the bottom of the water a very low pier for its support. The tube sections were to be sunk from scows. The plan, it will be observed, is substantially the same in principle as that since adopted for the construction of the tunnels under the Seine River in Paris, under the Harlem River in New York, and under the Detroit River in Michigan.

Should the Channel tunnel ever be constructed, its form may ultimately be such as that proposed by Sir Edward Reed. Moreover, it would overcome the objections of British naval men. For a length of no less than 3,160 feet Reed's tubular railway would be exposed to direct fire of the guns of ships between the high-water and low-water limit. Any breach or hole made in it below high-water mark would admit the sea at the next tide to the whole interior.

The problems involved are neither novel nor intrinsically very difficult. The most serious obstacles to be encountered are the raising of an amount of capital that must of necessity be enormous, the opposition of shipping interests, and the difference in gage between French and English railways. The capital cost is necessarily enormous. To ship goods from London to the continent or from Paris to London without breaking bulk would clearly be an impossibility. The tunnel would therefore offer merely a more rapid means of communication between British and French towns.

QUICK-STEAMING MARINE BOILERS.

There is over half a million horse-power in cruisers, battleships, and lesser arms of the service in the United States navy. Any one of the smaller vessels may be swinging idly at her anchor, with cold boilers, and in ten minutes from notification get under way, and be off upon her mission. It seems incredible to those who have business upon the great waters that a huge warship can be got under way in about the time that it takes to hitch up a two-horse team when the horses and their driver are on the spot ready for business, but it is an actual fact, as shown by the following official figures.

The United States steamer "Cincinnati" has eight boilers of the water-tube type which, when tested for efficiency of steam raising, gave the following results: Fires started at 9.40; in five minutes steam formed; in six minutes the gage showed 25 pounds pressure; in 7 minutes the gage showed 35 pounds; in half a minute more the pressure had jumped to 45 pounds; in the next half minute it gained 10 pounds more; in 9 minutes from starting fires with cold water in the boiler the pressure was 65 pounds, and the pressure rose every thirty seconds 10 pounds, until at ten minutes and forty-five seconds from starting fires the gage showed 115 pounds; in eleven minutes and a half the pressure was 155 pounds per square inch, ample to get under way and handle ship as required. In twelve minutes and forty seconds there were 215 pounds per square inch on the gage, and the vessel was free to go wherever she listed at full speed. Now, if this boiler had been of the old tank type, shell boiler, it would have taken two hours to attain the same result, not infrequently more. The boilers mentioned are very large, holding about 50 tons of water, more or less, according to the height of it in the water glass, but notwithstanding this fact the entire contents were raised to working pressure in the time stated. Concerning this feature in the practical handling of naval vessels, Admiral George W. Melville said, in a report after the war with Spain for the rehabilitation of Cuba: "It would have been of the greatest advantage during the blockade of Santiago to have had boilers capable of raising steam in less than half an hour. Coal need not have been used to keep all the boilers under steam all the while. The 'Massachusetts' might have shared the glories of the fight if she had been fitted with water-tube boilers. The 'Indiana' would have kept up with the 'Oregon' and 'Texas,' the 'New York' would have developed at least three knots more speed, and the navy would have been spared a controversy. I think the 'Colon' would not have got so far as she did, but we did not have water-tube boilers." The pertinency of Admiral Melville's remarks applies equally as well to merchant vessels, for in cases where ships have to remain a long time in dock, say for ten hours and more, taking off or getting in freight, the necessity of banking fires would be dispensed with; the fires being drawn and fresh ones started at a few minutes' notice. It must be noted that while modern marine boilers of the type alluded to steam rapidly, they are not injured in any way, or even forced to obtain the desired results.

This is not an innovation—the installation of water-tube boilers in naval ships; the first employment of them dates back nearly half a century, in fact to the "San Jacinto," of the year 1858-59. This vessel carried the Martin vertical water-tube boiler, which was an hermaphrodite boiler, being externally very much like the fire-tube boiler of the period, in that it had a shell, braces, and water bottom, the water tubes taking the place of a crown sheet over the furnace, and extending into a steam space above. The products of combustion circulated around and between the tubes, emerged into an uptake as usual. But, although strenuous efforts were made by those interested to establish the favorable performance of this type of water-tube boiler, it was very unsatisfactory, both in naval and merchant ships. The tubes were of solid-drawn brass, 2 inches external diameter by 13 wire gage, but they soon became choked solid with stony saline accretions, which stopped evaporation to such an extent that they were useless as steam generators. The steamers "Fulton" and "Arago" of the old Havre line had these water-tube boilers. Old sailors can recall their limping into port with five and six pounds of steam, scarcely enough to get home with. Compare this performance with that of the modern water-tube boiler, which has no shell, no water-bottom, no braces or staybolts, carries twenty times the steam pressure that its prototype of half a century ago did, and can stand continuous service during the circumnavigation of the globe without repairs of any moment. The "Chicago," of the United States navy, which has eight water-tube boilers, spent the winter and spring of 1899 in active service on the Atlantic coast; then made a trip around Africa, returning to New York *via* South America, stopping *en route* at Rio Janeiro, a total distance of 35,000 miles, and on arrival was sent at once to Buenos Ayres, the boilers requiring no repairs. A performance like this is ample reason for equipping naval ships with water-tube boilers.

Not very many years ago, less than a quarter of a century, it required a good deal of persuasion to induce users to listen to arguments in favor of water-tube boilers; but now, although fire-tube boilers are by no means out of use, the water-tube type pushes them hard for manufacturing purposes at least. Boilers of both classes, however, have been so greatly improved, that there is no comparison possible between the splendid generators of the present and those of two decades ago. One great factor in the improvement has been the character of the metal employed in their construction. For an unreliable, variable quality of iron, steel has been substituted, with the result that pressures have been increased and the life of boilers generally prolonged. Another advance has been made in the character of the workmanship, by no means the least of the causes leading to the regeneration of steam boilers of the period. The wonderful metal now available for the boiler maker deserves more than a passing notice. When, by the aid of hydraulic presses, we can make this sheet steel flow into all sorts of shapes and corrugations without the development of a single check, crack, or craze in a whole shipload of it; when we recall that in the past we had to flog our boiler plates slowly and painfully into the former, or over it, thankful if we escaped disaster, the splendid quality of the present-day product is realized.

It is now possible, because of the metal and the means, to bend sheets one and one-half inches thick to a circle of fifteen feet in diameter as easily as we used to bend quarter-inch iron.

SPONTANEOUS IGNITION OF COAL.

The old hypothesis suggested by Liebig, according to which the spontaneous inflammation of coal is due to the oxidation of the pyrites, can no longer be maintained. Spontaneous ignition, as pointed out by Dr. Heideprim (Welt der Technik), would seem rather to be attributable to a direct oxidation of the carbon. In fact, carbon when heated has been found eagerly to absorb oxygen from the air, and this heating effect can be increased until ignition occurs. The part played by moisture in the process has not yet been determined. The physical conditions of the carbon (hardness, size, etc.) are other factors influencing the process. In connection with a recent investigation of three hundred cases of self-ignition, all kinds of mineral coal apart from anthracite were examined. In most cases the ignited coal was ordinary coal, and less frequently nut coal or coal dust. The higher the layers, the more readily will self-ignition take place. An efficient ventilation by channels in the coal layers and the thermometrical recording of temperatures by long thermometers inserted in the coal have been found to be good preventive measures, while the only available means of extinguishing such fires has been found to be a transfer of the coal and simultaneous flooding.

THE HEAVENS IN FEBRUARY.

BY HENRY NORRIS RUSSELL, PH.D.

The astronomical literature of the past month does not contain much of popular interest. It may, however, be mentioned that Metcalf's comet—discovered last November—has turned out to be a periodic one, moving in an ellipse of rather small eccentricity (for a comet) with a period of about eight years. It was about as near to us at the time of its discovery as it can ever get, its distance being some sixty million miles, and even then it was very faint, so that it can never be at all conspicuous.

This adds one more comet to the large family which is attributed to Jupiter. It may seem rather strange to speak of comets as belonging to the family of a planet, but we have good reason for the phrase. All the comets of short period—of which more than a score are known—move in orbits which pass close to that of Jupiter. This invariable rule cannot be the result of accident, and it is not hard to find an explanation for it.

If we follow back the motion of one of these comets and of Jupiter, we will sooner or later come to a time when the two bodies must have been close together. In such a case, when the comet is very near Jupiter, the planet's attraction on it will be very powerful, and may in some cases be much stronger than that of the sun. The result of such an encounter will be a complete change in the size and shape of the comet's orbit, while, since the comet is of very small mass, its attraction will not change the motion of Jupiter by a measurable amount.

Several such cases have been actually worked out, though an enormous amount of labor was demanded by the calculations, and it has usually been found that the previous orbit of the comet was much larger than its later one, and so remote from the earth's orbit that the comet must have been quite invisible to us. In at least one case a comet has been "lost" in this way —by having a small orbit enlarged—and we may never see it again.

Now a large majority of the comets that are discovered move in practically parabolic orbits, coming from an immense distance toward the sun, passing round it, and receding into space again. If such a comet happens to pass near Jupiter, its orbit will be changed, and it may be so altered that it becomes an ellipse of short period. There is good reason to believe that the known short-period comets have originated in this way, and so we speak of them as Jupiter's "family."

The other large planets have similar but less numerous families of comets, whose periods in all cases are roughly half those of the planet. For example, Halley's comet, with a period of 76 years, belongs to Neptune's family.

THE HEAVENS.

Referring to our map, we find that Auriga the Charioteer is right overhead, with his brightest star, Capella, northwest of the zenith. Southeast of this is Gemini, with the planet Jupiter (which lies close to the stars η and μ) making it more conspicuous. The Little Dog with the bright star Procyon is lower down.

Due south is the splendid form of Orion, below whom are the small groups called the Hare and the Dove. On the east is the Great Dog with the superbly brilliant Sirius. Below this is part of the ship Argo, a very large and fine constellation, which we are too far north to see properly. Its brightest star, Canopus, which has no superior save Sirius, is just outside our map, but can be seen, due south and very low down, by observers in Virginia and Kentucky and farther south.

Eridanus fills a large part of the southwestern sky, and then come Cetus the Whale and Pisces the Fishes, neither of which has any very bright stars.

The variable Mira (marked o in the map of Cetus) is now fading after one of the brightest recorded maxima. Taurus the Bull and Aries the Ram are due west, and Perseus, Andromeda, and Cassiopeia northwest, with Cepheus below the latter. The Dragon and the Little Bear are below the pole, and the Great Bear is coming up on the right.

Cancer the Crab, which is in the southeast, is only interesting for the star cluster called Præsepe or the Bee-Hive, but Leo the Lion is a full group with many bright stars and easy to recognize and remember.

The Hunting Dogs and Berenice's Hair, which are both rising in the northeast, are not very important. The Sea Serpent Hydra is a very large constellation, but we now see only a part of it, including the serpent's head and less than half his length, for it will be hours yet before his long tail drags itself clear of the horizon.

THE PLANETS.

Mercury is apparently close to the sun at the beginning of February, but soon passes out to the eastward and becomes an evening star. During the latter part of the month he is very favorably placed for observation, setting at about 6:40 on the 21st and near 7 P. M. on the 28th. He is in perihelion (nearest to the sun in actual distance) on the 27th, and is in consequence unusually bright, as he receives more light from the sun than at his average distance. On the 21st he is in conjunction with Saturn, at a distance of a little over 1½ deg. Mercury, which is the northernmost of the two planets, will be considerably the brighter.

Venus is morning star in Sagittarius, and rises at 4 A. M. in the middle of the month. On the 8th she is at her greatest elongation west of the sun, 47 deg. from him, and in the telescope appears exactly like a half-moon. She is still extremely bright, but is gradually fading as she recedes from us.

Mars is morning star in Scorpio, and rises at about 2 A. M. in the middle of the month. He is not yet conspicuous, but will be so in the summer.

Jupiter is the most conspicuous thing in the evening skies. He comes to the meridian at 9:25 P. M. on the 1st and 7:35 P. M. on the 28th, and is visible almost all night. Some unusually interesting phenomena of his satellites deserve attention. On the 1st, in the course of a single night, the second and third satellites are eclipsed behind the planet, while the first and fourth transit across his disk. On the 10th the shadows of the first and second satellites may be seen crossing the disk at the same time. On the 19th the first satellite is in front of the planet and the second behind it, while the shadow of the third appears on its disk. Finally, on the 26th, it is possible to watch while the second and fourth satellites pass behind the planet and the first and third, together with their shadows, cross its disk.

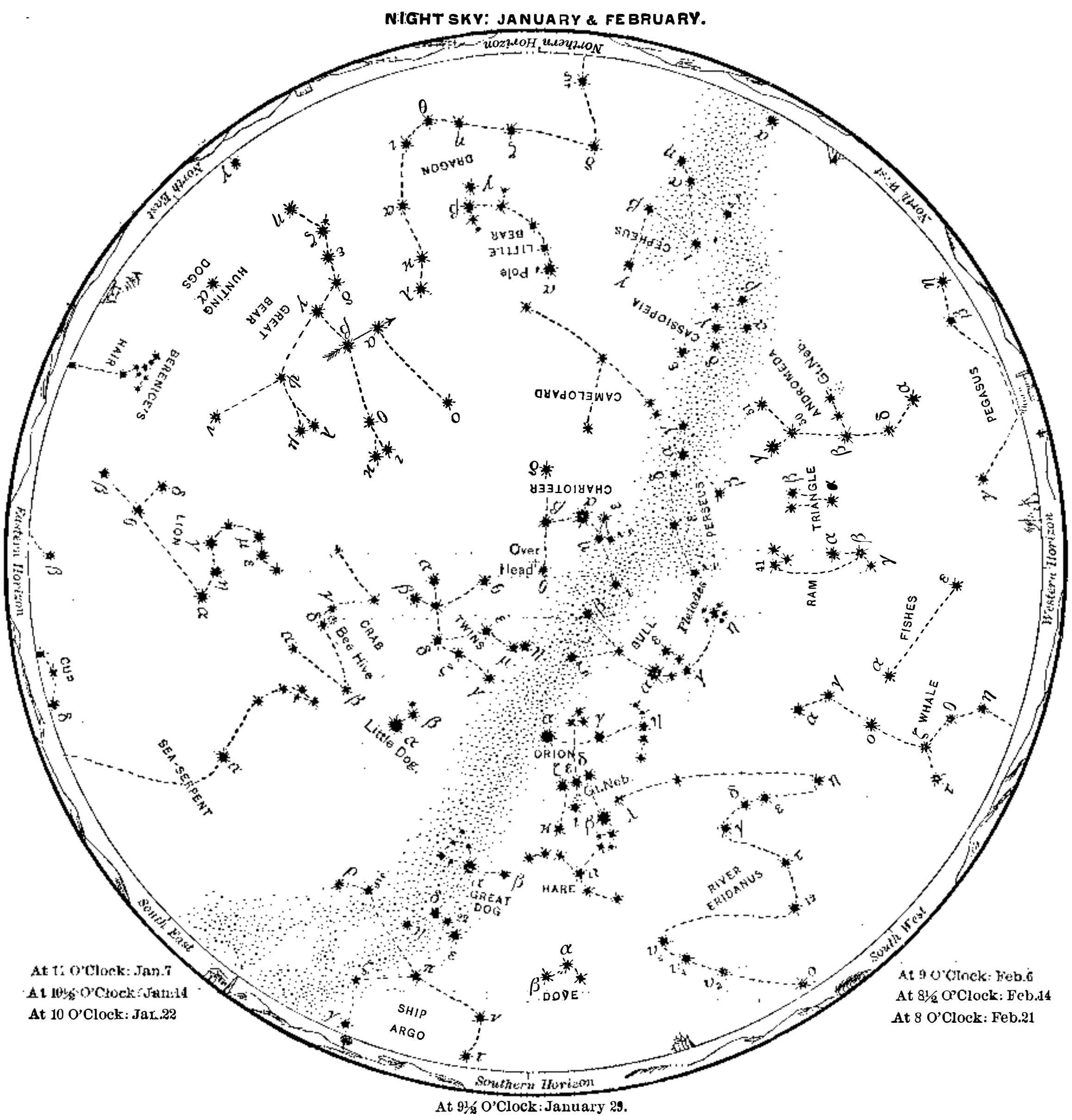
Saturn is evening star in Aquarius, and is only well visible in the earlier part of the month. On the 1st he sets about 7:30 P. M., while on the 28th he is on the horizon at 6 o'clock and is no longer to be seen.

Uranus is morning star in Sagittarius, rising at about 4:30 A. M. in the middle of the month. On the 17th he is in conjunction with Venus, being 3 deg. south of her. Neptune is in Gemini, not far east of Jupiter. His position on the 3d is R. A. 6h. 45m. 0s.; dec. 22 deg. 9 min. north, and on the 27th R. A. 6h. 43m. 10s.; dec. 22 deg. 12 min. north. It is hard to find him without an equatorial telescope with properly graduated circles.

THE MOON.

Last quarter occurs at 8 P. M. on the 5th, new moon at 1 A. M. on the 13th, first quarter at 11 P. M. on the 19th, and full moon at 1 A. M. on the 28th. The moon is nearest us on the 10th and farthest away on the 21st. She is in conjunction with Mars on the 6th, Venus and Uranus on the 9th, Mercury on the 12th, Saturn on the 13th, Jupiter on the 22d, and Neptune on the 23d.

Princeton University Observatory.



In the map, stars of the first magnitude are eight-pointed; second magnitude, six-pointed; third magnitude, five-pointed; fourth magnitude (a few), four-pointed; fifth magnitude (very few), three-pointed, counting the points only as shown in the solid outline, without the intermediate lines signifying star rays.

THE CORNU HELICOPTER.

The Cornu flying machine is one which is to enter the field to try to capture some of the aeronautic prizes. It is of the type known as helicopter, and has a pair of horizontal propellers which are worked by motors and are designed to lift the machine from the ground, and it also has a set of plane canvas surfaces which are to aid in the flight. The new machine is only in the experimental stage as yet, in the shape of a working model, but it seems to give good promise, if the recent reports are to be believed. A series of trials with the experimental flyer were made not long ago at Lisieux, France, where it had been constructed by M. Cornu. In these tests the apparatus was guided by a pivoted tube which served to hold it and prevent it from rising to a greater height than ten feet. The same device made the flyer describe a circular path of 100 feet circumference. In the first trial of the apparatus, it was found to rise in the air, with the planes disposed vertically. The two propellers were operated by a small gasoline motor of 2 horse-power size, but in this case it worked at only 1½ horse-power, since the ignition point was lowered. As regards the total weight which the propellers had to raise under these conditions, it is stated to be 30.47 pounds. There seemed to be no difficulty in making the machine rise in the air. During the second trial, the movable planes were inclined so as to receive the air which was sent to them by the lifting propellers, and as soon as the motor had been set running in the same conditions as above, the machine rose up again, and this time took a sidewise movement, proceeding to the limit of its course. In its movement it took, besides its own weight, the device which guided it. The present machine is a reduced model of a large apparatus which M. Cornu and son expect to build in the near future and they are to enter it for the Deutsch-Archdeacon prize of $10,000.

When natural gas was first brought into use in America there seemed to be a general idea that the supply was inexhaustible. It was sold at low rates and usually without measurement. This method encouraged waste in the consumption of gas, and was shortly abandoned by the larger companies. To-day nearly all consumption is sold by measurement. It is believed, says the Iron Age, that the time has now come when it is possible to procure statistics of the quantity of gas consumed, and next year this will be undertaken. The method will give such figures in the future that a more direct knowledge will be obtained of the capacity of gas areas to maintain a commercial supply of gas for a certain number of years.

TO-MORROW'S WEATHER: HOW IT IS FORETOLD.

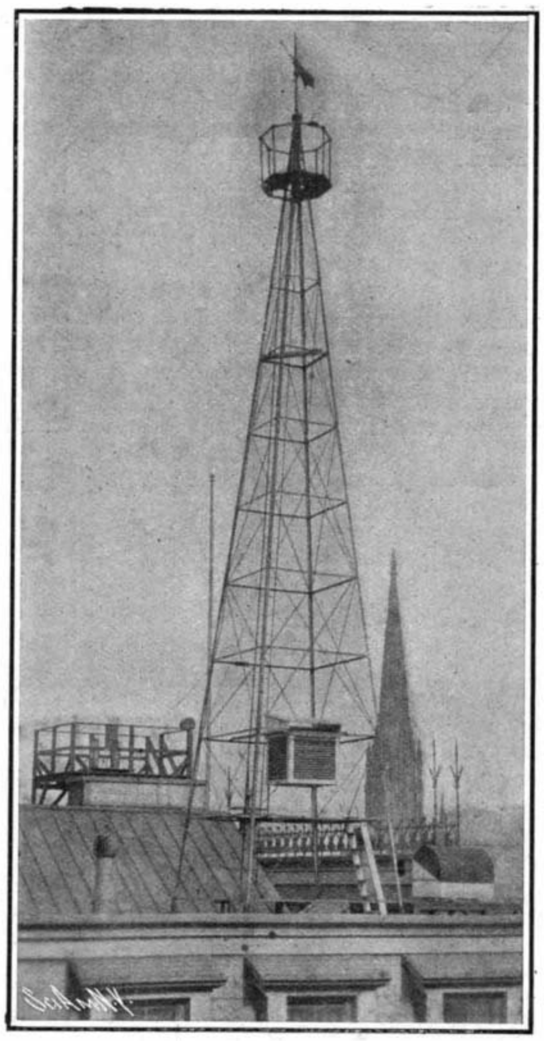
BY DAY ALLEN WILLEY.

The United States government is responsible for the publication of one of the most remarkable daily newspapers in the world. It is a newspaper which has its telegraph dispatches and its local news. It is also illustrated—at least by maps. The "form" is sometimes lithographed instead of being stereotyped, although the paper is run off the press like any daily in a large city. Perhaps the most striking feature of this publication is that its staff of reporters consists of a series of machines, which not only secure the local intelligence but record it by means of the electrical current.

This newspaper—or rather, series of newspapers—is published by the government through the various weather bureaus which have been established in the principal centers of population. While it varies to some extent in size and arrangement, in general it is modeled upon the plan which has been adopted by the Weather Forecasting Division at Washington. Like the Sunday newspaper of the metropolis, this publication of the United States is also prepared in color, the coloring being used to signify storm areas and wind currents.

These newspapers also have an Associated Press service, supplied by the Weather Forecasting Division. As the preparation of the newspaper begins in the telegraph room where the dispatches are received, a brief description of this department is of interest. The staff of operators is not only in communication with the 200 signal stations of the country by the telegraph wire, but also Washington receives not a few wireless messages. These are not directly transmitted to the Weather Bureau. They come from one of the wireless receiving stations in the city and are sent by the ordinary telegraph or telephone. As soon as the observers secure the necessary data concerning the weather, they immediately "wire" it to Washington, where the bulletins or messages are carried to a force of clerks in the Forecasting Division, who summarize and arrange them for compilation and publication. This portion of the weather forecasting staff may be called the copy readers or copy editors of the newspaper. Their copy, however, passes to another force of clerks who note and compare statistics regarding temperature, the atmospheric pressure, velocity of the wind, precipitation of moisture, with the records which are kept by the Weather Bureau, and send them out again in the form of telegrams predicting the weather. These clerks may be termed the editorial staff of the Associated Press.

As the majority of the weather newspapers are modeled upon the one issued by the Forecasting Bureau at Washington for this city and vicinity, a brief outline of the manner in which it is published will give a clear conception of the system employed elsewhere. As fast as the weather statistics are received by the telegraph operators any information of especial interest to Washington is transmitted to one of the staff whose duty it is to edit it for composition. Two men usually are sufficient to do the composing and make up the form, for the latter is merely changed from day to day like some of the pages of the ordinary daily paper. The man who makes up the form corrects the map, placing the marks which indicate the direction of the wind as well as other signs upon it. As the preparation of the form begins as soon as the clerk finishes the copy, it is ready for lithographing in a very short time. Meanwhile in the mechanical department the lithograph stone is being prepared for the impression, so that when the form is ready it is reproduced without loss of time. The stone is next placed upon the bed of the press and perhaps in less than an hour after composition began, the paper is being run off. The



Tower Supporting Weather Vane, Anemometer, and Contact Box.

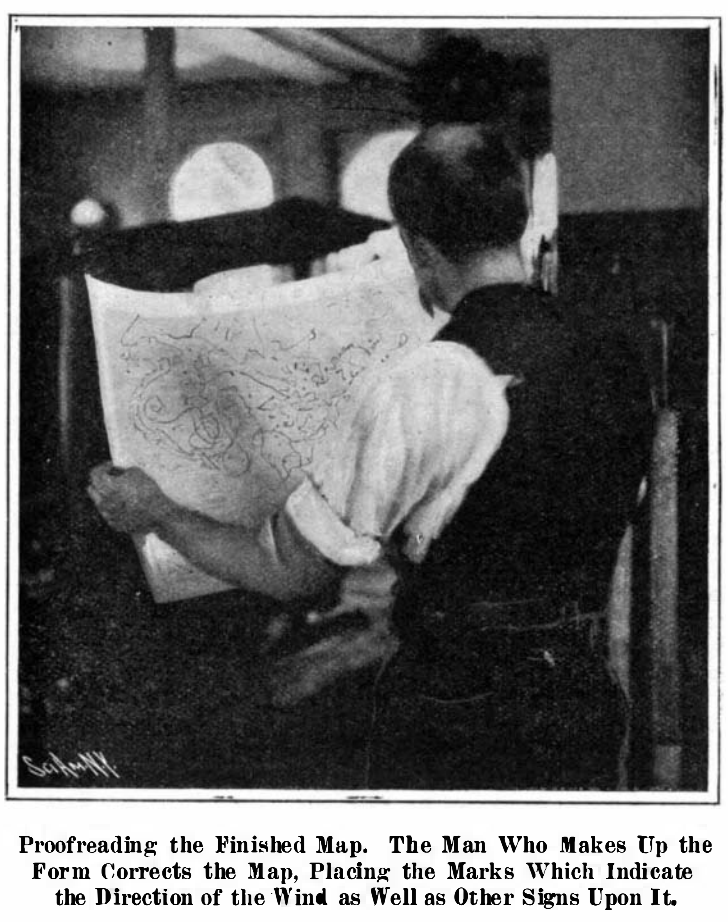
first sheets are carefully examined to note any possible errors which may have occurred. As soon as the sheets are sufficiently dry they are sent out immediately for distribution.

Only a few of the weather newspapers are lithographed, however. The chalk plate process which is so extensively utilized at present in newspaper illustration, is also employed in preparing the daily weather charts in small districts; for by means of this process the few needed can be prepared at a comparatively small expense. In place of the ready-made symbols showing the temperature, velocity of the winds, etc., the characters are sometimes put in with a pen in using the chalk plate. Some of the newspapers are less than half the size of the sheet published at Washington, but all contain a complete weather map of the United States as well as of southern Canada, with the temperature, barometer, and direction of the wind and condition of the weather at the time the last observation was made. In addition, each contains a weather forecast for the vicinity made by a local observer, in addition to the forecast telegram from Washington for the section from which the bulletin is issued, as well as a brief summary of the weather conditions throughout the country. Despite the variety of information afforded, the entire composition on one of the ordinary small maps is less than a thousand words, so that it can be set up very rapidly, while the tables for recording temperature, wind currents, precipitation, etc., are kept standing in type and need only be corrected. If the city is a seaport or located on one of the larger rivers, additional information relative to stages of water, tides, possible storms, as well as the weather reports from foreign stations may be included.

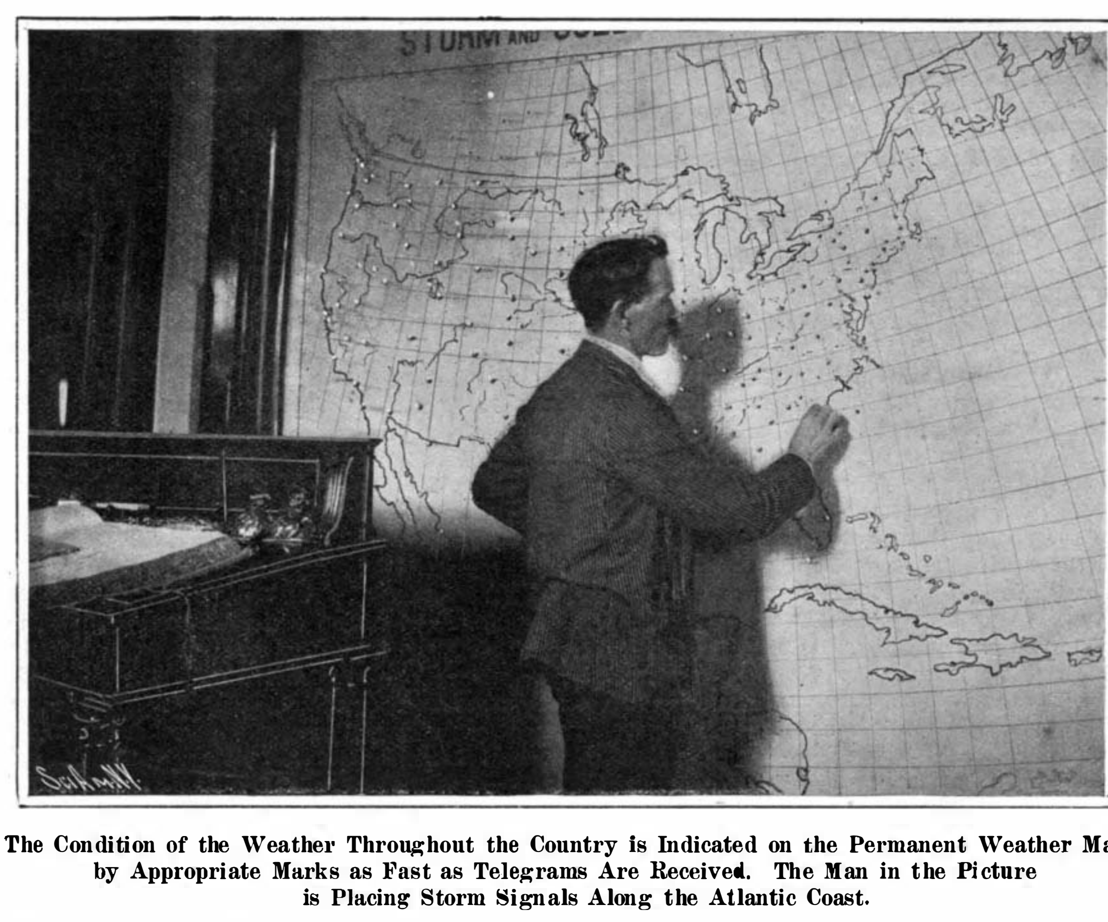
While this interesting journal is published but once a day, it contains only a portion of the information which is compiled by the forecasting division of the Weather Bureau for the general public. Early in the evening the telegraph operators and the staff of clerks are again at work, receiving the batch of night telegrams which come in about eight o'clock, Washington time. These are recorded and summarized, then if necessary, forecasts are telegraphed to stations where such information is of importance. The forecasts are made public in a variety of ways. They may be signaled by colored lanterns from some commanding edifice—usually the tower on the weather observation station. They are published in the newspapers and sometimes printed on small bulletins for additional circulation at night. It is perhaps needless to say that publicity is given the forecasts during the daytime by flags hoisted on the stations, as well as by the familiar slips of brown paper which are sent by mail and messenger in the large cities.

So rapid, yet efficient, is the system that in an hour after the morning forecasts have been wired from Washington, every farmer, for example, who has telephone communication with the most isolated station or is anywhere near a telegraph or telephone office, can obtain data as to the possible weather conditions in his vicinity during the next twenty-four hours. The great value of this information has been many times illustrated, especially in Florida, where timely notice of cold waves has in some instances saved millions of dollars to the orange growers alone.

The weather observation station is usually indicated by the mechanism so often placed upon its roof. It may be in one of the "sky scraper" office buildings, or on a lower structure, but in either case one sees the familiar skeleton tower to which is attached the weather vane and the anemometer, two of the mechanical reporters which gather information, and sometimes the thermometer box. Another necessary addition is the automatic measure for determining the amount of rainfall or snowfall, while to-day, as a century ago, the barometer is one of the reliable methods of predicting weather, and is indispensable in making forecasts. The gaily decorated fowl, trotting horse, or other object which surmounts the roof of the house or barn and is supposed to determine the direction of the wind, is far different from the weather vane used by the meteorologist. The design adopted by the government consists of an iron rod about five-eighths of an inch



Proofreading the Finished Map. The Man Who Makes Up the Form Corrects the Map, Placing the Marks Which Indicate the Direction of the Wind as Well as Other Signs Upon It.



The Condition of the Weather Throughout the Country is Indicated on the Permanent Weather Map by Appropriate Marks as Fast as Telegrams Are Received. The Man in the Picture is Placing Storm Signals Along the Atlantic Coast.

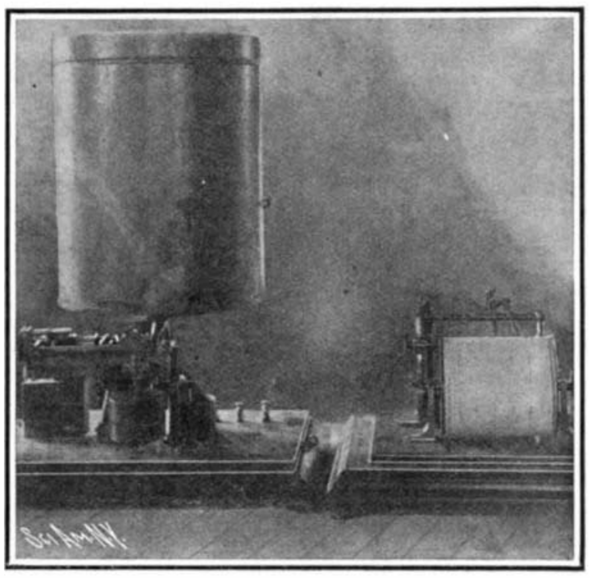
TO-MORROW'S WEATHER: HOW IT IS FORETOLD.

in diameter and 42 inches long, the tail of the vane being formed of thin wooden boards spread apart about 9 inches at the outer ends. To the other end is attached an arrow point. Despite the weight of metal in the vane, it revolves upon a series of three anti-friction rollers, so nicely adjusted that they do not require lubrication and the amount of oscillation is reduced to a minimum. Connecting it to the recording apparatus is an iron rod usually terminating in a contact box, as it is termed. The anemometer, which is the cup design invented by Robinson, consists of four hemispheres made of aluminium or brass attached to small square steel arms. Their revolutions turn a spindle which terminates in an endless screw fitting into a series of geared wheels. One of these drives another screw which, in turn, actuates two dial wheels divided into miles and tenths. The anemometer may be attached to the tower supporting the weather vane by a side arm or mounted above it as may be convenient. The height of the tower varies according to the surroundings. It is necessary to have the instruments where they are exposed to the direct force of the wind—where its direction is not diverted by buildings or other obstacles.

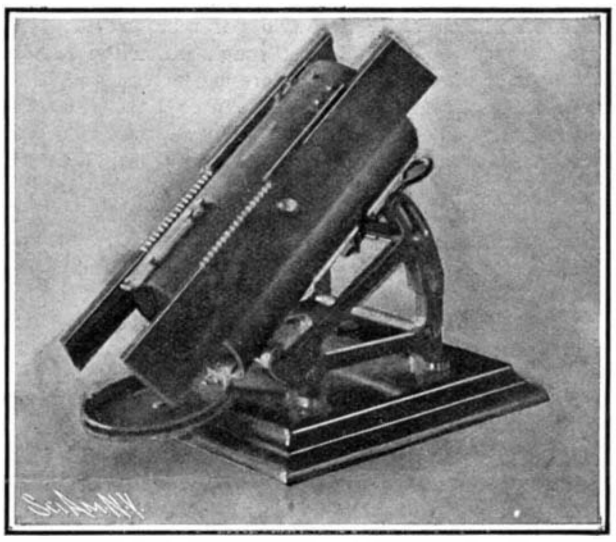
Not only are the velocity and direction of the wind thus reported, but with the aid of the electric current they are recorded as well. The meteorograph utilized for this purpose is one of the most remarkable instruments in the weather service, for it not only keeps a record of the performances of the weather vane and anemometer, but registers the amount of precipitation or the duration of sunshine, as the weather is clear or otherwise. For this reason it is sometimes termed a quadruple register, and with good reason. As will be noted in the accompanying illustration, the register contains a drum around which is wrapped a sheet of paper which receives the characters made by the recording pens, which note the changes in all the mechanism. This drum makes one revolution every six hours, being moved by clockwork to insure regularity. After each revolution the drum is moved endwise about half an inch by the action of a screw, thus preventing a record already made from being marked over.

From the meteorograph, wires extend to the gearing, which is actuated by the spindle of the anemometer. As the toothed wheels revolve they open and close an electric circuit, thus operating magnets which in turn actuate a recording pen. The direction of the wind is recorded by the use of four magnets which, however, allow eight different directions to be noted if necessary. To the armature of each magnet is attached a long printing arm terminating in a pen point. When a current opens and closes the magnet, the printing point is forced down upon the cylinder, making a dot. The position of the dot on the paper indicates the direction of the wind. The contact box connected with the weather vane contains a series of four cam collars and levers, also four contact springs, one for each point of the compass. When the wind begins to blow directly north the base of the rod extending from the vane to the contact box presses against what is called the "north" spring, which, in turn, touches the corresponding lever, thus sending an electric impulse through the corresponding magnet. When it is blowing northeast, for example, two of the springs are brought into contact with the levers, with the result that two circuits are closed and two magnets will actuate the pens with which they are connected.

As rainfall is a rarity during the period when the sun is shining, one magnet and pen are usually employed to record these indications. The electric current for the sunshine record passes through what is called a clock contact, which gives an electric impulse once every minute by connection with the hand of a specially designed clock. The record for sunshine is a series of short pen strokes arranged in zig-zag fashion. The characters for rain are also zig-zag, but obtained by the precipitation in the rain gage which is connected to the magnet by an electric circuit. While what is known as the hand measuring gage is still in use, an automatic or tipping bucket gage is being substituted for it at the principal weather stations throughout the country. By means of this apparatus, every hundredth of an inch of rainfall is accurately registered. The precipitation which is, of



Automatic Gage for Measuring Precipitation in the Form of Rain, Snow, or Sleet.



Automatic Blue-Printing Machine by Which the Intensity of the Sunlight is Photographed.

course, received in the top, enters a funnel-shaped receptacle with a small opening in the center, so that the water is conducted to a point directly over the tipping bucket, as it is called. This is divided into two compartments, one of which is always presented to receive the water. When the quantity of liquid has reached a hundredth of an inch, it tips and empties the compartment, the other side of the "bucket" being elevated at the same time. The liquid which has been emptied is collected in a receptacle below, so that it can again be measured by hand gage if desired. The motion of the tipping bucket opens and closes the electric circuit and thus actuates the precipitation recording pen.

But wonderful as are the accuracy and reliability of the instruments which we have described, perhaps the most notable mechanism is the barograph, which is in use at the present time in the majority of the weather stations. As the name implies, it is not only a barometer but also a barometric recorder. While the ordinary barometer is also employed, the barograph has become an actual necessity, as it makes a continuous record of the barometric oscillations, hour by hour, upon a sheet of moving paper. The design of Prof. C. F. Marvin, who has become so noted for the construction of meteorological apparatus, is employed.

In this form of the barograph the barometer tube is placed at the left of the recording section of the apparatus, suspended by a hook from what is known as a balance. The weight of the barometer tube upon the horizontal beam with which it is connected at the top is balanced by a rolling carriage and a fixed weight. The equilibrium of this carriage is maintained by a contact spring attached to a balance beam at the extreme right and immediately over the recording cylinder. By the employment of this spring the carriage is moved into the proper position by means of a wheel turned by a horizontal screw. Every time the carriage is set in motion by the disturbance of the equilibrium caused by the movement of the mercury, the spring closes an electric circuit, thus actuating a recording pen which traces the pressure curve, as it is called, upon the paper cylinder. Thus, the rise and fall in the mercurial column is noted. So delicate is the adjustment of this instrument that it is affected by an atmospheric pressure as slight as the ten-thousandth of an inch.

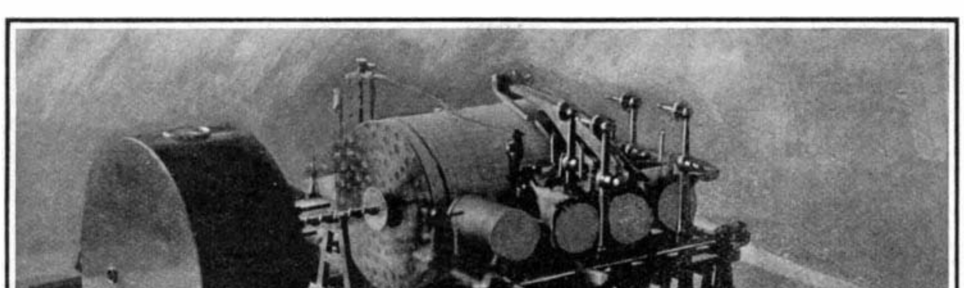
One of the auxiliary instruments utilized at Washington and some of the larger stations is what is called an automatic sun photographer. This machine, which is illustrated in the accompanying photograph, is so designed that the intensity of the sunlight is photographed automatically, being reproduced on a strip of blue-print paper. Thus the record can be kept of the clearness of the atmosphere at various points in the United States.

Another interesting form of mechanism in connection with the work of the Forecasting Bureau is the recorder attached to the weather kite, as it is termed. To the kite is fastened a small anemometer of the design shown in the illustration, which is connected by wiring to the recorder, which is inclosed in an aluminium case. It is modeled on the same principle as the quadruple register already described, but is only intended to note the direction and velocity of the wind, so that it is provided with but two pens for this purpose. With the kite instruments, much valuable data has been obtained at heights several thousand feet from the surface. Experiments on an elaborate scale are being made with it at the new observatory at Mount Weather, Virginia.

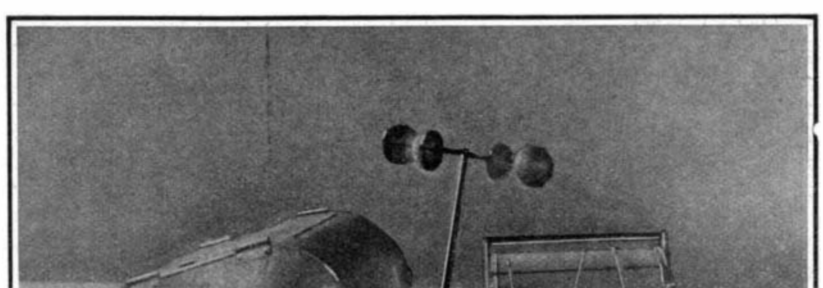
Fusibility of the Slag of Blast Furnaces.

The Revue de la Metallurgie contains an account of the researches of M. O. Boudonard on the fusibility of blast furnace slag. This fusibility is regarded as one of the most important properties of the slag for investigation. The fusing temperature of a slag should be about that of the metal. If too refractory, it necessitates a useless consumption of the combustible. On the other hand, a viscous slag, though much lighter than the metal, will form an emulsion with it, which subsists even after prolonged repose. Great fluidity is, therefore, necessary to avoid drawing off globules of metal held in suspension. The investigation has included the systematic study of the fusibility of the silicates of lime and of alumina, the aluminates of lime, and alumino-calcic silicates.

Brilliant effects for electric signs are now to be readily obtained with little cost by the use of small colored transparent caps which fit over the rounded ends of the incandescent bulbs. This permits the owner of a changeable electric sign to alter the legend at will and to indulge in the use of colors without the necessity of keeping on hand a large supply of colored lamps, some of which are very expensive.



Quadruple Recorder for Automatically Noting the Velocity and the Direction of the Wind, and if the Weather is Clear or Rainy,



Mechanical Outfit of the Government Weather Kite, Showing Instrument for Recording Wind Conditions When the Kite is in the Air.

THE "EXPRESS" COAL-BAGGING LIGHTER FOR COALING WAR VESSELS IN HARBOR.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The British naval authorities are experimenting at the Devonport dockyard with a new type of coal-bagging lighter for coaling war vessels when berthed or anchored in harbor.

The purpose of the invention is to provide means for filling bags with coal on board the lighter without any recourse to shoveling, and the automatic transportation of these loaded coal bags directly from the lighter to the bunkers of the warship without any handling whatever at any intermediate points. Rapidity in loading has been the object on the part of the designers, and with this appliance there is assured a coaling capacity of 60 tons an hour from each of the two transporters with which the lighter is equipped.

The hull of the lighter resembles that generally adopted for this class of craft. It is constructed entirely of steel and can carry a maximum load of 1,000 tons of coal. It measures 145 feet in length by 36 feet beam and 19½ feet molded depth, and has a draft of 14 feet when fully loaded. The hull is subdivided by means of three transverse bulkheads into four main compartments. In the forward compartment is accommodation for the crew; that next aft contains the boiler and steam-raising plant for driving the hoisting mechanism, electric-light installation, etc.; the two center compartments contain the coal. In the center of the craft, at the bottom, is a small reserved space where the hoisting engines, pumping engines, condenser, and electric-light plant are placed. Above this area are the air-filtering and ventilating fan chambers. On the deck itself are two vertical towers or elevators fore and aft respectively for conveying the coal from the loading compartments to the warship alongside, while in the center of the deck are two slewing cranes for transshipping the coal from a collier to the lighter itself.

At the bottom of the lighter, extending practically its entire length on each side, and parallel to one another, are two galleries or filling rooms. These are about 7 feet in height, with a sloping crown at either side. On each side of this gangway are ranged benches at a sufficient height from the floor to enable the mouth of the sack when hung up to be just level with them. The crown of the roof slopes over these benches and the coal contained in the compartments above falls by gravity through orifices onto the benches and is raked by the men into the open mouths of the sacks. Along the edges of the benches where the coal bags are suspended are fitted bag holders which hold the mouths of the bags open to their fullest extent while the men are raking in the coal. In order to prevent the coal from falling onto the floor of the filling rooms, fixed and portable screens are provided.

As rapidly as the bags are filled they are mechanically lifted onto an overhead rail along which they travel to the foot of one of the vertical elevators by means of a reciprocating pawl device. These elevators extend to a height of nearly 45 feet above the deck of the lighter and are constructed of steel with a crow's nest at the top from which the operator can easily follow and control the conveying operations upon the deck of the warship. Hinged to each elevator is a radial transporter arm long enough to reach over the deck of the vessel alongside. This arm has a vertical travel of 30 feet up and down the elevator, so it can be easily adjusted to the most suitable height; furthermore, it is so arranged that it can be turned through a considerable angle. When out of use the arm is packed vertically up the side of the elevator tower, completely out of the way. Each elevator is fitted with a Mackrow-Cameron "Express" transporter capable of lifting 120 tons of coal in bags per hour.

At the top and the bottom of each elevator tower is a grooved wheel over which travels an endless chain provided at intervals with hooks. The bag of coal, upon reaching the base of the elevator, is caught up by one of these hooks and lifted off the overhead rail extending through the galleries and is immediately hoisted by the traveling chain up the interior of the tower until it reaches a predetermined point, where the radial arm projects. It is then automatically released from the elevator chain and directed onto the radial arm, along which it is run to the point on the deck of the warship where it is to be delivered. Trunks are provided for returning the empty bags as rapidly as their contents are discharged to the filling galleries, and the cycle of operations is repeated until coaling is completed.

The two slewing cranes are each of 2½ tons capacity and are of the high-speed Cameron type. They have a maximum overhang of 80 feet from the center line of the lighter, which enables them to reach well over the deck of the collier barge or other craft with ease. Their working radius is any distance between 8 feet and 40 feet, between which limits the loads can be lifted and dumped. In the case of a collier with the coal loose in the hold to be discharged into the holds of the lighter itself, there is a grab of one ton capacity, though they can be utilized equally well in transporting bags of coal from a barge to the lighter or *vice versa* as required, and can if the exigencies so demand assist in the coaling of the vessel already being served by the elevators. The coal drawn from the lighter is shot into the hoppers of the lighter through large hatchways in the deck. Thus while the lighter is coaling the warship alongside, the slewing cranes can be simultaneously replenishing the hoppers of the lighter itself from the opposite side. These slewing cranes are each capable of handling from 50 to 60 tons of coal an hour.

Naturally, while coaling operations are in progress the air within the bag-filling galleries becomes heavily impregnated with coal dust. In order to insure a perfect supply of clean, fresh air within this area the dust-laden atmosphere is withdrawn from the galleries by the ventilating fans, passed through the filtering medium, and fresh air supplied in its stead.

The boat is lighted throughout by electricity, there being some sixty incandescent lamps distributed through the loading galleries, engine and boiler rooms, and the crew's quarters. In order to facilitate coaling operations at night large arc lamps are fitted over the crow's nests on the elevator towers, and communication between the various parts of the lighter is afforded by electric bells and speaking tubes.

It will be seen that the transportation of the filled and the empty bags is entirely automatic throughout, the human element entering only in regard to the filling of the bags.

The bags of coal, upon reaching the warship's deck, are dumped down and wheeled away upon trolleys to the bunkers by the coaling crew. The designers recommend, however, that two ports be provided in the sides of the battleships through which the radial transporter arms of the elevators can extend and connect with a system of overhead runners fitted on board and attached to the skid beams so as to form a continuous bar. In this manner the bags of coal would travel from the leading rooms on the lighter direct to the bunkers and the contents be there discharged, by which arrangement intermediate handling would be entirely obviated and coaling considerably facilitated and expedited. Furthermore, the decks would be left quite clear and any necessity of clearing away ship's boats and gear, as is now usually the case when coaling is carried out on war vessels, would be dispensed with.

In the official trials recently carried out by the British Admiralty at Devonport for the purposes of testing the possibilities of this craft both in the coaling of war vessels and also the charging of the lighter itself from barges and colliers moored alongside, eminent success was obtained. In order to test the apparatus to the utmost these trials were extended over a period of four months and in each trial a new crew for operating the lighter was employed, so that it was impossible for exceptional results to be obtained owing to the men becoming expert with the gear and consequently more expert in its manipulation as a result of continual practice. In the first place, the elimination of the preparations heretofore incidental to the coaling of a warship, such as the removal of boats and davits, etc., was emphasized, since in no instance was it found necessary to disturb the vessel's equipment in any way, the transportation bar being projected through any opening in the ship's side capable of admitting a 2-hundred-weight bag. As the coaling crew became expert in the removal of the bags of coal from the outer end of the transporter speed in coaling was accelerated, and the facility and lighter labor involved in the task was rendered very apparent. The most noticeable feature was the speed with which the vessel could be coaled by this system as compared with the other methods in vogue in the dockyard, the capacity of the transporter far exceeding that attainable with the other processes.

In the course of the trials seven vessels of varying types were coaled, the quantity taken on board ranging from 1,000 tons for the "Duke of Edinburgh" to 172 tons for the "Monmouth." In the case of the former vessel the trial extended over six hours, during which time 609 tons were placed on board, the remaining 391 tons being taken on after the trial. The highest coaling speed was attained in shipping 705 tons on board the "Isis," when 41.75 tons an hour were placed on board from each transporter. In the final trial, in coaling the "Victorious" with 720 tons, the task was accomplished in 5 hours 40 minutes actual working time. Coaling was effected entirely by the transporters themselves without any assistance from the independent cranes. Had the crew been fresh the work would have been completed in shorter time; furthermore, the men had had but little experience in handling the apparatus. Trials were also made with the cranes for transshipping coal from barges to the lighter itself. On this occasion 580 tons were lifted onto the lighter in 807 trips, the average load each trip being 14.37 hundredweight or approximately 50 tons an hour. In the official tests of the capacity of the grab 14.84 hundredweight was the average of forty trips.

Cobalt Mining in Canada.

BY ALLAN PORTER.

The new mining region which is being explored in northern Ontario is perhaps as important from a scientific standpoint as from the fact that it is of considerable extent. While the principal output has been silver, it is now known beyond question that the percentage of the cobalt in the ores is so high that this interesting substance will probably be utilized to a far greater degree in industries than ever before. While many reports have been current about the mineral wealth of this region, fortunately its natural formation as well as the mines which have been opened have been investigated by such experts as Prof. William Earl Hidden, of the London Geological Society, Dr. Robert Bell, of the Canadian Geological Survey, and Prof. Nichol, of the Canadian School of Mines. All of these mineralogists concur as to the extent of the ore veins and the percentage of metal which they contain.

It may be needless to say that the small quantity of cobalt utilized in industries has been almost entirely in the form of an oxide. While it is known to form an alloy of a high grade when mixed with copper, iron, or manganese, and is superior to nickel for plating on metal, the difficulty in separating it from the elements with which it is usually combined has caused it to be employed almost entirely as a pigment. Porcelain is glazed with it, while the cobalt fused with borax results in a beautifully tinted glass. In a single year such a small quantity has been produced that less than fifty tons of the oxide are consumed by the various industries in America. The bulk of the oxide is imported, most of it coming from New South Wales, Switzerland, and New Caledonia.

Those who are familiar with the geology of Ontario are not surprised that the ore deposits in the vicinity of the town of Cobalt should prove so extensive. The new mining center is but 90 miles northeast of Sudbury, which, as recently stated in the Scientific American, has become one of the greatest nickel-producing centers of the world. The rocks of the Lower Huronian age and the Keewatin formation come to the surface for a considerable distance in the vicinity of Cobalt, outcroppings of ore having been found as high as 500 feet above Lake Temiskaming, while workings in the lake itself have also yielded ore of a high grade. Although the principal mining operations at the present time are being conducted immediately around the town of Cobalt, ore containing a large percentage of not only cobalt and silver, but also some gold, has been found at Ingram, 30 miles north of the present field, while a vein has also been located 30 miles south, which gives 9 per cent cobalt, 7 per cent nickel, 23 per cent arsenic, with a mere trace of silver, but averaging nearly $10 worth of gold to the ton. While the entire region about these points has been but partially examined, the experts to whom we have referred believe that the Huronian and Keewatin strata, which contain the ore, extend near enough to the surface to make the ore-bearing region fully 60 miles in length and of unknown width.

As we have stated, the examinations of the veins thus far opened have been sufficiently exhaustive to give an idea of the character and grade of the ores, while a number of the mines has been opened to a sufficient extent to make a conservative estimate of the possibilities of the output. While silver is the principal output, the ores are remarkable for their diversity. They include native silver, smaltite, niccolite, argentite, cobalt bloom, nickel bloom, millerite, dyscrasite, galena, copper and iron pyrites, and zinc blende.

The principal vein stone thus far found is calcite, while considerable quartz is taken out mingled with the ores. Some of the outcrops so closely resemble pure silver that very exaggerated statements have been made as to the richness of the field. It has been claimed that pieces of ore have been taken out that are practically pure silver weighing as much as 150 and 200 pounds, but as a matter of fact no nuggets of pure metal anywhere near these dimensions have been obtained in the opinion of the mineralogists. The analyses of quantities of ore taken from different portions of the field give the clearest idea of the proportions of the various metals. A carload of ores taken at random from a series of five veins at Cobalt showed the following percentages when analyzed: Silver, 11.41; cobalt, 11.27; nickel, 3.78; arsenic, 44.16.

It will be noticed in this carload the percentage of cobalt nearly equaled that of silver. A carload from another portion in the vicinity, however, gave 15.6 per cent of cobalt, merely a trace of silver and 61.74 per cent of arsenic, the percentage of nickel being 7. These figures can be taken as a fair standard of the grade of ores in the district, although some of the mines contain a considerably larger percentage both of silver and cobalt. The bulk of the ores is transported to New Jersey for reduction, the average cost of transportation per carload being $150. The quality of the metal, however, is such that the several mining companies have been sending not only the first-grade but their second-grade ores to be treated, as the second-grade assays from $200 to $300 per ton.

La Rose mine, which was the first to be opened and has been worked the most systematically thus far, furnishes at present the best illustration of the extent of the veins. The main shaft at this mine is down to 100 feet and drifts have been made for a distance of over 300 feet at this level. These drifts show that the vein of ore is as extensive and as rich as the portion which was first discovered. The mine was one of the series to be investigated by the mineralogists. Here the diamond drill has bored to a depth of 350 feet, ore being found at the greatest distance from the surface. The Tretheway mine contains ore of such a grade that 50 tons of it have actually yielded 190,000 ounces of silver, in addition to 12 per cent cobalt and 3½ per cent nickel. Like most of the other operations in the district, however, this mine consists of merely an open cut which at the present time is 60 feet in length and 25 feet in depth; the vein of ore averages but 8 inches in width, which will give an idea of the percentage of metal which it carries. The veins thus far located throughout the district are not noted for their size. They average from 10 to 12 inches, in one or two instances widening to 18 inches. The geologists are still in doubt as to the formation of the veins, but believe they were created by the action of highly heated water which permeated the narrow vertical fissures where they are found. These fissures cut through the rocks of the geological ages to which we have referred.

Owing to the presence of so much ore near the surface, mining operations in the Cobalt district are notable for the crude methods employed. As already stated, the majority of workings are practically on the surface, the earth and rock covering being stripped off and open trenches dug to conform to the size and direction of the vein. Some of the largest producers have not been mined to a distance of 25 feet below the surface as yet. The system usually employed in getting out the ore from these workings is to utilize explosives, sometimes the pick, to loosen the formation, when it is loaded into buckets and hoisted by means of a boom derrick to the top. The windlass operated by hand-power is one of the common methods. Sidings of tramways have been laid from some of the larger mines to the Temiskaming and Northern Ontario Railway, a line which the Canadian government has built through this district from Toronto.

At La Rose and a number of the deeper mines where shafts have been sunk, the ore extracted from the chambers on the various levels is carried to the foot of the shaft by wheelbarrows, loaded in the buckets, then hoisted by windlass and cable to the surface, a steam engine of suitable horse-power being installed for this purpose. The buildings at the larger mines consist merely of the shaft house—a frame shed covering the mouth of the shaft and hoisting machinery—and stock house where the ore is broken up into suitable sizes and sacked for shipping to the smelters. Some of the companies have not even provided storage for the ores, and it is a common sight to witness ores containing $2,000 and $3,000 per ton in silver lying in bags in the open air awaiting opportunity to be hauled to the railroad station.

Owing to the difficulty of securing the cobalt and nickel by the process employed at the New Jersey smelters it is understood that a very large proportion of these valuable substances is wasted in the effort to obtain all of the silver which is contained in the ore. A reduction works is now in course of construction at Cobalt in which the German process utilized in treating what is known as Saxon ores will be employed. It is known that by this process ores containing cobalt, arsenic, and silver are so economically treated that nearly all the cobalt and silver are saved. The mining department of the Canadian government has taken up the project and the works are being constructed under the supervision of two German metallurgists who are familiar with the treatment referred to.

Readers of the SCIENTIFIC AMERICAN, however, are aware that Thomas A. Edison has been making an elaborate series of experiments for several years with the view of producing an electric storage battery which will be more economical and durable than the types now used for commercial purposes. From time to time reference has been made to the work which Mr. Edison is doing. It is known that during the last year he has made several examinations of mineral deposits both in the United States and Canada. In a recent interview he made the statement that he had discovered a substitute for lead which would revolutionize the storage battery. The metal which he intends utilizing is cobalt, and it is evident that he has discovered a process by which it can be secured from the ore in such a form that it is available for his purposes. The cobalt contained in the various nickel ores thus far exposed in the United States, however, is insignificant compared with the extent of the ores in the new mining district. As Mr. Edison made the statement referred to after he had visited this section of Canada, it is probable that he will utilize a portion of its output in the new battery which he announces he is about to manufacture. The advantages of this battery over the majority of types in use can be appreciated when his statement is quoted. This is to the effect that for $200 a battery can be constructed and equipped which will supply motive power to propel a vehicle for two passengers a distance of 100,000 miles before another need be substituted. In other words, by the use of cobalt Mr. Edison believes he has found what might be called a permanent battery.

Correspondence.

Esperanto Grammars.

To the Editor of the SCIENTIFIC AMERICAN:

Doubtless you have long ago formed your opinion as to the merits of Esperanto, the international language. I hope that it is favorable; but as there is much irresponsible criticism of Esperanto, I want to offer an opportunity for every thinker to judge for himself. I have had prepared 100,000 brief grammars of the language in pamphlet form, and will send one free to any person who is sufficiently interested to ask for it, inclosing stamp for reply. I think it really due to this great movement for an international auxiliary language, which now embraces thirty nations in its scope, that you publish this letter, so that your readers may have the opportunity of judging for themselves.

ARTHUR BAKER,
Editor L'Amerika Esperantisto
(The American Esperantist).

Oklahoma City, January 15, 1907.

Perhydrase Milk.

To the Editor of the SCIENTIFIC AMERICAN:

In your current issue we find an item relating to perhydrase milk, in which you state that the cost of this milk is about four or five cents higher per liter than that of ordinary milk. However, this is erroneous, since there is an increase of four to five pfennige, or 1 to 1¼ cent, only per liter.

You state further that "perhydrase milk must be kept in a dark place. Exposure to light will give it a bitter taste." This refers not only to perhydrase milk, but to milk in general, as Drs. Römer and Much have ascertained by numerous tests. If *any milk* is exposed to light, even for a short period, it acquires a bitter taste and becomes injurious to health, while if kept in a dark room, it remains sweet. They therefore recommend the use of colored, preferably dark red or dark green, glass bottles for the keeping of milk; while if kept in the ordinary white bottles, or in bottles of blue glass, milk will "turn" after a short time if exposed to light.

These remarks may prove of interest to your readers.

New York, January 17, 1907. C. BISCHOFF & Co.

Supplementary Railroad Signals.

To the Editor of the SCIENTIFIC AMERICAN:

Considering the recent railroad collision accidents in this locality, it has occurred to me the following plan of signaling might be used advantageously.

Place two electric lights, one red, the other white, on each telegraph pole on the line of the railroad between all stations, to be connected at the stations with any electrical plant sufficient to light the signals from one station to the other (when found that it was needed). Should the signal agent find that he had made a mistake, or for any other reason wish to stop the train, touching the button in his office will light all red signals instantly ahead of the train that has passed him. The engineer seeing this will know that he must be cautious, and go slow or stop for further orders. Then, when all things are righted, turn on the white light and permit the train to continue.

I suggest this as an additional safety signal, where there is now in use the block system, and also where there is no block system at all. If there could be electricity used between stations by the engineer, he could connect to these same wires and give signals himself to other trains "fore and aft." This would be essential in cases of wrecks or other delays. I believe, if this plan had been put in use, President Samuel Spencer and party would be alive to-day.

R. MAYS CLEVELAND.

Marietta, Greenville County, S. C.

The Current Supplement.

The opening article of the current SUPPLEMENT, No. 1622, describes a German coal-tipping device. The second installment of the article on the new incandescent metallic filament electric lamps is published. A. Frederick Collins gives full details of the location and erection of a 100-mile wireless telegraph station. This article should be read in connection with that by the same author published in SCIENTIFIC AMERICAN SUPPLEMENT No. 1605, describing in detail the design and construction of a 100-mile telegraph set. F. E. Junge gives some considerations affecting the application of waste gases for power purposes. Jacques Boyer writes on mushroom culture in France. Just as the living organisms of man and animals and plants suffer various changes as the result of disease, so also many of our manufactured products are subject to undesirable changes in their character. Bread is among these. The diseases of bread are accordingly made the subject of a very clear and instructive article. A very good article is published on hard solders, and some excellent formulas are given. Mr. V. E. McCourt writes exhaustively on the origin, occurrence, and chemical composition of peat.

The Automobile Races on the Ormond-Daytona Beach.

The races this year on the Florida beach were by no means as interesting as heretofore. The only cars to compete were a few stock machines and the rebuilt, cigar-shaped, Stanley steam racer that last year covered a mile in 28 1-5 seconds—at the rate of 127.6 miles an hour. A special light-weight racer fitted with an air-cooled, 8-cylinder, V motor, and a Curtiss motor bicycle with the same type of engine, did not succeed in breaking any records.

First of the races to be held on Tuesday, January 22—the first day—was a 5-mile race from a standing start. This was won in 4 minutes and 25 seconds, or at a rate of speed of 67.9 miles an hour, by E. B. Blakely, a young Harvard student, driving a 70-horse-power American Mercedes. A 20-horse-power English Rolls-Royce was second, and a 30-horse-power Stanley steamer third. The 5-mile open championship with flying start was won by F. H. Marriott, driving the special Stanley racer, in 4 minutes and 44⅘ seconds—a speed of 80 miles an hour. Capt. C. E. Hutton, on his 20-horse-power Rolls-Royce, was second in 4:52 4-5, while a 30-horse-power Stanley again took third place. A one-mile race with flying start was won by W. Durbin with a Stanley racer in 53 2-5 seconds. The 30-horse-power Rolls-Royce was second and a 30-horse-power Stoddard-Dayton third in this event. The second best time of the day—3 minutes and 51 4-5 seconds—was made by Marriott with the Stanley racer in a 5-mile match race. He beat Blakely, on his 70-horse-power American Mercedes, by but 5 seconds, however. A mile race for stock touring cars was won by Ralph Owen driving the same Oldsmobile touring car with which he recently completed the strenuous journey from New York city to Ormond Beach. His time for the mile was 1:12. Thirty-horse-power Winton and Wayne cars were second and third respectively.

The chief event of the second day was a 10-mile race in which the Stanley freak racer blew out a cylinder head after the first half mile, breaking the rear part of the chassis and damaging the engine beyond repair. Three other Stanleys in this race broke down and had to be towed to the garage. The race was won by the 70-horse-power American Mercedes by less than 10 seconds from F. E. Stanley, who drove one of his own 30-horse-power cars, notwithstanding that the steam machine broke its pump rocker arm just before it finished. A 50-horse-power Welch touring car was third. The time of the winner was 7:42 1-5, which means a speed of 77.8 miles an hour. A 20-mile race with one turn for American touring cars was won by the 50-horse-power Welch in 22:32 4-5, or at a speed of 61½ miles an hour. This is a new record for stock touring cars of but 50 horse-power. An international touring car race (distance, 20 miles) was won by Hutton on his Rolls-Royce in 23:5 2-5. Curtiss, on his 2-cylinder motor bicycle, made a mile in 46 2-5 seconds, and went ahead of W. Ray, who drove a 2-cylinder Simplex, by about 50 feet. On Friday, however, Ray made a new record of 44 2-5 seconds for the mile, which corresponds to a speed of 81 miles an hour.

On the third day of the races, Thursday, the 70-horse-power American Mercedes, driven by Blakely, won the 100-mile race, including seven turns, in 1 hour, 26 minutes, and 10 seconds, at an average speed of nearly 69½ miles an hour. The Rolls-Royce car was second in 2:02:35, and the New York-Florida Oldsmobile third in 2:57:40. The 10-mile open handicap was also won by Blakely in 13:59. The Stanley racer did a mile in 31 4-5 seconds, and F. E. Stanley drove his 30-horse-power machine a mile in 45 2-5 seconds, thus making a new record for steam touring cars. On Friday, January 25, the last day of the races, a special 6-mile match between two 30-horse-power runabouts was won in 7:35 3-5, and the English Rolls-Royce stripped touring car defeated a 30 H. P. Franklin touring car in like condition by running 12 miles in 13:12 2-5. With the repaired Stanley racer, Marriott came within two-fifths of a second of equaling his record of last year. In a second attempt later in the day his machine struck a bump while running very fast. This threw it high in the air, and caused it to overturn and roll over and over when it again struck the ground. Marriott was thrown free of the remains of the racer. He was severely, though not fatally, injured. This accident will no doubt put an end to attempts at attaining tremendous speed with freak machines. One of the other Stanley racers made a mile in 35 seconds, or at a rate of 102.8 miles an hour.

THE SEA-RAFTS OF THE NORTHWEST.

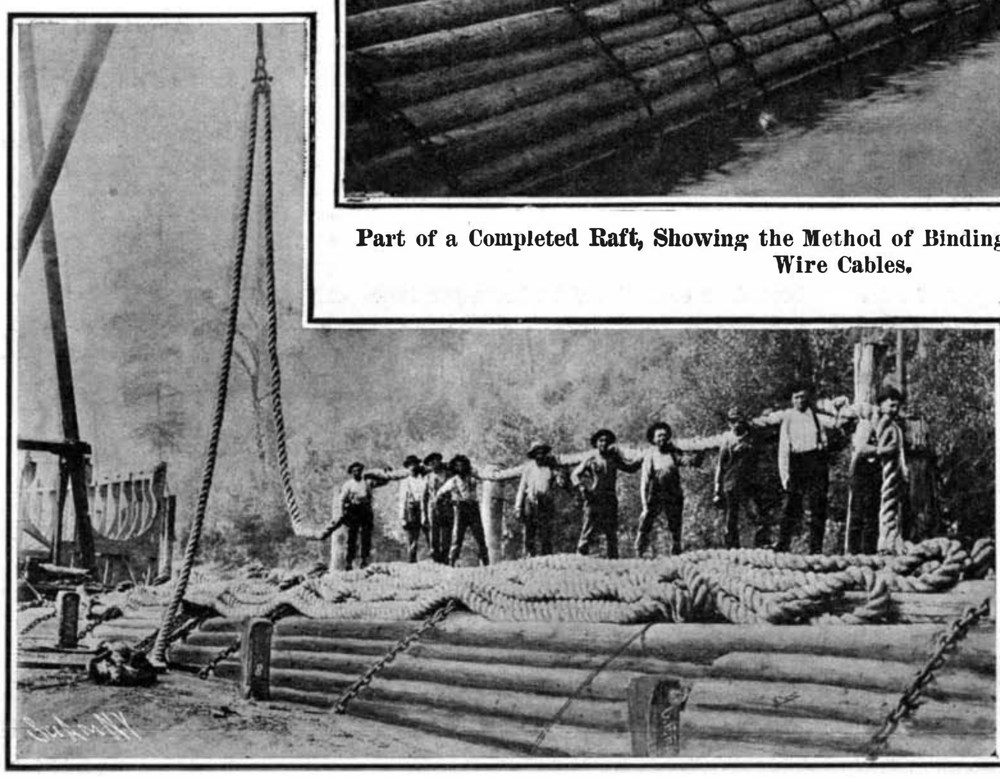
BY DAY ALLEN WILLEY.

In addition to the square timbers, planking, and boards cut for buildings, bridges, and other purposes in Washington and Oregon annually, a very large quantity of material for piling and telephone and telegraph poles is secured from the forests in the Puget Sound country and along the Columbia River. Until recently most of this timber was transported to market in sailing vessels and steam barges, as it is used principally in central and southern California.

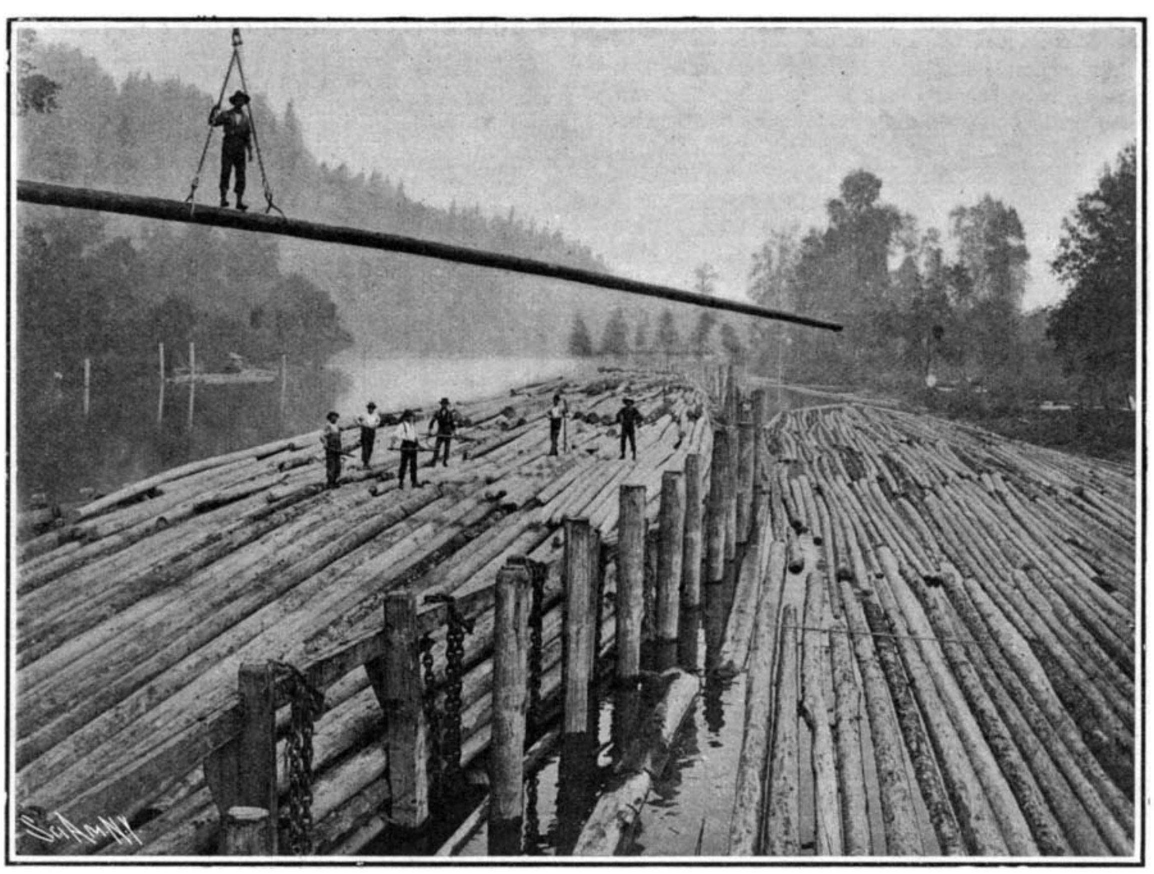
The cost of transportation by steam and sailing vessel, and the limited capacity of even the largest craft for this kind of freight, caused some of the companies engaged in getting out poles and piling to design what are called in the Northwest sea rafts. As the accompanying illustrations show, these rafts are of truly enormous dimensions, and in shape closely resemble a cigar, tapering to a point at both ends, thence gradually enlarging to the greatest diameter at the center. While the sea rafts are of varying sizes, the smallest usually contain at least 5,000 pieces of timber, ranging from 80 to 110 feet in length and from 8 inches to nearly 2 feet in diameter at the butt. Consequently, some of the rafts made in this peculiar fashion are nearly as long as the largest transatlantic liners, measuring no less than 650 feet from end to end. So compactly are the poles arranged, however, that the greatest diameter is not over 60 feet; but, as the photographs show, the enormous weight of the wood forces a raft down in the water until the highest portion is rarely over ten feet above the surface. To fasten such a raft so that it will withstand the force of the seas to which it is exposed in the trip down the coast from the Columbia River or Puget Sound to San Francisco and the southern California coast, no little engineering skill is required. As the cigar shape offers less resistance to the force of the waves than any other, this has been adopted. In order to pile the timber in this form, a huge skeleton or shipway, as it would be nautically termed, is constructed. This is practically a cradle, which is moored in the water adjacent to the boom where the raft timber is confined. By means of a boom derrick of suitable dimensions and power, the poles and piling are lifted from the boom singly and placed in the proper position in the cradle. They are so adjusted as to overlap each other, the plan followed being somewhat similar to that in laying a brick wall, the end of each stick being placed opposite the center of the one adjacent to it. While to a novice the raft looks as if it were made up of timber thrown in without any order, every pole is carefully placed in position. Sometimes the work of filling the cradle occupies several months. After completion the raft is wrapped with iron chains lashed around it at intervals ranging from 12 to 20 feet apart. These chains are composed of 1½-inch links, and the ends are toggled together after the chains have been stretched taut by a hand or steam windlass. To prevent the chains from slipping, iron staples are driven through the links into the outside poles. In addition to the chains, however, "side lines," as they are called, consisting of wire rope are stretched around the raft between the chain sections, so that when the wrapping is completed, the mass of logs is bound together very securely. When the wrapping is finished, the raft is ready for launching. The cradle in which it has been formed consists of two sections held together at the bottom by bolts. To each bolt is attached a rope; and when the raft is ready to be floated, it is necessary only to pull on these ropes. The bolts then slip back in their sockets, and the two sections of the cradle fall apart, ready to be towed away by tugboats. In building the raft, however, two 2-inch chains are stretched lengthwise from end to end through the center. One of these is bolted to a sort of bulkhead at one end, consisting of a band of iron, which is fitted around the projecting ends of the outer pieces. The other chain, called the "towing chain," is connected at the forward end with the towing hawser, and secured inside the raft by lateral chains which extend also from side to side, being fastened to those which encircle the raft. In this way the towing strain is well distributed, and is not borne merely by the bow end. To move this unwieldy bulk, two powerful steamers are usually employed at sea, one for pulling directly ahead, and the other to aid in keeping the raft in the right course, especially in rough weather. But a comparatively small portion of the surface is exposed to the seas. Otherwise it would be impossible to transport the timber in this form. On the other hand, the depth in the water allows only a very slow rate of speed to be maintained. The average time required between the Columbia River and San Francisco, for example, is from ten to fifteen days according to the weather, although the distance is only about 750 miles.

The Columbia River rafts are put together at a town called Stella, which is located in the lumber country about forty miles from the mouth of the river. These rafts are the largest which have yet been transported down the coast. One which was sent to San

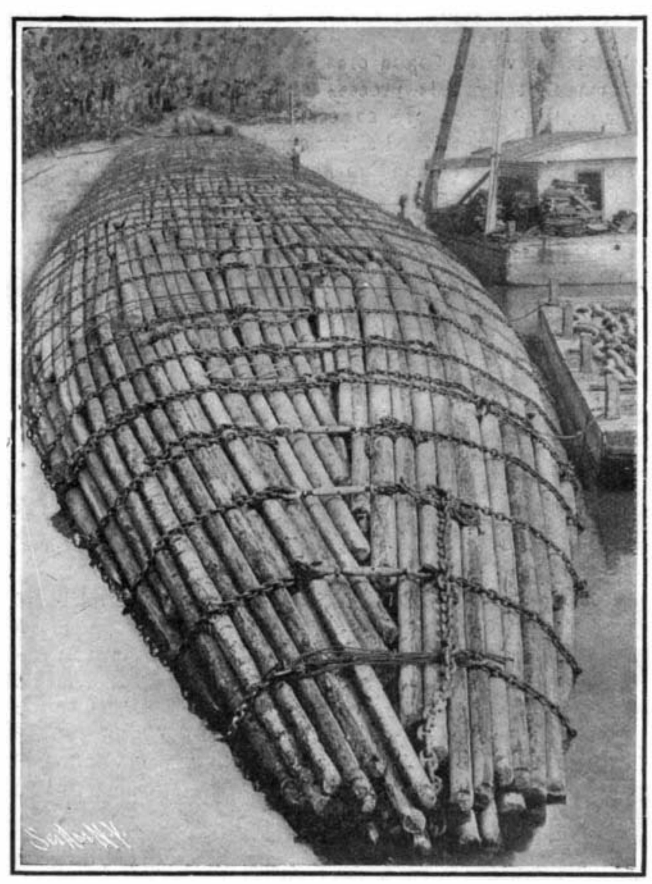
Part of a Completed Raft, Showing the Method of Binding It Together with Chains and Wire Cables.



Coiling the Towing Cable on Top of the Sea-Raft.



Building a Big Sea-Raft on the Lower River.



Columbia River Sea-Raft.

THE SEA-RAFTS OF THE NORTHWEST.

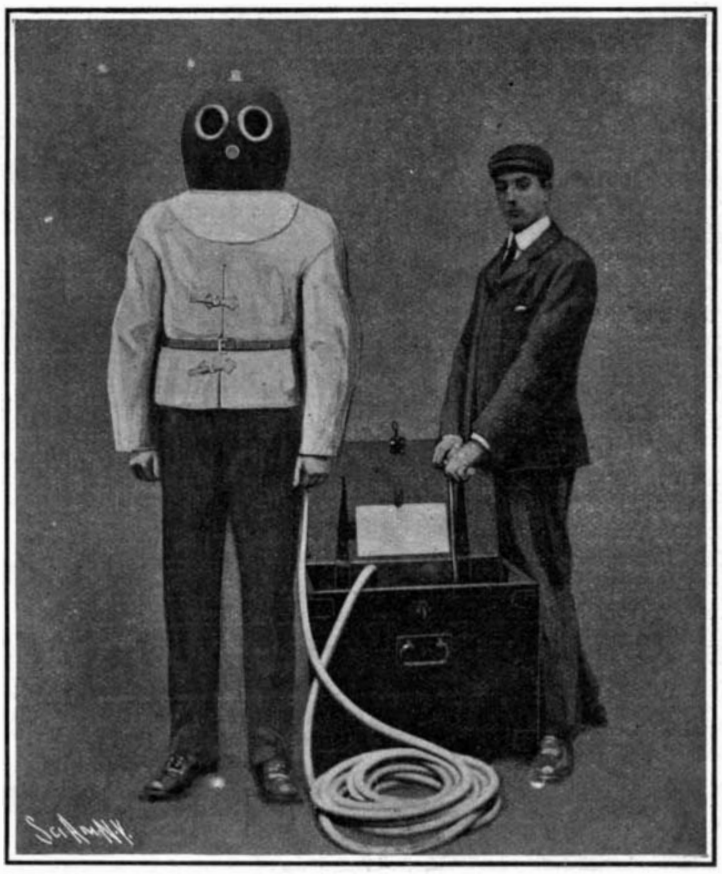
Francisco contained no less than 800,000 linear feet of lumber, to be used for wharf piling. If the piles which it contained were stretched in a row, they would actually extend a distance of nearly fifteen miles. The majority of these rafts have been safely taken to their destinations, although one or two have gone to pieces. Where such accidents have occurred, the mass of timber has covered the ocean for a distance of many miles, and has formed a very dangerous menace to navigation. For this reason an effort has been made by other transportation companies to have a law passed in the States of Washington and Oregon, preventing the building of the sea rafts, on the ground that they are a menace to navigation. Thus far the agitators of this movement have been unsuccessful.

BREATHING MASKS AND HELMETS.

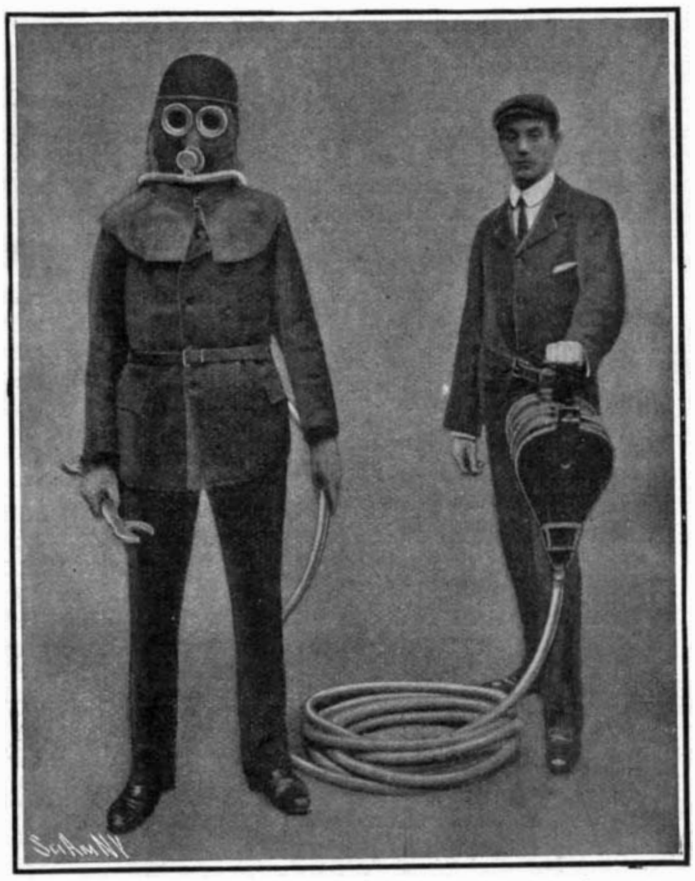
BY W. G. FITZ-GERALD.

One of the most interesting and curious of all industries is the manufacture of smoke helmets, smoke jackets, artificial respirators, and self-contained breathing apparatus generally, such as are used in mines of all kinds, collieries, gas and chemical works, fire brigades, sewerage works, ships' coal bunkers, the ammonia chambers of refrigerating factories, steel works, breweries, well-sinking plants, and other industrial concerns.

The curious gear is intended to supply the user with factitious but perfectly respirable air, more or less independent of any connection with the outer atmosphere, for about four hours at a stretch. Some varieties, like the Fleuss-Davis patent, have no air pipe or other connections with the base of operations, so that for exploring and rescue work in mines, etc., its scope of usefulness is practically unlimited. The wearer, with his cylinder of compressed oxygen, is perfectly safe in the most deadly gases, and can walk any



Helmet and Jacket Combined; the Tube is Supported by the Belt to Avoid Dragging Upon the Helmet.



The "Complete Mask" Type of Breathing Apparatus of Vulcanized Rubber.

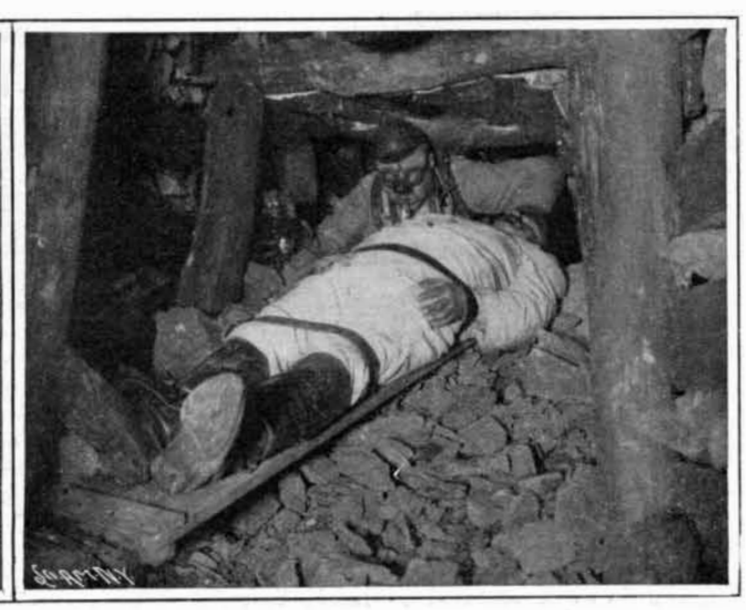
Breathing Device for Use in Coal Mines.

Reviving a Victim Overcome by Poisonous Gas by Means of Supplementary Oxygen Supply.

Type of Helmets Used in German Fire Departments.

Passing an Unconscious Miner Through a Heading Out Into the Open Air.

Penetrating to the Scene of a Disaster in a Coal Mine.



Taking a Victim of a Mine Accident to the Surface, Strapped Upon a Stretcher.

BREATHING MASKS AND HELMETS.

distance and explore the most intricate turnings of a mine with every freedom of action.

The principle of the Fleuss-Davis apparatus is that its wearer breathes the same air over and over again; the carbonic acid being absorbed from it after each expiration, by means of the charge of caustic soda in the breathing chambers, and at the same time the requisite amount of oxygen is restored to it from the steel cylinder carried, thus rendering it pure and fit to be inhaled once more into the lungs. In some cases where this apparatus is to be used in remote places, in which it would be impossible to get the oxygen supply cylinders recharged, a regular plant goes with the apparatus for making oxygen and compressing it to 120 atmospheres. There are no objectionable nose clips and mouthpieces, and the worker's breathing goes on quite naturally.

He may if he wish carry a special telephonic apparatus and self-contained electric hand lamp, which burns eight hours continuously with one charge. His queer-looking apparatus includes a steel cylinder containing a full charge of oxygen compressed to 120 atmospheres, and also a charge of caustic soda for the breathing chambers.

The question of renewing the oxygen is often a serious one, say in the remote mining districts of South America, where the complicated and tiresome processes, involving the use of chlorate of potash as a generating agent, with retorts, a furnace, purifiers, and the like, would prove costly and difficult for the manufacture of oxygen on a small scale Some shipping companies absolutely refuse to carry compressed oxygen in steel cylinders; but now a new substance, known as "oxylithe," has come along, affording a simple and effective means of producing oxygen gas with the minimum of trouble. The stuff is prepared in small cakes ready for immediate use, and on coming in contact with water it gives off chemically pure oxygen in the same way that acetylene gas is produced from calcium carbide, except that there is absolutely no element of danger in the preparation; thus storage cylinders are rendered unnecessary These breathing apparatus are made in many varieties, according to the type of work for which they are needed. Another consists of a water and air-proof helmet and jacket in one piece. The helmet is very light and strong, and is permanently attached to a jacket of stout yet supple leather, or material consisting of India rubber between two layers of tanned twill.

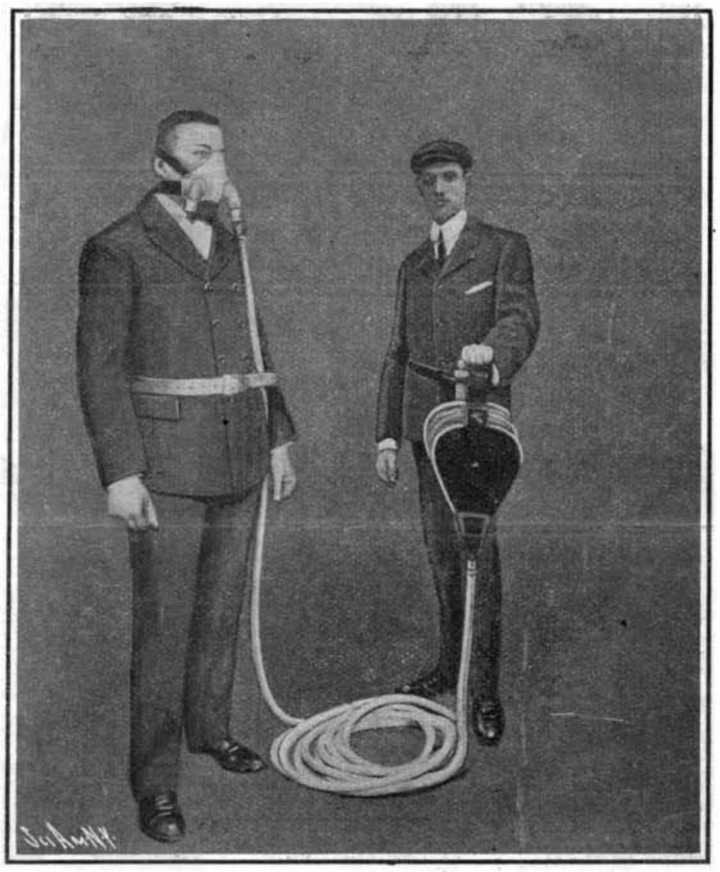
The helmet has an air inlet connection, to which the air tube is attached; the interior being so constructed that the air pumped in is at once, while quite fresh, distributed over the wearer's face, while the vitiated or excess air is passed through an outlet valve. There are windows of clear mica; and with this type there is absolutely no weight on the worker's head.

The air-supply apparatus can be worked either by hand or foot, and gives an ample volume of air under all conditions. The rubber air tube is of the non-collapsible kind, and is fifty feet in length, with extra lengths as required. It is fitted with a coupling at each end for connecting the helmet and air apparatus; and there is a leather waist belt, fitted with a device for holding the air tube securely in position and preventing it from dragging on the helmet.

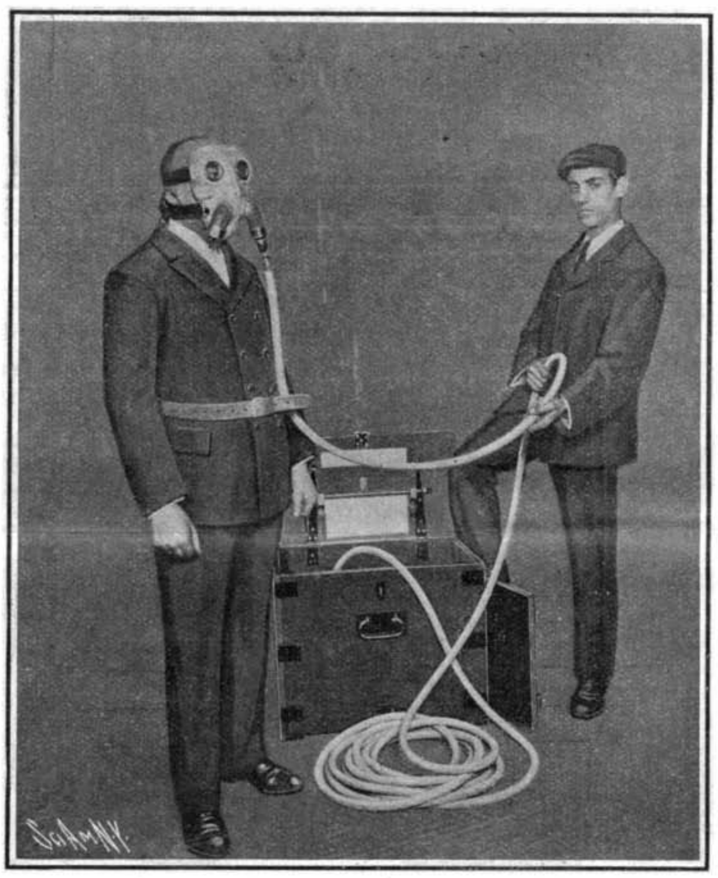
Attached to the latter there is a special telephone for connecting with the attendant. Next we have what is known as the "complete mask" type of breathing apparatus. The mask is of strong vulcanized India rubber, so constructed as to be shaped to fit any face comfortably. It has an air inlet valve, and also an outlet valve for the disposal of vitiated air, mica goggles, and a device for quickly securing the mask to the face. If two workers are to be supplied with air at once, this is done by means of a double-acting hand bellows.

A much more powerful air supply, however, can be given if desired by the ordinary air pump used by divers, and this is desirable when the workers in non-respirable air are at a considerable distance from the source of supply. A special respirator is provided for men who work in noxious gases that do not affect the eyes. It consists of a very light mask covering nose and mouth, and intended originally for the use of gas men engaged in tapping mines. Obviously, however, it can be used for other work of a noxious or poisonous nature. The wearer draws his supply of air through a short, light and flexible tube fitted to an inlet valve on one side of the mask, and exhalation is through an outlet valve and tube fitted on the other side. Both tubes pass over the man's shoulders, are held together by a small clip, and are led a few yards outside the mephitic area to the fresh air. In most cases the second tube can be dispensed with; the outlet valve line being quite sufficient to carry away the vitiated air.

Of course this type of respirator can be used only in cases where its wearer is but a very short distance from fresh air. There is hardly a coal mine in the world, a gas or chemical works, fire brigade, or refrigerating plant using ammonia chambers, which is not now equipped with this strange-looking apparatus; and many hundreds of human lives have been saved by its aid. Indeed, on occasion a grave catastrophe has been averted. A case in point was the stopping of the flooding of the Severn tunnel by the famous diver Alexander Lambert—who, by the way, recovered nearly $300,000 in specie from the wrecked steamer "Alphonso XII.," sunk off Grand Canary in nearly 200 feet of water.



Special Device for Working in Non-Respirable Gases Which, However, Do Not Affect the Eyes.



A Mask Without Helmet, of Vulcanized Rubber. This Device Can Be Adjusted with Great Rapidity.

BREATHING MASKS AND HELMETS.

During some repairs in the Severn tunnel a year or two ago, a certain door in the drainage quarter had been inadvertently left open, and water was roaring and racing through the shaft. Seizing a Fleuss-Davis apparatus, and fixing it in position on his face and back in a few moments, Lambert crept and swam nearly a quarter of a mile along the shaft, and by sheer strength closed the door, thus enabling the pumps to overcome the tremendous volume of water.

Again, everyone knows how poisonous the atmosphere becomes in a coal mine after an explosion; and less than thirty years ago, before apparatus for artificial respiration was invented, it was impossible for rescuers to venture down to the aid of men overcome by poisonous gases. To-day, however, the moment a catastrophe is known at the pit's mouth, volunteers put masks and helmets in position, jump into the cage and go down into the reeking depths, where no living creature could venture in the ordinary way.

Disasters have also been averted in the sewers of great cities, where hundreds of men are employed; in oil ships, and even in gold and silver mines. Last year fifty-seven men were rescued by these smoke jackets and helmets in the far-famed Broken Hill silver mines of Australia. Here are enormous underground workings supported by wooden pit-props. For some reason or other the Broken Hill is subject to terrible fires, some of which have raged for twelve months without going out.

Last December a fierce rush of flame shot through one of the galleries, entirely imprisoning about sixty workers. The blaze was of short duration, but the galleries were filled with acrid smoke, seemingly as poisonous as the fumes of picric acid. It was evident that the imprisoned men could not live long in such deadly vapors. One hero after another endeavored to get through by holding wet cloths over his face, but after a hundred yards or so he would fall unconscious, and all but lose his life.

Finally half a dozen artificial respiration apparatus were brought from the town, and like a flash men had donned them, and were racing in security through the dense poisonous smoke wreaths. They soon came upon the bodies of their comrades, some of them propped against the side of the workings, and others tossed this way and that on the mud floors as though in sleep. All but three or four of the men were got out alive, and a short but energetic treatment soon restored them to consciousness.

As to the work of the fire brigades of the world with these smoke helmets, smoke jackets, and respirators, this is too well known to be more than mentioned here. A passing word must be said, however, about the duties of men who work in the ammonia chambers in refrigerating factories; without this strange-looking gear such labor would be absolutely impossible. Then there are many trades and industries, like the making of cordite and other high explosives, as well as the manufacture of grindstones, which imperatively call for the use of such protection for the hands employed.

As said before, in cases where the wearer must penetrate for longer distances into a non-respirable atmosphere, the supply of oxygen must be self-contained in the apparatus. We illustrate herewith several German devices of this character. The oxygen is usually compressed and carried in light metal cylinders, being discharged as required through a suitable valve to the mouth piece. The apparatus sometimes also includes an extra supply of oxygen for use in reviving persons overcome through the inhalation of noxious gases. The illustrations indicate the terrible difficulties with which the rescuers must often contend in coal or other mines, after an accident of the kind to which such mines are liable. One of the engravings shows the type of helmet, not with a self-contained oxygen supply, which has been adopted in many German fire departments.

Charles D. Walcott, the New Secretary of the Smithsonian Institution.

On January 23 the Regents of the Smithsonian Institution unanimously elected Charles D. Walcott to fill the place of the late Samuel P. Langley as Secretary of the Smithsonian Institution.

Mr. Walcott was born at New York Mills, N. Y., on March 31, 1850, and became an assistant in the New York State surveys in 1876. He was appointed assistant geologist in the Geological Survey in 1879, and took up a study of the Cambrian rocks, the oldest known on the globe. His paper presented before the Geological Congress in London in 1888 was epoch-making concerning studies of these formations.

In 1894 Mr. Walcott became director of the U. S. Geological Survey, succeeding Major J. W. Powell.

To Mr. Walcott is due much of the success of the reclamation service, and under his direction this service has grown and increased until it now employs more than five hundred civil engineers and assistants in constructing works in all parts of the arid West, under an expenditure of upward of $1,000,000 a month.

CONCERNING EARS.

BY R. LYDEKKER.

Like many other terms in general use, the word "ear" has a double signification. In its wider, and perhaps proper, sense it denotes the entire organ of hearing, both external and internal. On the other hand, in its more restricted signification it is confined entirely to the outer or external ear; and it is in this sense that it is most generally employed at the present day, as witness the fact that both seals and whales are commonly spoken of as being earless animals, although their internal organs of hearing are very strongly developed. In our translation of the Bible we have examples of both usages. Thus the somewhat curious phrase "the deaf adder which stoppeth her ears" refers, of course, to the internal organ of hearing, seeing that serpents have no external auricular appendage. On the other hand, in the reference to the cutting off the ear of one of the high priest's servants in the Garden of Gethsemane the term is employed in its more restricted sense, as denoting the external ear only. Similarly, when we speak of an animal having large or small or long or short ears, we refer solely to the external position of the auditory apparatus. And from the latter example it will be perfectly obvious that in its popular acceptation the word is now very generally, although by no means invariably (as when we speak of the "drum of the ear"), employed in this narrower sense.

Naturalists have felt the difficulty arising from this diversity of usage, and are accordingly in many cases accustomed to refer to the external ear as the "pinna" or "conch," while that portion of the ear lying within the skull is referred to as the internal ear. There is, however, no uniformity of usage even among writers of this class; and in the ordinary descriptions of mammals the term "ear" relates only to the external portion of the apparatus, as when we speak of the long-eared bat or the long-eared fox.

As already mentioned, it is in this more restricted signification that the word is employed in the present article. And here it may be remarked that mammals (or quadrupeds, as they are commonly called) are the only animals that possess ears, in this sense of the term; the so-called ears of the long-eared and short-eared owls being merely tufts of feathers, in no wise representing the mammalian ear. Curiously enough, this peculiarity is not given as one of the distinctive characteristics of mammals in at least many textbooks.

Not that all mammals have ears (in the present sense of the term). To a certain number of species, owing to peculiar modes of existence, such appendages would obviously be not only inconvenient, but absolutely useless, and they have accordingly been more or less completely discarded. The sea bears and sea lions (Fig. 1), which spend much of their time out of the water, are of special interest in this respect, as demonstrating that all earless mammals must be descended from ancestors with well-developed external ears. In the case of these sea bears and sea lions (hence collectively known as the "eared seals") the ears exist as tiny rudiments, which can be of no possible use to their owners, even when on land. Their presence suggests, however, that these animals have taken to an aquatic mode of existence at a later period than the true or typical seals, in which all traces of the ear have disappeared, as they also have in their cousins, the walruses. Whales, porpoises, dolphins, and their like afford other examples of aquatic mammals in which the ears have been completely lost; while the aperture of the internal ear is reduced to little more than the size of a pinhole. Not that we are to assume that whales and dolphins cannot hear; on the contrary, owing to the great sizes and peculiar shell-like form of the bones of their internal ears, it is perfectly clear that their powers of hearing must be very strongly developed, although it is by no means improbable that the vibrations of sound may be received and conducted from the water by the general surface of the body to the special organ of hearing.

Sea-cows, or dugongs, and manatees may be cited as other examples of aquatic mammals which have lost their ears; and since these creatures have no sort of relationship to whales and dolphins (beyond the fact that both are members of the mammalian class), it is quite clear that the loss has taken place independently in the two groups. The Australian duck-billed platypus is an exclusively fresh-water mammal in which the ears have completely disappeared; and other instances of the same nature are displayed by certain shrew mice inhabiting the streams of Tibet, as well as by some curious water mice from those of the Andes. In all these instances the loss of the ears has, of course, taken place quite independently.

Animals like the otter and the sea otter, which spend as much of their time out of the water as in it, present, as might have been expected, an intermediate condition in the matter of ears, these being smaller and more rounded than in many of their purely terrestrial relatives.

The loss of the ears is, however, by no means confined to aquatic mammals, as such appendages would be just as much in the way, and every bit as useless, in the case of burrowing animals. Accordingly, we find that the ears have vanished in the moles of the northern hemisphere, in the golden moles of southern

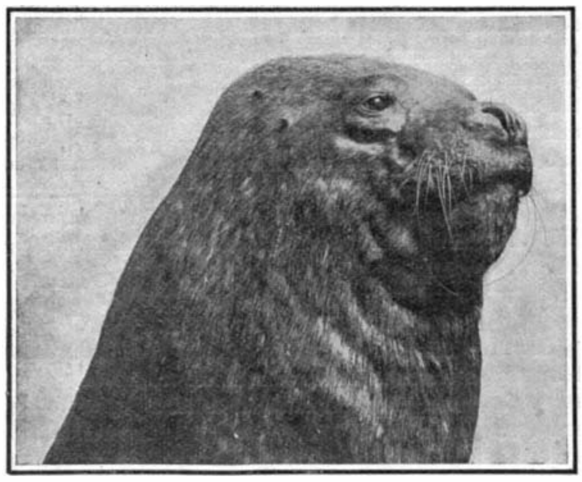


Fig. 1.—HEAD OF SEA-LION, SHOWING THE RUDIMENTARY EAR.

Fig. 2.—THE LARGE EARS OF THE REED BUCK.

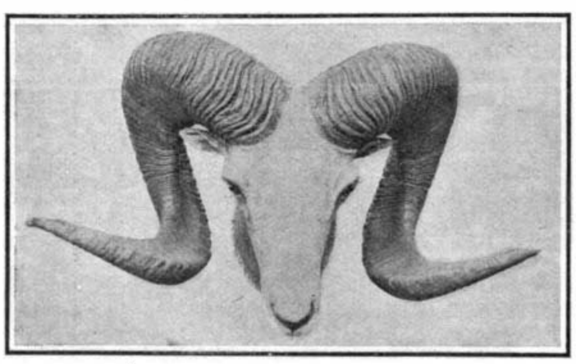


Fig. 3.—HEAD OF WILD SHEEP, SHOWING THE SMALL SIZE OF THE EAR.

Fig. 4.—THE WHITE RHINOCEROS HAS A CURIOUS TUBULAR EAR.

and eastern Africa, in the marsupial mole of Australia, in the great strand mole of Cape Colony, and in the tiny and repulsive-looking naked sand rats of Somaliland. All these creatures, it should be observed, pass practically the whole of their lives underground; and the absence of close relationship between any of them (some being very widely sundered indeed) affords conclusive evidence that in each instance the loss of the ears has been an independent adaptation to the needs of a special mode of existence.

On the other hand, in burrowing animals which pass only a portion of their time underground we find very variable conditions of ear development. For instance, in the curious scaly anteaters, or pangolins, of Asia and Africa—creatures which look more like reptiles than mammals—the ears are very small, indeed, and must be almost useless. Accordingly, it is natural to suppose that these anteaters spend a large portion of their time in their burrows, as indeed appears to be the case. Again, in many of the South American armadillos, which may be found at all hours of the day above ground, although most, if not all, of them are burrowers, the ears are, on the contrary, very strongly developed, being in one instance so large as to have earned for their owner the name of *mulita*, or little mule. The ears are still larger in that most remarkable animal, the African ant bear, or aard-vark, which spends the whole of the daylight hours deep down in its burrows, but wanders abroad at night in search of the white ants on which it feeds. During its nocturnal wanderings large ears are probably essential to its safety; and when in its burrow these appendages must doubtless be in some manner folded back so as to be out of harm's way.

Within the limits of particular groups, large ears may be taken, as a rule, to indicate either great powers of hearing or the necessity of catching every wave of sound. Thus, forest-dwelling animals generally have much larger, and especially broader, ears than their relatives inhabiting open country. An excellent instance of this is afforded by the okapi of the Semliki forest, as contrasted with the giraffe of the more open districts of Africa—the ears in the one case being excessively broad and leaf-like, while in the other they are comparatively narrow and pointed. Similarly, Grevy's zebra, which inhabits scrub jungles in Somaliland and northeast Africa generally, has much larger and wider ears than the ordinary zebras of the open veldt.

In the larger hoofed mammals, coming under the designation of "big game," there is great variety in the size of the ears, which is not always easy of explanation, although it is probably connected in a great degree with the nature of the ground they inhabit. Remarkable contrasts in this respect are afforded by the reed bucks of Africa (Fig. 2) and the wild sheep of Central Africa (Fig. 3), the ears being as proportionately large in the one instance as they are small in the other. As implied by their name, reed bucks frequent the dense reed brakes fringing many of the African rivers, and have, therefore, to depend in great part for safety on the acuteness of their hearing. Wild sheep, on the other hand, dwell on the open mountain plateaus, and rely chiefly on their senses of sight and smell for warning of the presence of enemies. It has, indeed, been suggested that the great spiral horns of the wild sheep of Central Africa act the part of megaphones in conducting sound to the small ears; but this theory not only requires proof, but is probably altogether unnecessary. Rhinoceroses (Fig. 4) are remarkable for their tube-shaped ears; this is, however, only an ultra development of what occurs in the case of the horse. Among the smaller mammals, mention may be made of the desert-dwelling Yarkand jerboa and the African long-eared fox and fennec (which are also inhabitants of open country) as species furnished with enormous ears. In these animals, as in other long-eared species, the size of the ear is correlated with a great development of that portion of the internal organ of hearing technically known as the bulla (= bubble), which appears on the under surface of the skull as a bubble-like shell of bone. It might be thought that the long ears of the species just mentioned controvert what has been mentioned with regard to such a feature being characteristic of forest-dwelling animals. That rule applies, however, only to large mammals, which are able to see considerable distances; small creatures being deprived of this advantage and, therefore, requiring the aid of hearing to protect them in their exposed haunts.

The creatures that have proportionately the largest ears of all are certain kinds of bats, such as the European long-eared bat and the Indian false vampire, the ears in these cases being furnished with an additional internal organ known as the earlet. The value of long ears to nocturnal flying animals like bats is, of course, self-evident. It is, however, noteworthy that many kinds of bats, such as the horseshoe bat, are furnished with peculiar leaf-like organs on the muzzle, which probably enable them to find their way in the darkness without, or with little aid from, the sense of hearing; and among such species we accordingly find that the size of the ears is moderate. Certain bats are altogether peculiar in that the two ears are united for a greater or smaller length at their bases on the crown of the head.

In the great majority of the larger animals the ears conform more or less to the ordinary conical and pointed type. A modification of this type also obtains in the lemurs of Africa and Asia; some of which—the African galagos—share with certain bats the power of folding up their ears when at rest. On the other hand, when we reach the higher monkeys and apes, we find the ears assuming that flattened and depressed form characteristic of the human species, this type being probably the one best adapted to an arboreal existence, at any rate in the case of comparatively large animals.

Adaptation to a life spent in the forest, where upright ears on the top of the huge head (which is used in pushing a way through the thickets) would be inconvenient and liable to injury, must probably be regarded as the reason why elephants have acquired ears of a flap-like and depressed type. No diminution in the power of hearing is, however, thereby induced, for when an elephant scents danger it immediately cocks its huge sail-like ears, and thus catches every available sound vibration.

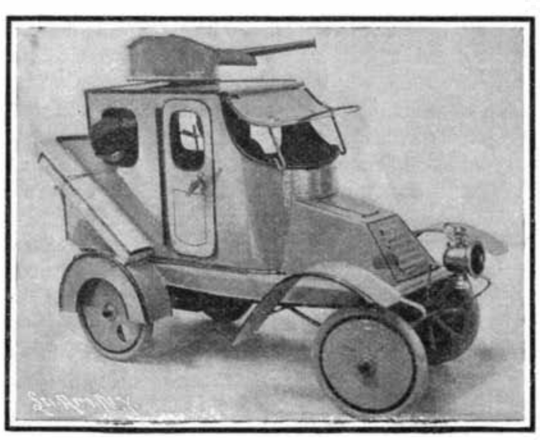
If proof were needed that the size and upright position of ears is correlated with the necessity of catching all possible waves of sound, we have it in the fact that among domesticated animals there is a tendency for these appendages to drop, or "lop," as in the case of spaniels and rabbits. That the ears of spaniels and "lop-rabbits" tend to grow to a great size, has nothing to do with the argument, the excessive development in these cases being due, as in the tails of domesticated sheep, to a kind of degenerate or retrograde action.

In this it has been possible to refer to a few only of the most salient points connected with the ears of mammals. The observant reader, when his attention has once been directed to it, will, however, not fail to find the subject an attractive one, wherein he may find a field of wide interest.

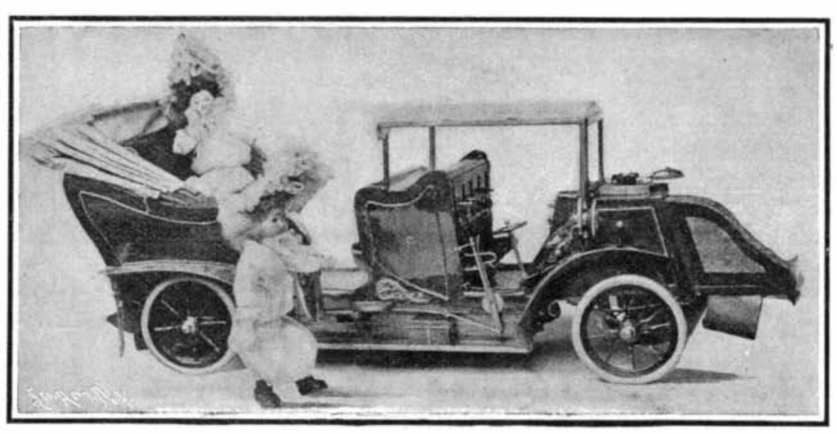
NEW TOY AUTOMOBILES.

BY OUR PARIS CORRESPONDENT.

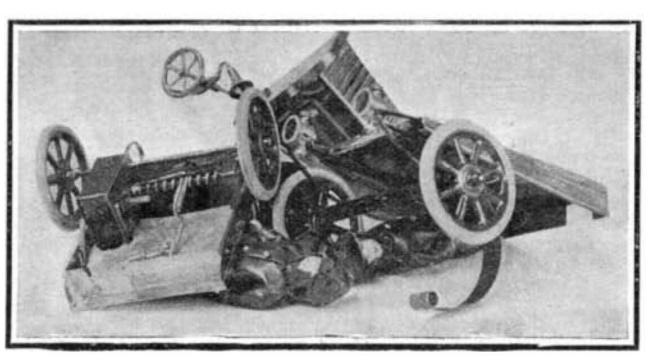
There has been held at Paris, during the last six years, an annual toy exhibition which is organized by M. Lepine, the Prefect of Police, and is intended to bring out the most interesting novelties of the year. Inventors, and especially the small manufacturers of toys, are encouraged by the models exhibited and the prizes which are awarded, and by the fact that the leading toy dealers visit the show and take up anything that seems novel. As Paris has a very large trade of this character, the show is now recognized as one of the features in developing the industry. Seeing that the public is having its attention directed more and more toward scientific and mechanical progress, such as airships, automobiles, and the like, it is only natural that mechanical toys should figure somewhat prominently at the present exhibition. We illustrate some of the designs which attracted the greatest attention. One is a very ingenious device in the shape of a collapsible automobile, which is so built that it will run for a certain distance at a high speed and then suddenly collapse, throwing the chauffeur out and giving an excellent imitation of a real motor accident. Another is a model of a large-sized touring car, and the third a model of the Charron-Girardot-Voigt war automobile.



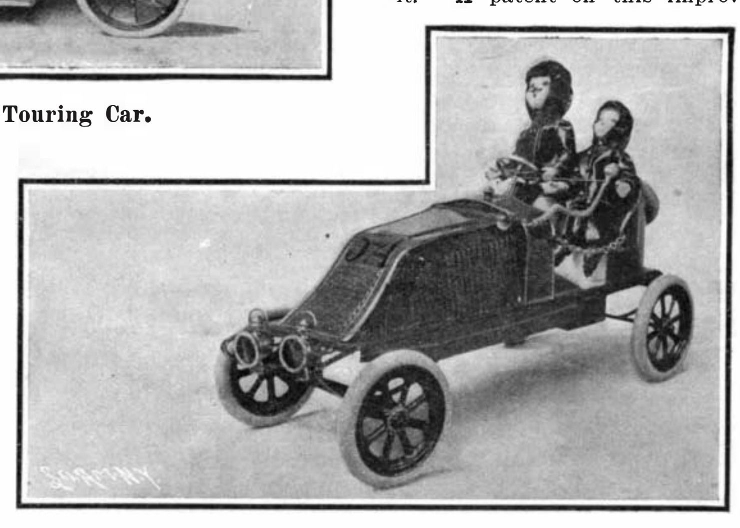
A Toy War Automobile.



A Model of a Comfortable Touring Car.



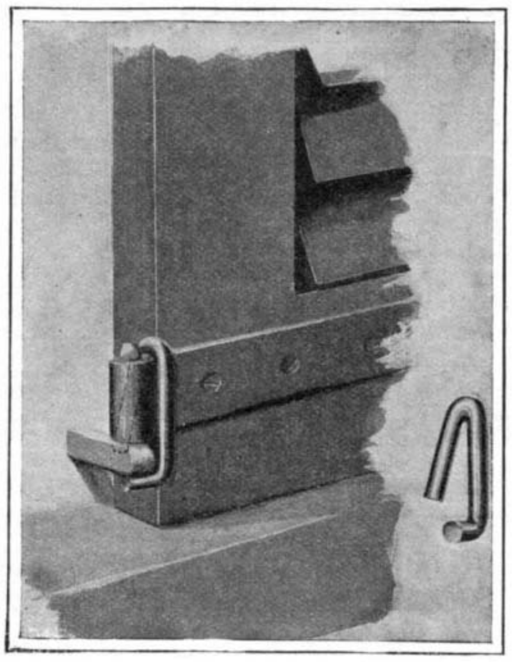
The Collapsible Automobile Wrecked.



The Machine Before the Wreck.

NEW TOY AUTOMOBILES.

WINDOW-BLIND GUARD.



WINDOW-BLIND GUARD.

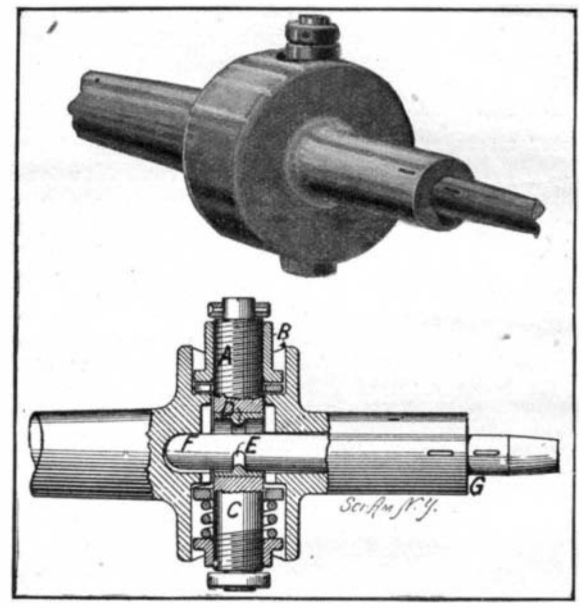
The fact that the ordinary hinges used on window blinds and shutters are inadequate for the office they serve, is often demonstrated in a high wind by the unhinging of a blind. In the usual construction it is the weight of the blind which keeps the hinges in place, and no provision is made for retaining the blind when the latter is accidentally lifted. To remedy this deficiency, a simple device has been invented, which may be attached to any blind hinge of standard make to guard against dislodgment. This window-blind guard is illustrated in detail in the accompanying engraving, which also shows the device in position on a shutter hinge. The hinge comprises the usual hanger, whose spiked end is driven into the window casement or the wall of the building. The hanger carries a pintle adapted to enter the eye or sleeve of the leaf hinge, which is attached to the blind. Between the sleeve and blind the guard is applied. The guard is made of stout wire bent to form a hook at the upper end, which hooks over the upper edge of the leaf. The lower end of the wire is formed with a finger, which projects approximately at right angles to the body of the guard. This finger is adapted to engage the under side of the hanger, thus preventing the leaf from being lifted off the pintle. The illustration shows the blind in closed position, and it will be evident that the blind may be opened without interference from the guard, whose finger will merely rotate with the leaf hinge while the blind is being swung open. A patent on this improved window-blind guard has just been granted to Mr. Louis D. Richardson, 789 Cranston Street, Providence, R. I.

A novelty which has been brought out during the present season consists of a skate which folds so completely that a pair may be carried in a man's pocket or a lady's muff. On the foot the folding skate has much the same appearance as the ordinary one, but upon being removed the portions by which it is attached to the shoe are foldable so that they occupy a position parallel to the blade. Thus they form a flat shape less than a half-inch in thickness. A wallet is furnished with each pair, one skate being fitted into each of the pockets. It makes a parcel less than an inch in thickness and of a length slightly greater than that of the skate.

CHUCK FOR ROCK DRILLS.

The accompanying engraving illustrates a chuck of novel form adapted for holding rock drills with sufficient yield to prevent their breaking under pounding or jarring strains of the driving mechanism. The chuck is of such form that the drill may be quickly placed and securely held between two opposed springs.

One of our views shows a section of the chuck. It will be observed that the chuck comprises a tubular member formed with a circular enlargement. In the circular enlargement a transversely extending chamber is provided. Fitted into this chamber is a stud *A*, threaded at its upper end to receive a nut *B*. Between this nut and shoulder in the chamber is a split spring washer. In an opening in the stud *A* is a sleeve *D*, formed with a central rib, which is adapted to engage a groove *E* in the drill shank. The lower end *C* of the stud is threaded to receive a nut, and between this nut and a washer which bears against a shoulder in the chamber, is a coil spring. Collars are provided at opposite ends of the stud to prevent entire removal of the nuts. The latter are loosened when it is desired to insert a drill in the bore of the chuck.



CHUCK FOR ROCK DRILLS.

The chuck and drill are provided with notches, which are adapted to be brought into alinement when the drill is inserted, so as to bring the groove *E* in proper position. The bore is slightly tapered to a larger diameter at its outer end. The nuts on the stud are now screwed down against their respective springs, and as one of the springs is stronger than the other, the shank of the drill will be pressed by the rib of sleeve *D* to the position illustrated, with the inner end bearing against the upper side of the bore at *F*, and the outer end bearing against the lower side of the bore at *G*. When the drill is in use it will yield against the action of the springs, and thereby serve as a cushion to take up any lateral strains which are imposed upon it. A patent on this improved drill chuck has recently been granted to Peter McKay, of Day Dawn, Murchison, Western Australia.

Cork forests exist in several parts of Morocco, and when order is established, and the cost of transport is lessened by the construction of roads and bridges, these forests may well be turned to profit.

RECENTLY PATENTED INVENTIONS.

Of Interest to Farmers.

GRAIN TRANSFERRING DEVICE.—B. B. Stauffer, Wichita, Kan. The improvement relates to self-feeders for threshing-machines. The object is to provide a transferring device or power-pitcher for carrying grain in the straw from a stack or the like to the self-feeder of the threshing-machine in such manner that the grain passes in even uniform layer to the self-feeder to insure a continuous and proper feeding of the grain without the aid of manual labor.

CUSHION FOR BALL-AND-SOCKET JOINTS.—C. B. Pinckney, Brunswick, Ga. In this patent the invention is an improvement in cushions for ball-and-socket joints, and is especially designed for use in mowing-machines and harvesters, having for an object the avoidance of the extreme wear ordinarily experienced in the use of ball-and-socket joints.

Of General Interest.

OIL-SHELL.—C. A. Glover, Bellport, N. Y. The shell is adapted to contain oil and to be fired from a cannon or mortar over a body of water to distribute oil thereupon at a point distant from the shore and is so constructed that during the major portion of its flight the outlet for the oil will be closed but automatically opened at or about the time the shell strikes the water, thereby permitting the oil to spread upon the rough element and quiet it.

POLE-SPLICING DEVICE.—F. N. Drane, Corsicana, Texas. The device is for use in splicing telegraph or other poles to timbers, concrete, or the like. Clamping means are provided by which the main pole may be firmly secured to a new butt, replacing the original butt that may have become rotted in the ground, thus obviating the expense of a new complete pole. Means are provided by which new poles too short but otherwise good may be spliced to useful lengths.

CALCULATOR.—K. H. J. Marckwordt, Guatemala, Guatemala. The invention pertains to calculators, such as shown and described in the application for Letters Patent of the United States formerly filed by Mr. Marckwordt. The object of the present invention is to provide a calculator designed for quickly and accurately carrying out a large number of arithmetical calculations, such as calculating wages, volumes, multiplication, degrees of alcohol, lumber measurements, degrees of sugar pulverization, and the like.

FOLDING SHAVING-BRUSH.—H. M. Rynehart, New York, N. Y. The purpose of the invention is to provide a construction of shaving-brush wherein while the handle remains attached to the body of the brush at all times the handle may be closed around the body of the brush when the brush is not in use to shorten the brush and protect the bristles.

HORSESHOE.—J. F. Robinson, Rockaway, N. J. One purpose here is to provide a construction of horseshoe of rubber having a metal skeleton core of horseshoe-shape, the ends of the core being connected by a bar member, so as to strengthen the shoe at its heel-section, the core being made of malleable or soft iron, so that after the rubber is cast upon the iron the shoe may be contracted or expanded to neatly fit the shape of the foot to which it is to be applied.

INSECT-TRAP.—Q. R. Jones, Yosemite, Ky. This invention pertains to improvements in devices adapted to attract and destroy insects—such as mosquitos, moths, and the like—the object being to provide a device of this character which will be simple in construction, and convenient for use in sleeping-rooms and the like. It can be readily cleaned.

Hardware.

HINGE.—S. N. Stevens, North Chelmsford, and E. P. Flanders, Lowell, Mass. The invention is particularly applicable to those used for the support of blinds or shutters. Its principal object is to provide a hinge embodying means for securing the blind at various angles. The improvement renders it difficult to raise or open the blind from outside.

Heating and Lighting.

AIR-HEATER.—E. T. Slaughter, Kansas City, Mo. The invention is an improvement in air-heaters in which cold or relatively cool air is passed over or through a drum or other form of casing heated by a gas or other burner, the air escaping in a heated condition into the room in which the heater is located or into a pipe leading therefrom to another room. Greater efficiency in the utilization of heat and economy of construction of the heater are obtained.

Machines and Mechanical Devices.

GAS-GENERATING RETORT. — T. L. Stewart, Oakland, Cal. The device is especially adapted for use in connection with gas-engines, heating, lighting, or other uses for which gas may be applied. When used to produce gas for use in gas-engines, the heat in the waste gases drawn off through the exhaust-pipe may be used to convert the gasoline, distillate, crude or other hydrocarbon oils into gas for such use and for any other purpose for which gas is desired.

BOAT-PROPELLING MECHANISM. — R. Rutherford, Montaville, Ore. An operator seated on the stern-sheets of a boat or, if desired, two operators, one seated on the stern-sheets and one on the after-thwart, may, through means of a transverse handle and its connections, rock the walking-beam, imparting a rotary movement to a crank-shaft and to a propelling-shaft, coupled thereto. In this manner the propeller may be rapidly driven.

SAWING-MACHINE.—B. E. Harreld, Eldon, Iowa. In this instance the invention is an improvement in machines in which the saw is reciprocated horizontally by cranks and means are provided for raising and lowering the saws to allow the insertion of a log or stick beneath them and to place them in working position thereon.

MACHINE FOR MAKING FENCE-POSTS.—R. L. Dennison, Kansas City, Mo. In the present patent the invention is an improvement in machines for making concrete articles, and is especially designed for the manufacture of fence-posts from shale and other plastic material. The interiors of the mold-boxes are conformed to the post produced, and taper from end to end.

Prime Movers and Their Accessories.

ROTARY ENGINE.—F. Nelson, Driscoll, N. Dak. The construction of this rotary engine comprises two cylinders communicating with each other, in which two rotators are mounted. These rotators are formed with teeth which intermesh so that the rotators rotate in opposite directions. Each rotator is formed with projecting piston heads at diametrically opposed points on its face, also midway between these heads with grooves adapted to receive the piston heads of its fellow rotator. Steam may be admitted either above or below the point of engagement of the rotators, thus governing their direction of rotation. Spring-pressed packing plates are provided between the ends of the cylinder and the rotators.

CURRENT-MOTOR.—J. W. Laurent, Spokane, Wash. The invention refers to improvements in motors operated by the water of flowing streams, the motor being especially adapted for elevating water for irrigating purposes, the object being to provide a current-motor that will be self-regulated to the rise and fall of the water and that may be operated by a comparatively light current.

Railways and Their Accessories.

RAIL-JOINT.—Anna E. Boman, Fargo, N. D. In the present patent the invention has reference to railways; and its object is to provide a rail-joint arranged to allow ready expansion and contraction of the adjacent rails and to prevent the undesirable clicking when the car-wheels pass over the joint. The joint is practically sufficiently flexible to accommodate the usual movement of the rails.

AUTOMATIC AIR-BRAKE FOR CARS.—W. J. Dankel, Pittsburg, Kan. The inventor improves upon that form of air-brake in which the piston-rod which actuates the brake-lever carries a piston, which plays between two air-chambers one on one side containing compressed air, which in expanding applies the brake, and the one on the other side of the piston being connected through a valve with the train-pipe, so th t when the pressure within the latter is reduced by the engineer, the pressure within the communicating air-chamber will be reduced and will allow the preponderating pressure in the chamber on the other side to expand and by advancing the piston apply the brakes.

Pertaining to Recreation.

MERRY-GO-ROUND. — G. B. McKinney, Barry, Ill. In this instance the object of the invention is the provision of a new and improved merry-go-round arranged to allow one or more of the passengers to readily propel the merry-go-round without requiring undue physical exertion on the part of the operators.

ARTIFICIAL BAIT.—L. P. Gibson, Little Rock, Ark. In the present invention the improvement has reference to fishing; and its object is to provide a new and improved artificial bait arranged to readily spin or revolve around the hook whenever the device is drawn through the water as in ordinary fly-casting.

Pertaining to Vehicles.

TRACTION DEVICE FOR VEHICLE-WHEELS. — H. S. Weaver, Butler, Pa. Though applicable to vehicle-wheels generally this invention has reference more especially to wheels for automobiles and the like, involving the use of cushioning or pneumatic tires; and one of the principal objects of the invention is to provide means for preventing slipping of the wheel when the vehicle or machine is being propelled over soft or muddy ground.

Designs.

DESIGN FOR A HAMMOCK-VALANCE.—D. W. Shoyer, New York, N. Y. This designer has produced a ruffle for a hammock, and on the cotton-corded material are woven a continuous line of dancing bears in grotesque habiliments. A fringe is added to the valance and it gives a graceful finish to the design.

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.**

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Inquiry No. 8557.—Wanted, to purchase live silk worm or other larvæ in cocoons, in small quantities.

Inquiry No. 8558.—Wanted, manufacturers of dishwashers for family use.

Inquiry No. 8559.—Wanted, makers of outfits for the distilling of water for drinking purposes, with capacity of about 50 gallons per hour.

Inquiry No. 8560.—Wanted, machinery for the manufacture of alcohol from molasses, sugar and apples.

Inquiry No. 8561.—Wanted, a machine for making emblems from pennies.

Inquiry No. 8562.—Wanted, names and addresses of auction grocery firms.

Inquiry No. 8563.—Wanted, a machine for cutting canvas.

Inquiry No. 8564.—Wanted, the name and address of the manufacturers of "The People's Typewriter."

Inquiry No. 8565.—Wanted, name and address of manufacturers os miniature lead castings representing animals, charms, shoes, etc.

Inquiry No. 8566.—Wanted, names and addresses of firms manufacturing cheap premiums for putting in prizes for popcorn, etc.

Inquiry No. 8567.—Wanted, the name and address of the manufacturer of the Commonsense Sash Pulley.

Inquiry No. 8568.—Wanted, manufacturers of meerschaum and French briar pipes fitted with amber stems.

Inquiry No. 8569.—Wanted, a machine for filling tin cans, holding about 10 ounces, 8 inches high, having screw cap over a nozzle about ¾ inch in diameter.

Inquiry No. 8570.—Wanted, an apparatus for stamping designs on leather, wood, plush, paper, etc.

Inquiry No. 8571.—Wanted, manufacturers of a feather renovator.

Inquiry No. 8572.—Wanted, parties engaged in operating plants for the reduction of old tin, such as cans, for the purpose of separating tin and solder.

Inquiry No. 8573.—Wanted, manufacturers of the following: The Magic Flute, The Humanotone, Peerless Sharpener and Can Opener, Moving Picture Top Phantasmagoria.

Inquiry No. 8574.—Wanted, the address of parties or firm making or prepared to make moulds for school crayons, soaps, etc.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(10357) A. M. asks: 1. I have made motor described in Supplement No. 641 and it runs perfectly as a motor, but will not generate any current when driven as a dynamo. It is series wound. Please let me know the remedy. A. Small motors very often are not wound so that they will excite their own fields and they cannot be used as dynamos, except by disconnecting the field and using a battery to excite the field. 2. Would there be any practical way to run it on 110-volt alternating lighting circuit? A. No.

(10358) H. M. W writes: We understand there is an easily prepared paper which may be used for the finding of the negative and positive poles of an electric wire. Will you kindly inform us how to make this paper and whether it will keep? We only wish for a small quantity. A. We give below two methods for this purpose, both of which are easy. First method: Dissolve sodium sulphate, a teaspoonful, in a half pint of water, in which also dissolve about the same quantity of potassium iodide and of starch. To dissolve the starch the water must be heated. Soak white blotting paper in this solution and dry it. Cut it into strips of any convenient size; a half inch by two inches is suitable. Keep the paper in a dry place such as a tin box or a glass bottle. To use, moisten a strip and place the two poles upon it, nearer together or farther part, according to the voltage of the current. A dark spot will appear at the *positive* pole. Second method: Dissolve 15 grains of phenol-phthalein in a half ounce of common alcohol. Dissolve also 20 grains of sodium sulphate in 4 ounces of water. Soak blotting paper in the first solution and drain off the superfluous liquid. Then soak it in the second solution and dry it. Afterward treat it in the same manner as in the first method. A red spot appears at the *negative* pole.

(10359) B. S. writes: Our church steeple of Hillcrest is about 160 feet high, is slate roofed or covered and the top consists of a sheet iron ornament some 12 or 15 feet; the church is of brick. The steeple has been struck and badly damaged by lightning within 3 years, although it stood for 20 odd years before it was first struck. It is thought by some that the large number of overhead telephone wires that go right by the church and the telephone station just across the street tend to attract lightning, which strikes the steeple first, it being a considerably higher point. Some contend that proper lightning rods would prevent damage, while others claim that lightning rods are incapable of carrying the great amount of electricity forming such a bolt of lightning. A. 1. We should not dare to have a building with an iron top disconnected with the earth metallically, as is this church spire. It is an invitation to a visit of the lightning. The lofty Washington Monument, in Washington, was struck and damaged till its metal tip was grounded by a lightning rod, since which it has been repeatedly struck, but without damage. Suitable lightning rods certainly are of service in protecting a building. We should suppose that the telephone wires were a partial protection to a neighborhood. 2. Is it a fact that no suction pump will pump or draw a greater height than 33½ feet before entering the pump, or in other words, before passing through the valves? If water can be raised a greater height by such a pump before it passes through the pump valves can you tell what distance it can be drawn and what causes the limit if there is any? A. A lifting, or as it is sometimes called, a suction pump, can raise water no more than 28 to 30 feet. Theoretically 34 feet is the limit to which the pressure of the atmosphere can push water up a tube with a vacuum above the water. No pump can exhaust the air above the water perfectly, hence no pump can get water 34 feet above the level of the water below. The pump lifts the air off the water in the pipe; the air outside the pipe pushes on the water in the well and pushes it up into the partial vacuum in the pipe below the valve of the pump. For this see any text-book of physics under pumps in pneumatics.

(10360) C. E. T. asks: 1. I am thinking of making a small direct-current dynamo, and would like to know the formula and meaning of the symbols for wrapping and determining the size of wire to be used in order to get a given voltage and current. A. Perhaps the simplest book for calculating the parts of a dynamo is given in "Practical Electricity," price $2 by mail. There is, however, no easy road to designing dynamos and motors. The best way for the amateur to go about the building of a dynamo is to select the size of machine he requires and buy plans for it all worked out. Many such designs have been published in the Scientific American and other periodicals and in books. We have frequent occasion to recommend such to our correspondents. They can be had very cheap. 2. I would also like to know the name of a good reliable varnish or lacquer for using on articles of steel or iron so they will stand a good deal of handling and to be kept in a damp place so as they will not rust. A. A good lacquer for rough ironwork is made with 6 parts asphaltum dissolved in turpentine, 1 part shellac dissolved in wood alcohol; mix and thin with turpentine or wood alcohol. For bright steel or iron, a shellac and mastic varnish is much used; 10 parts shellac, 1 part mastic dissolved in wood alcohol. Color with any of the aniline dyes. Blue is much in use.

(10361) G. P. M. asks: What are the true primary colors? A. Primary colors are the colors into which white light is separated by the dispersion of a prism. Those named by Newton are red, orange, yellow, green, blue, indigo, and violet. Artists reduce these to three—red, yellow, and blue. Scientists generally consider red, green, and blue to represent the primary color sensations, and in one theory there are supposed to be three sets of nerves in the retina which can respond to these three colors. The idea of three primary colors is that from the combination of these three all hues may be produced which are to be found in white light.

(10362) E. A. writes: Please give me an explanation of the following phenomenon: During a rainstorm a click or brief ring of the telephone bell is frequently audible. It is evidently due to the lightning being coincident with it. But how does the lightning produce the effect? Also, why may a spark often be seen shooting from five to twenty feet from the 'phone? Is it harmful? Please answer the following questions: What chemicals are used in the makeup of a Mesco dry battery cell? Please explain the chemical action. Is the cell affected by heat or cold? Are the chemicals injurious to the body if handled? A. The clicking of electrical apparatus during thunderstorms is due to the action of the lightning flashes upon the lines. When they are struck there will frequently be a flash from the wires, even though the lightning arresters do their work properly. The lightning produces the effect because it is an electric discharge, the same a he usual current, only much more intense. It is not entirely safe to handle electrical apparatus during a thunderstorm, when the wires are strung upon poles, though the lightning arresters usually protect the instruments. We have not the formula for the composition of the Mesco dry cell. It probably contains the same materials as the Leclanche cell, since all dry cells are modifications of this form of cell. These cells are very little affected by heat and cold, cannot be frozen by winter temperature even on mountain tops, and the chemicals are not poisonous. The general chemical action is that the ammonic chloride acts upon the zinc chloride. The hydrogen goes to the manganese dioxide and forms water with its oxygen. This is only general, since other substances may be used and other and more complicated reactions take place.

(10363) A. H. H. writes: A. C.'s land problem in Scientific American of December 22, Query 10271, can be solved by arithmetic in the following manner: 20 : 1.34 : : x : 10. 20 × 10 = 200. 200 ÷ 1.34 = 149.253 + rods = one side of field. And 149.253 + × 149.253 + = 22276.458 + square rods in field. Now 22276.458 + divided by 160 = 139.222 acres. Explanation: Assume a field 20 rods square. It would of course equal a field of 400 square rods. ¼ being plowed away, leaving 300 square rods, each side of which is 17.32 + rods. From center of this unplowed plat to its edge equals ½ of 17.32 + = 8.66 + rods. Now, 10 rods, half of this assumed field, — 8.66 + rods = 1.34 + rods, which is ¼ of assumed field plowed. Then by proportion: If by plowing 1.34 + rods from a field of 20 rods square, ¼ of the field is plowed; how many acres in a field if an outside strip 10 rods wide is ¼ of it? A. Although no letters are used in the solution above, the genius of it is algebraic as much as if all the quantities were represented by letters. Algebra is a branch of mathematics in which the relations of the quantities are assumed, and upon these assumed quantities, usually letters, the operations are performed till the proper values in numbers are discovered, or till the relations of the letters in the problem are determined in the simplest manner possible in the case. In this problem the number 20 is used as if it were a letter, and operations are performed upon 20 till its relation to the correct number appears. Thus it is seen that the solution is algebraic in essential character, although no letters are employed. Our algebraic solution was simpler than this so-called arithmetical solution.

(10364) G. H. H. asks: 1. Where lay the path of totality of the total eclipse of 1868 or 1869, which was visible, I think, in Iowa, etc.? Duration of eclipse? Width of path? A. We have not the path of the eclipse of 1868 or 1869 in Iowa at hand. You may be able to get it from the U. S. Naval Observatory, Washington, D. C. 2. How must I understand the magnitude of stars given in Standard Dictionary, where Sirius is given as 1.4 and Arcturus 0.3, when Sirius is said to be the brightest fixed star? A. The magnitudes of stars are now given in magnitudes and tenths, based upon the fact that a first-magnitude star is about 100 times as bright as one of the sixth magnitude. Each magnitude is therefore as many times as bright as the one next below it, as starting with 1 and multiplying by the same number will give 100 after five multiplications. This number is the fifth root of 100, or 2.512. Upon this basis an average first-magnitude star is of the brightness of Aldebaran and Altair. The Pole star is of the second magnitude. Stars brighter than the first-magnitude stars must be expressed by a number indicating that fact. Sirius is —1.4 magnitude. See Young's "Elements of Astronomy," which we send for $2.

(10365) C. B. asks: 1. Can stains on the finger nails caused by pyrogallic acid in a photographic developer be removed, and how? A. Cyanide of potassium will remove most stains produced by photographic chemicals. It should be used with extreme care. It is better to have the stain than to be poisoned. 2. Can you give me a developer for films which will not stain fingers and does not contain bromide of potassium? A. There is no developer which will not stain, and none in use at present which do not require bromide of potassium as a restrainer. 3. Can a 110-volt alternating current be transformed to a 10-volt direct current without using a rotary transformer, and how? A. It is necessary to use a rotary transformer to convert an alternating current into a direct current. 4. How much water should be added to c. p. sulphuric acid to make the so-called H_2SO_4 dilute? A. Dilute sulphuric acid is a somewhat indefinite term. When a concentrated acid shows 1.84 on the hydrometer, it will show 1.07 hydrometer if made a 10 per cent solution, and 1.14 hydrometer if made a 20 per cent solution. Both these percentages are used, and are called dilute acid.

(10366) S. A. W. asks: An article on standard time on page 124 of Todd's "New Astronomy" contains the following: "The whole country is divided into four sections or meridian belts, approximately 15 deg. of longitude in width, so that each varies from those adjacent to it by exactly an hour. The time in the whole 'Eastern' section is that of the 75th meridian from Greenwich, making it five hours slower than Greenwich time. This standard meridian coincides almost exactly with the local time of Utica and Philadelphia and extends to Buffalo." One would infer from the above that Buffalo or the 79th meridian was the western boundary of the eastern standard or 75th meridian time belt. If each section or belt is 15 deg. wide and the 75th meridian is at the center of the 'Eastern' section, I cannot see why the western boundary of this section should not be 7½ deg. west of the 75th meridian or ½ degree west of the 82d meridian, which would be at a line drawn from Port Huron, Mich., to Tampa, Fla., which is as far west of Buffalo as Buffalo is west of the 75th meridian. Will you kindly explain this through the columns of your paper? A. The statement quoted from Todd's "New Astronomy" is correct. The inference made from the statement is not correct. The places at which the change shall be made from the time of one section to that of the next westerly section depends largely upon the convenience of the railroads and not upon the longitude. The system of standard time in America was adopted for the benefit of the traveling public and the railroads, and not to satisfy any sentiments of astronomers as to scientific fitness of things. It was a practical and not a scientific arrangement. So the roads centering in Buffalo make the change from Eastern to Central Meridian time at Buffalo, since the roads of several companies end at Buffalo. The change is made at Pittsburg for the Pennsylvania system. A comparison of the maps of the roads giving the points at which the changes of time are made will show some strange departures from the longitudinal belt of 15 degrees in width. At one place in the Southwest Pacific time meets Central time so that the Mountain division is quite eliminated at that point.

(10367) C. M. T. asks: 1. What is air, and how it is generated? A. Air is a mixture of nitrogen 4 parts, oxygen 1 part, with traces of some other gases. To these are added minute quantities of carbon dioxide and other products of animal life as impurities. Water vapor is also always present in the atmosphere. 2. Did it exist from the very birth of the earth or some time after? A. The atmosphere has been on the earth from the first, although its composition has changed as the earth has cooled. Once all the water of the earth was in the atmosphere, and remained there till the temperature fell below the boiling point of water. The water then came down in great rains. 3. Is the air destructible? Can it be destroyed or burnt out by fire? If it is not destroyed, you mean to say that the air which we breathe to-day is the same that was on the earth millions of years ago? A. The nitrogen of the atmosphere cannot be destroyed by any ordinary means. It is a most inert substance chemically. The oxygen is readily passed into combination with carbon by combustion, and with many other substances by chemical combinations as oxides. The most familiar example of this perhaps is iron rusting in the air. Plants and animals all live from the oxygen of the air. The animal world takes oxygen from the air to breathe and gives it out as carbon dioxide, which the plant takes up and separates for its food, giving off the oxygen again into the air. Thus oxygen is continually passing out of the air and back again into the air. In a sense the air we breathe to-day is the same as animals breathed at the first. But since that time it has been subject to numberless chemical changes, and has been perhaps in liquid and solid forms many times.

(10368) V. P. H. and others: We are receiving many queries regarding cannon, guns, balls, etc., shot from moving trains in every variety of ways which ingenuity can devise and describe. A recent correspondent states seven different propositions, all different conceptions of one and the same thing. We have not time or space to take up this matter. We have heard it discussed for a long lifetime, and apparently it will not down. The answer to all these conundrums is in the Second of Newton's Laws of Motion: "A given force produces the same effect whether it acts upon a body at rest or in motion; whether it acts alone or together with other forces." This has been accepted universally for centuries, and is an established fact. To apply this law to the case in question it is only necessary to say that the discharge of the powder produces the same effect upon the ball under all circumstances. It is also necessary to say that the motion of the train produces the same effect upon the ball as if the powder had not been exploded. The ball is at any time just where the two motions will together carry it. Calculate this and you have the answer. We do not desire communications upon this subject. Let our esteemed correspondents find something new to write about.

(10369) J. E. B. writes: In your issue of December 22, 1906, question 10271, a farmer having plowed a strip ten rods wide around a square field finds he has finished one-fourth of the field. How many acres? You say that this is not an arithmetical problem, but requires algebra for its solution. Fifty years ago a country school teacher in Iowa used to tell us that *all* problems could be solved by arithmetic. Perhaps he was right. Solution No. 2. Divide a square by diagonals into four triangles. Divide one triangle into two right-angle triangles by a perpendicular from the center of the square. Assume that the base of one of these triangles is any length, four rods long. Then, as base and perpendicular are equal, the area is one-half of the square of the base, viz., eight square rods. One-fourth of this triangle having been plowed, the base and perpendicular of the remaining similar triangle would be the square root of twelve, viz., 3.464. This subtracted from 4 leaves 0.536, the width of the plowed strip. Then, by proportion, 0.536 : 4 : : 10 : 74.6. But the base of the triangle is one-half of the side of the square, viz., 149.2 rods, your answer by algebra. A. Your solution of the problem regarding the plowed field is quite correct. You assume a figure with a "base of any length, four rods long." Then from this you calculate the parts on the conditions of the original problem, and at last arrive at the proportion between your assumed figure and the figure given in the problem, from which the length of the side of the square field is found. Permit us to say that this process is not arithmetical, but algebraic. It is easier to use a letter to represent the side of the square and proceed with the calculation till the numerical value of the assumed letter is found than to do it as you did. To use only numbers does not make a process arithmetical. In an arithmetical process the numbers given in the problem are taken and the calculation is based upon those numbers and continued till the answer is found. In an algebraic solution the answer is assumed, usually as a letter, or else some quantity so related to the answer that the value of the answer can be computed from the assumed quantity, and the calculations are based upon the assumed number or quantity. This is what you did in solving the problem. Arithmetic has its place and uses. So has algebra. Many of the older arithmetics contained problems which were solved by assuming a quantity and working with it. This rendered the solution algebraic. It was by such processes that your old teacher justified his saying about solving all problems by arithmetic.

(10370) L. W. asks: In the year 1833, in the month of November (do not recall the day of the month; I would have been eight on 2d of March) I witnessed just at daybreak in the morning that great and notable event of the falling of the stars, or meteoric shower. It was a magnificent sight, and as vivid to my mental sight as at the time. It resembled and I thought it was large snowflakes, but disappeared as fast as they fell. Why I was out of my trundlebed at that time and looking out of the window, I do not recall. My parents or no one saw it but myself, as I was frightened and went back to bed. This was in Centreville, Allegany County, New York. From that time on I have never seen the like, neither any one who has. But I have talked with those who saw them at that time. Now they are said to be periodic, about the 14th of November. Now what I wish to know is, where are they perceived—in what localities? and why not universal? Are shooting stars classed as meteors? What is the cause of meteors? A. The meteoric shower which you so vividly remember occurs once in about 33¼ years, on the night of November 14. If it occurs when the sun is above the horizon of a place it is not seen at all. It occurs here in New York in the early morning hours. There were showers in 1833, 1866, 1898, and in 1901. None of these later showers were as brilliant as that of 1833. The earth crosses the orbit of the meteors each November 14, but the meteors are at the same place at the same time as the earth only once in 33¼ years.

(10371) W. B. C. says: Why is it that when water freezes bubbles are formed in the ice? I once left a tumbler of water outside on a cold night, and on finding it the next morning, I found the water frozen half way down the glass in a series of domes. Between the bottom of the ice and the unfrozen water was a bubble of air as big as a pea. I have always been curious to know how that air got there, as so far as I know the glass was absolutely undisturbed while the water was freezing. The solution of this problem would interest me very much. A. Bubbles of air appear in ice because the air was dissolved in the water before it was frozen. Upon freezing, the air separates from the water. Water in a natural condition always contains air, else it would be tasteless and fish could not live in it. If a glass of cold water is allowed to stand and grow warm, the air separates from the water in a similar manner and appears as bubbles on the sides of the glass.

(10372) S. M. D. asks: Is there any limit to the distance that a certain amount of electricity will travel over wire, that is, will a weak battery send electricity as far as a strong battery? A. There is a limit of distance to which a small amount of electric current can affect an instrument so that it can be perceived. This is at a less distance than a strong current can affect the same instrument. In this sense a weak current cannot travel as far as a strong one over a wire. A weak battery cannot produce the same effect through a mile of wire as a strong battery can; but if we had more delicate instruments we might still detect the weak current much farther than we can at present. It is not so much the defect of the current as of the instruments for observing it.

(10373) G. H. says: I would like to get or make a cold solution, say a few degrees above the freezing point, in small quantities. Could you advise me where I can obtain such a thing or what chemicals are needed to produce it? A. You may obtain a low temperature by the addition of hydrochloric acid to crystals of sodium sulphate. By using strong acid a fall of temperature to ten or more degrees below freezing can be had. Different proportions of acid and water will cause different temperatures. We have no tables giving the parts of each to be used, and you can determine by experiment the parts of each to be taken for the temperature you wish to obtain. Water alone poured upon the crystals will produce quite a fall of temperature.

NEW BOOKS, ETC.

Inorganic Qualitative Chemical Analysis. By William Stowell Leavenworth, M.Sc. Easton, Pa.: The Chemical Publishing Company, 1906. Pp. 153. Price, 1.50.

This book provides a manual holding an intermediate position between an elaborate treatise and a skeleton outline of the subject. The work is concise but clear throughout; it is hardly available for the elementary student, as a certain familiarity with general chemistry will be found necessary. The appendix contains a full and useful list of reagents, a list of suitable apparatus, and other convenient data, which will be found useful for supplementing the information contained in the body of the volume.

Business Organization. By Samuel E. Sparling, Ph.D. New York: The Macmillan Company, 1906. 12mo.; pp. 374. Price, $1.25 net.

This volume is an outgrowth of a course of lectures on Business Organization and Management, delivered at the University of Wisconsin in connection with the courses in Commerce. The growth of the literature of commercial activity indicates the increasing interest manifested in the systematic study of business institutions and corporations. But as there have been few books fully covering modern business from the viewpoint of organization, Dr. Sparling's contribution will fill a decided want in this connection. The book is well written and covers the subject thoroughly, notwithstanding that the plan of treatment was necessarily somewhat arbitrary.

Taschenbuch der Kriegsflotten. VIII. Jahrgang, 1907. By B. Weyer, Kapitänleutnant a.D. Munich: J. F. Lehmann's Verlag, 1907. 12mo.; pp. 403.

Capt. Weyer's Annual may be considered a very compact and accurate review of the state of naval affairs in all countries down to the first of December, 1906. Following the plan which has been adopted in previous issues, he has endeavored to present a photograph of every type of ship, together with longitudinal and plan views, in which the armor and gun positions are clearly indicated. Constant use of the previous volumes that have appeared justify us in assuring for this book a well-deserved success.

A Technological and Scientific Dictionary. Edited by G. F. Goodchild and C. F. Tweney. Philadelphia: J. B. Lippincott Company, 1906. Large 8vo.; pp. 875. Price, $6.

The title of this useful book explains fully its object. The definitions are concise, brief, but nevertheless of sufficient length to be of value in almost every case. Chemical formulas are freely given. Illustrations are provided, supplementing the explanations of certain of the terms defined. Various important subjects are discussed at great length.

Internal Energy. By John V. V. Booraem, M.E. New York: McGraw Publishing Company, 1906. 12mo.; pp. 144.

The author has undertaken a task in this book which at first glance would appear positively staggering. This is to suggest a simple working hypothesis whereby the amount of all chemical energy stored within a body may be estimated. The work is based upon familiar lines of experimental data, the idea originating from a mathematical study of the periodic curves of the atomic volumes and melting points. The hypothesis is based upon a mathematical method, and provides for expressing the relations of heat to mass through great ranges of temperature.

Le Canal de Suez. By Voisin Bey. In Seven Volumes. Paris: H. Dunod et E. Pinat, Editeurs, 1906.

Second Report of the Wellcome Research Laboratories at the Gordon Memorial College, Khartoum. By Andrew Balfour, M.D., B.Sc., F.R.C.P. Edin., D.P.H. Camb. Khartoum: Department of Education, Sudan Government, 1906. 4to.; pp. 255.

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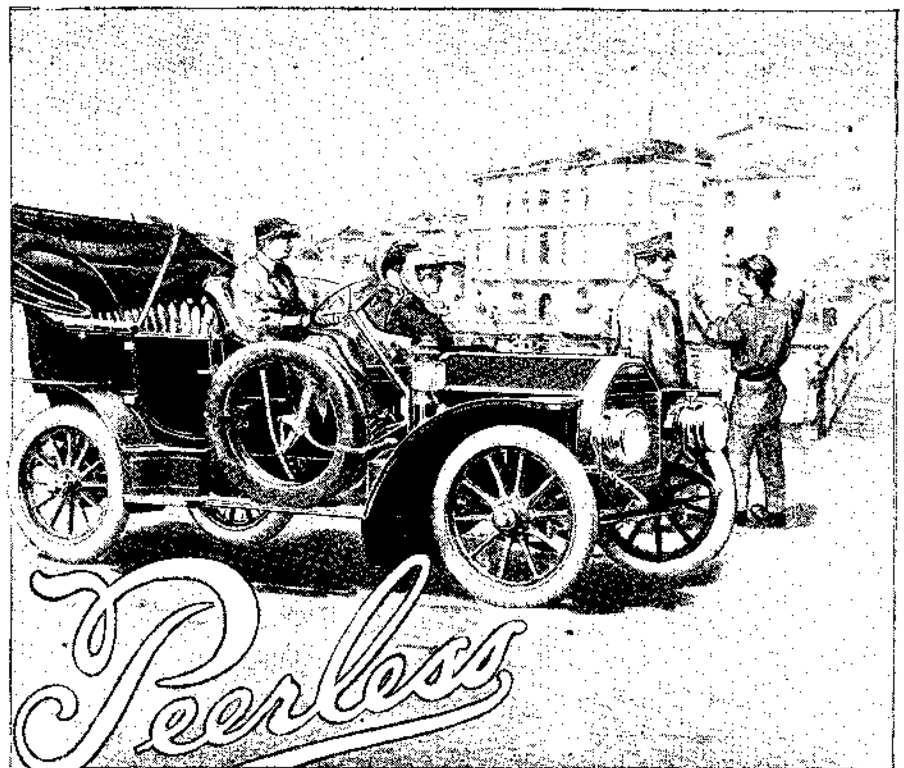

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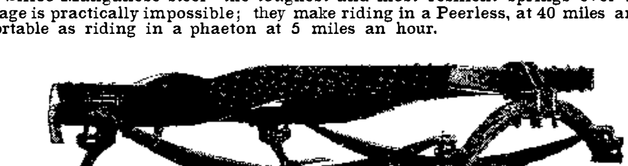

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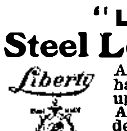

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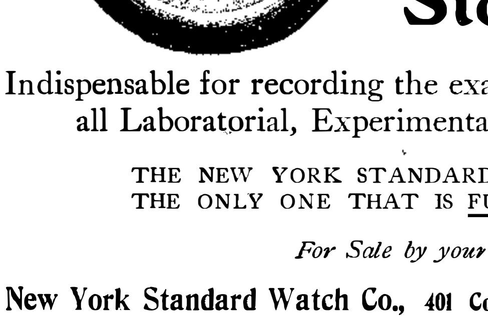

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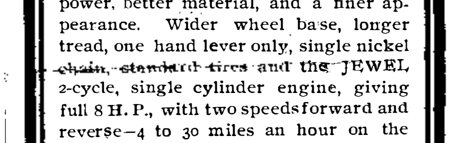

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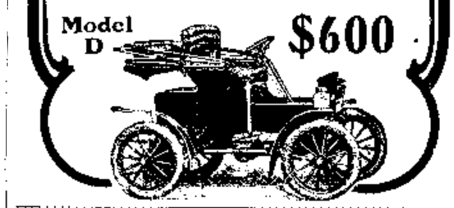

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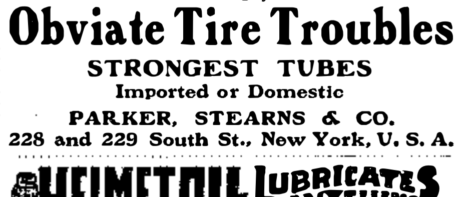

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