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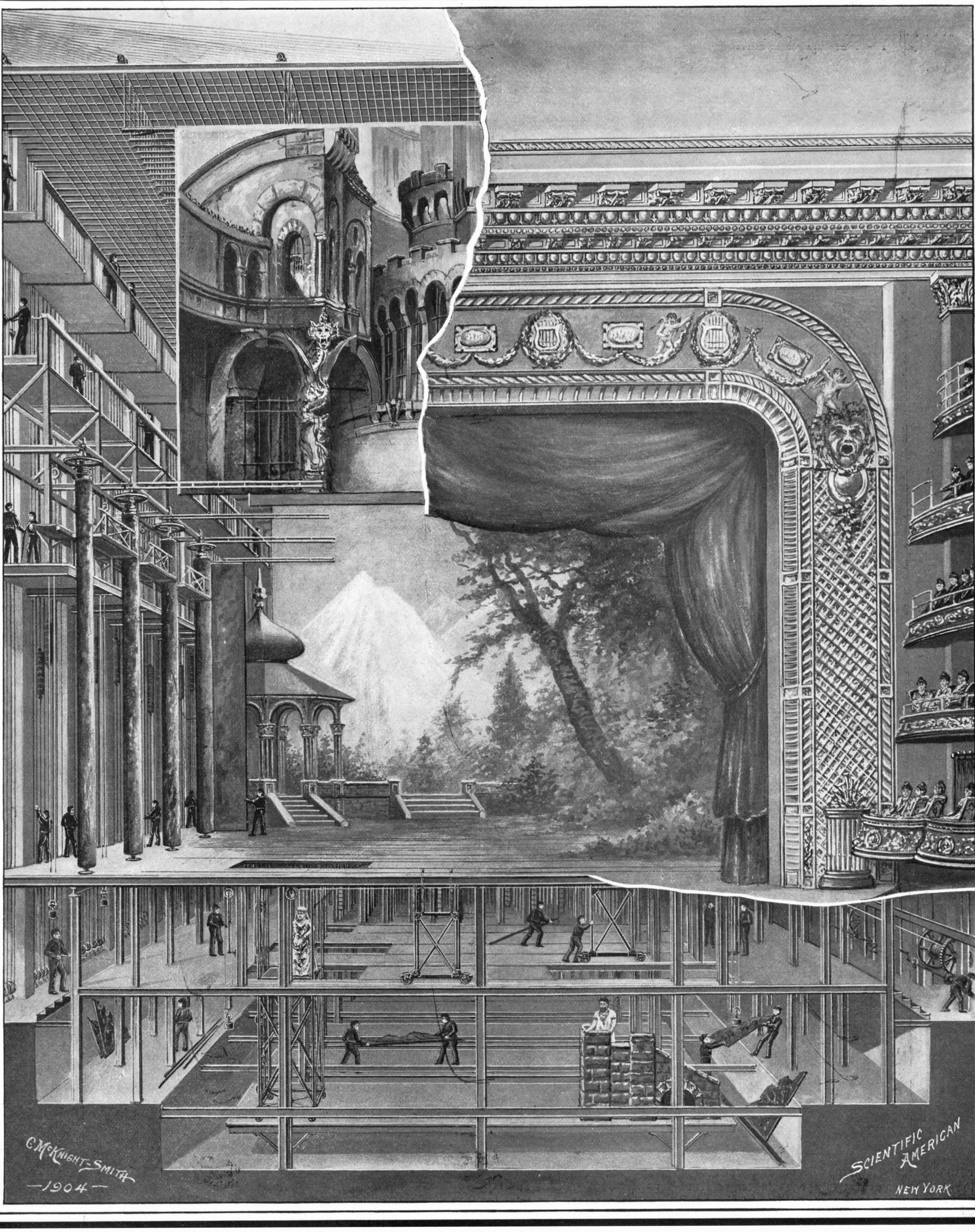

Working Drop Scenes. Moving Panoramas. Drop Scene, Klingsor's Tower is aloft. Movable Trap on Bridge. Section of Klingsor's Tower, lowered into the cellar by a movable bridge. Bridge Winches.

Set Scene, Klingsor's Magic Palace and Enchanted Garden.

THE NEW STAGE OF THE METROPOLITAN OPERA HOUSE, REBUILT FOR THE PRODUCTION OF "PARSIFAL."—[See page 117.]

The stage is divided into sections, the floor is removable and its place can be taken by "bridges," which can be raised to the level of the stage, carrying set scenery. The wing scenes are operated from the cellar.

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NEW YORK, SATURDAY, FEBRUARY 6, 1904.

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.

NEAR COMPLETION OF THE FIRST HUDSON RIVER TUNNEL.

During the past eighteen months the work of completing the first Hudson River tunnel has made such rapid progress that only about one hundred yards remains to be excavated, before the Manhattan heading is reached. Some time in March it is likely that the officials of the New York and Jersey Railway Company will be able to make the trip—on foot, of course—from Manhattan to New Jersey below the bed of the Hudson River. Now that the ledge of rock which was encountered a few months ago, not far from the Manhattan shore, has been cut through, the shield is being driven forward at a speed that is remarkable for this class of excavation, as much as 26 feet having been covered in the twenty-four hours. A little to the south of and parallel with the tunnel that is now nearing completion, is the second tunnel, the excavation of which commenced in November of last year. The new shield that is being used on this work will progress very much faster than did the old shield, and this for several reasons. In the first place, the diameter is considerably less, and therefore the number of cubic yards to be taken out in a given distance is reduced; secondly, the excavation is taking place entirely through silt, with no rock to hinder progress; and, thirdly, the shield itself is of more modern design, more convenient to handle, and is fully seventy per cent more powerful. Already it has been pushed forward more than 1,300 feet beneath the river, and it is likely the average estimated speed of 30 feet per day will be realized if no unforeseen contingency arises.

CORROSION OF ARCHITECTURAL STEEL.

Although the report of the Insurance Experiment Station in Boston on its recent tests of steel corrosion, under conditions approximating those of steel columns in modern buildings, confirms the results of previous tests of this character, the subject is of such supreme importance that we give herewith a brief digest of the facts. Of course, the value of such experiments depends upon the correctness of the assumption that a severe trial of a short duration gives us the data from which we can argue as to the results of a less severe test, extending over a far greater period. Each specimen of steel was cleaned and incased in Portland cement concrete of varying composition. After the concrete had set for twenty-four hours in air and seven days in water, the specimens were exposed to as severe tests as could be devised, and after various lengths of time the cement casings were broken, and the steel specimens were cleaned, weighed, and measured. The conclusion is reached that if structural steel is incased in a sound covering of good concrete, it is proof against corrosion for a period of years which is so long as to make the subject of more interest to our great-grandchildren's children than to us. In other words, steel, properly covered with concrete, may be expected to last until changes in the laying out of the city, or the substitution of yet more modern construction, necessitates the removal of the building. Obviously, the life of the costly office buildings, hotels, and warehouses that are being erected in such profusion, depends not so much upon the work of the steel-maker, as upon the particular "boss" who has to watch the mixing of the cement and its application to the skeleton steelwork.

EQUABLE TEMPERATURE IN THE SUBWAY.

To those who have a natural prejudice against subway or tunnel travel, there will be a decided compensation in the comparatively equable temperature that will prevail in the New York Subway. During one of the waves of extreme cold that visited the city this winter, the chief engineer had the temperature taken at stated intervals at the street level and in the tunnel below. It was found that on January 5, when the thermometer on the street near the City Hall was one degree above zero, in the Subway below it registered 41 degrees. On the day previous, at nine o'clock in the morning, when the street temperature was 7 degrees in City Hall Park, it was 40 degrees in the Subway below. Other tests showed that when outside temperature fell anywhere below 32 degrees, it averaged about 40 degrees in the tunnel. On the other hand, it has been found that the average temperature of the tunnel in the summer time is about 65 degrees. It is scarcely necessary to explain that the sudden changes of temperature which mark the climate of New York city have not sufficient time to affect the envelop of steel, concrete, and earth surrounding the tunnel, before there is a return to normal conditions. During the winter there must necessarily be a gradual fall of the average temperature in the tunnel; but cold air that is carried in through ventilating openings and at station entrances is compensated for by the radiation of heat from the warm mass of the ground through which the tunnel is cut. In the summer time, the heat that enters the tunnel is absorbed by the same medium; and the indications are that there will be an average difference of 20 degrees between the street and the tunnel temperatures throughout the year.

AN IMPERIAL FLOATING EXHIBITION.

A movement is on foot in Great Britain to institute a moving exhibition, which will at once remind American readers of our exhibition railroad cars, which are occasionally sent out for the purpose of introducing the natural resources of some particular State to the country at large. The scheme referred to is to dispatch a steamer loaded with specimen products of British industries on a tour of the world, the itinerary providing for a call at thirty-two colonial and foreign ports. It is expected that the exhibition will fulfill the double purpose of enabling buyers through the world to personally inspect the manufactured goods of Great Britain, and of bringing the representative of each exhibiting firm in contact with prospective customers and giving them an opportunity to learn in detail what are their peculiar requirements. The itinerary of the steamer includes the ports of Africa, India, Ceylon, Straits Settlements, China, Japan, Australasia, South America, West Indies, and Canada. It is estimated that the round-the-world trip will last about seven months. Although the idea of a floating exhibition on such an ambitious scale is novel, the broad principle is one that is already recognized in this country, and our merchants and commercial bodies will do well to keep in touch with the movement, and ascertain from the American Consul at each port how far it fulfills its purpose.

RELATIVE STRENGTH OF THE NAVAL POWERS.

The navies of the world are in a state of such progressive development, that it is difficult at any given time to state exactly what is their relative strength. In the case of two rival powers which have a number of battleships and armored cruisers under construction, it is quite possible that the balance of strength between the two depends entirely on the forwardness of the work on these new vessels. One nation may be building upon a methodical plan, which insures the delivery of so many vessels each year, while the other may be building in a desultory fashion; in the one case the new ships may be within a year of completion, in the other they may be two or three years behind time.

If we estimate the relative strength upon the basis of the total number of battleships, armored cruisers, and scouts—that is to say, all warships above 1,000 tons displacement—that are actually completed, we find that Great Britain comes first with a total of 201 ships completed, of 1,516,000 tons displacement; France second with 96 ships, of 576,000 tons displacement; Germany third with 73 ships, of 388,000 tons displacement; Russia fourth with 43 ships, of 315,000 tons displacement; United States fifth with 35 ships, of 295,000 tons displacement; Italy sixth with 38 ships, of 259,000 tons displacement; and Japan seventh with 31 ships, of 206,000 tons displacement. All of these navies, however, have a large building programme in hand; and taking them in their order, the names of the countries and the total tonnage of ships under construction are as follows: Great Britain, 351,000 tons; United States, 322,000 tons; France, 180,000 tons; Russia, 139,000 tons; Germany, 118,000 tons; Italy, 70,000 tons; and Japan, 10,000 tons.

Now it is evident that if these new ships could be completed at once, there would be a great change in the relative standing of the navies, for the United States has under construction a larger aggregate of tonnage than that of the whole of her completed navy as it stands to-day. The relative order of strength in such a case and the total tonnage displacement would be as follows: Great Britain, 1,867,000 tons; France, 756,000 tons; United States, 616,000 tons; Germany, 506,000 tons; Russia, 499,000 tons; Italy, 329,000 tons; Japan, 253,000 tons. It will thus be seen that the United States moves up from fifth to third position, with a long lead over Germany. It is interesting to note, by the way, the great preponderance of the strength of the English-speaking naval powers, Great Britain and the United States. In regard to the British navy, it is noteworthy that at her present rate of building she is greatly exceeding the mark of strength which she is popularly supposed to have set herself, namely, that her navy shall equal the combined strength of any two continental navies. As a matter of fact, were the present building programmes completed, her navy would equal in tonnage that of the three most powerful continental navies, France, Germany, and Russia, and would have 117,000 tons to the good at that; while a combination of the British and United States navies would give a total of 2,484,000 tons, which would be within 10,000 tons of equaling the total tonnage of all the other navies of note in the world, including that of Japan. On the side of the English-speaking combination, there would be the great advantages of a common tongue and great size and speed of individual ships, while a world naval combination would suffer from the enormous disadvantage of being heterogeneous in speech, race, and in the classification of its ships. We confess that while we had a general impression of the naval predominance of the English-speaking race, we were not prepared to find that the development of the navies of the two countries had so greatly outrun that of the rest of the world. To these considerations may be added the fact of the incalculable strategic advantage that the countries possess in a chain of coaling stations and dockyards scattered throughout the high seas, that would give them incomparable facilities of refuge, repair, and replenishment in the event of a world-wide conflict.

THE GRANTS OF THE CARNEGIE INSTITUTION.

The last annual meeting of the trustees of the Carnegie Institution was noteworthy for the fact that the sum of $200,000 was set apart for scientific research during the fiscal year of 1902-1903. The institution has been working silently since its inception, but none the less effectively. The grants which have been made may be considered as a most fitting recognition of scientific services rendered by the foremost living savants. Even he whose interest in science has made him familiar with the current work of many investigators, will doubtless find among the list of men who have thus been honored many whose names are unknown to him, but whose work is for all that worthy of encouragement.

It is impossible in this brief space to enumerate all the grants which have been made; for these, the reader must be referred to the last three numbers of the SCIENTIFIC AMERICAN SUPPLEMENT, in which all the awards are given, together with a brief abstract of the scientific work done by each investigator who has been honored.

We may be permitted, however, to call attention to a few scientists, the brilliancy of whose work has been bedimmed in the glamor of the more startling discoveries which have attracted the world's attention. Among the grants made to men who are not so well known to the world as they ought to be, may be mentioned that to Mr. Lewis Boss for investigations upon the motions of brighter stars, and of all stars of whatever magnitude supposed to have motions as great as ten seconds per century, and any other stars that were especially well determined prior to 1850. The sum of $5,000 awarded to him was not too much for so extensive an investigation. Prof. George E. Hale's grant of $4,000 was well spent on the photographic study of stellar parallaxes with a 40-inch telescope. When it is considered that 114 plates containing about 350 exposures have been obtained, some idea of the value of the work may be gleaned.

New tables of the moon are urgently required for the purposes of astronomy and navigation. For a long period the problem of constructing and perfecting such tables has been delayed by an unexplained discordance between the observed motion of the moon and the motion which should result from the action of all known bodies upon it. The exact cause of this discordance cannot be recorded, because the observations made from 1750 to 1850 have never been worked up and compared with the tables. By the aid of a grant from the Carnegie Institution, Prof. Simon Newcomb was enabled to take up this work with results that will be of benefit not only to science, but to commerce as well.

Among the larger grants, must be recorded that of $10,000 to Dr. Robert Fletcher, of the Army Medical Museum, for preparing and publishing the "Index Medicus." Established in 1879, under the direction of Dr. J. S. Billings and Dr. Robert Fletcher, the Index was discontinued in 1899 for lack of pecuniary support. The scope of the work is broad. It contains in classified form, month by month, reference to everything published throughout the world which relates to medicine or public hygiene.

It is particularly gratifying to note that Prof. H. N. Morse, of Johns Hopkins University, has been awarded

$1,500 for researches on osmotic pressure. Although osmotic pressure has been recognized for twenty-five years as one of the great forces of nature, no direct measurements have been made to furnish an adequate experimental basis for the laws supposed to govern it. Prof. Morse has been engaged for several years in attempting to overcome the difficulties which lie in the way of quantitative measurement of osmotic pressure.

Not the least important of the chemical investigations carried out under the auspices of the Carnegie Institution was the determination of values of atomic weights by Prof. Theodore W. Richards, of Harvard University. Prof. Richards has submitted a memoir, about to be published by the Carnegie Institution, containing the records of his experiments on a new method of determining compressibility. By means of this method, the compressibility of bromine, iodine, chloroform, bromoform, and other substances has been determined over a range of 700 atmospheres.

One of the most important investigations which has been carried on through the munificence of the Institution is that of Prof. Durand, of Cornell University, on ship resistance and propulsion. Very gratifying progress has been made in the preliminary measurements, speeds having been determined from distance and time records in 444 cases, and thrust turning momentum determined by integration in 655 cases.

Lastly we must mention an award of $500 to Prof. Atwater, of Wesleyan University, for researches involving the direct determination of the amount of oxygen consumed by man for sustaining the bodily functions. Readers of this journal are doubtless familiar with the elaborate series of experiments conducted by Prof. Atwater with his respiration calorimeter, experiments which have cleared away many a doubt as to the relative nutritive values of various foods. The grant to Prof. Atwater has been expended chiefly for designing and constructing or purchasing apparatus for developing methods of determining oxygen and for tests and experiments made with the apparatus. An award of $6,000 to Dr. Gamgee was made for work in the same field, in order to prepare a report on the physiology of nutrition, which was the task assigned to him. He began by inspecting European laboratories and by visiting scientific men in Europe. It goes without saying that the work of Prof. Atwater formed not the least important subject of his studies.

CARROLL DAVIDSON WRIGHT.

BY MARCUS BENJAMIN, PH.D.

The time-honored custom of alternating the selection of a representative from the sections devoted to the physical sciences with one from the sections devoted to the natural sciences, for the presidency of the American Association for the Advancement of Science, failed to prevail at the Washington meeting held last winter, when a conspicuous departure from that practice was made by the election of a distinguished representative of the section on Social and Economic Science, whose eminence was sufficient to carry him without opposition into the highest office to which an American scientist can be chosen.

Carroll D. Wright is of worthy New England ancestry, being descended on the paternal side from early English colonists, and on his mother's side from the Davidsons, who were of Scotch blood. He was born in Dunbarton, N. H., on July 28, 1840, and received an academic education. His natural inclination would have led him to college, but he early began to teach, and with such success that he soon became the assistant principal of the Mount Cæsar Seminary, in Swanzey, where he also began the study of law.

The coming of the civil war was a serious event to the young men of New England, and Wright was quick to offer his services to his country, enlisting as a private in the Fourteenth New Hampshire Volunteers, of which in 1864 he became the commanding officer.

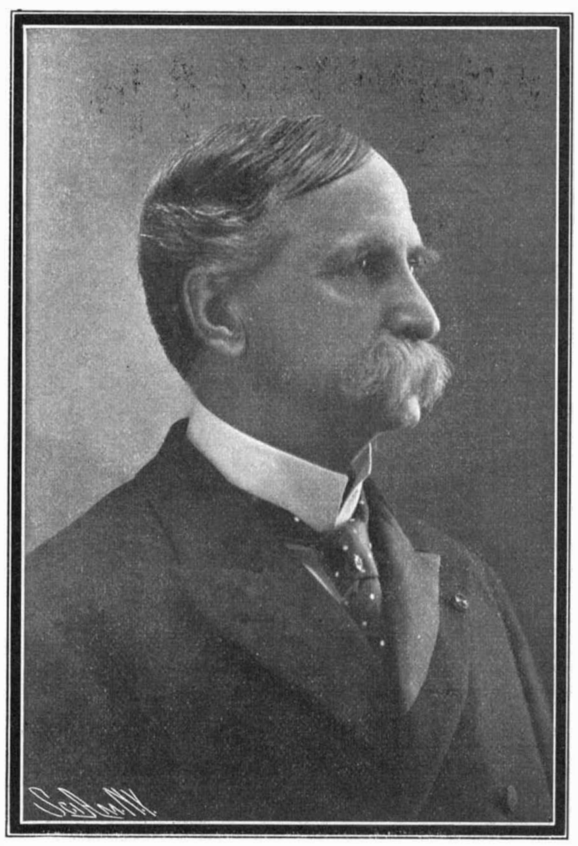
At the close of the war he returned to his chosen profession, and in 1865 he was admitted to the bar of Keene, N. H. He selected patent law as his specialty, and settled in Massachusetts. For ten years he devoted himself to the practice of his profession, in which he was thoroughly successful. Meanwhile, Col. Wright's marked influence over men was made conspicuous in his new home by his election, in 1871, to the Massachusetts Senate, in which body he served for three years, rendering valuable services, and especially as chairman of the Committee on Military Affairs.

His ability was so evident that it commended itself to the governor of Massachusetts, who in June, 1873, at the close of his senatorial career, appointed him chief of the Massachusetts Bureau of Statistics of Labor, which office he then held until 1888, also during that period taking the decennial census of Massachusetts in 1875 and again in 1885. In addition, he was supervisor of the United States census for the State of Massachusetts in 1880, and subsequently a special agent of that work to investigate and report on the factory system.

In January, 1885, he was called by President Arthur to the higher office of National Commissioner of Labor in Washington, which place he still holds, although he will soon retire to actively fill the presidency of Clark University, in Worcester, Mass., to which he was elected in 1902. In addition to the regular duties of his office, President Cleveland intrusted the completion of the eleventh census to him in 1893, in charge of which work he remained until 1897.

No event in recent years in the history of the United States is comparable in importance with the agreement made during the autumn of 1902, on the part of the coal miners of Pennsylvania on one hand and the operators on the other, to submit their differences to arbitration, and with this agreement Col. Wright had much to do. It may be well, however, to emphasize the fact that the many years of experience in treating similar matters in his annual reports had given Col. Wright a wide range of knowledge, and also it must be remembered that in 1894 he had had much practical experience, for he served as chief of a commission that was appointed to investigate the strike in Chicago during that year. It was therefore most natural, when the great strike in the coal regions of Pennsylvania began to be felt by the public, and the necessity of bringing it to an immediate end was apparent, that President Roosevelt at once turned to Col. Wright as the best and most competent intermediary. During the preliminary arrangements, Col. Wright was in constant consultation with the President, and on the creation of the Anthracite Strike Commission he became its recorder. He more than anyone else guided the deliberations which so happily caused the termination of that terrible strike.

Col. Wright's knowledge of social economics has



CARROLL DAVIDSON WRIGHT.

been taken advantage of by educational institutions, especially in Washington, for he has served as honorary professor in the Catholic University of America since 1895, and he has also held the chair of statistics and social economics in the school of comparative jurisprudence and diplomacy of Columbian University since its foundation. Harvard, Johns Hopkins, Michigan, Northwestern, Brown, and Dartmouth, have invited him at different times to deliver courses of lectures before their students. In other ways he has also been active, and conspicuous among these is his selection by Mr. Carnegie to serve as a trustee of the richly endowed Carnegie Institution in Washington.

His contributions to science have been large, and include more than fifty annual reports, together with many pamphlets and monographs on social and economic topics. His larger works are "The Factory System of the United States," "Relation of Political Economy to the Labor Question," "History of Wages and Prices in Massachusetts, 1752-1883," "The Industrial Evolution of the United States," and "Outline of Practical Sociology."

Dartmouth has conferred upon him the degree of Ph.D., and Wesleyan, Clark, and Tufts that of LL.D. He is one of the very few corresponding members of the Institute of France in this country, an honorary member of the Imperial Academy of Science of Russia, a member of the International Statistical Institute and of the International Institute of Sociology, and an honorary member of the Royal Statistical Society of Great Britain. At home he succeeded Gen. Francis A. Walker as president of the American Statistical Society, and he is a leading member of the American Social Science Association, a councilor of the American Economic Association, and a member of the American Academy of Political and Social Science.

He joined the American Association for the Advancement of Science at its second Washington meeting in 1891, and in 1894 was made a fellow. Col. Wright continued to take an active interest in the section on Social and Economic Science, of which he became chairman in 1902, as well as vice-president of the association. He presented at the Washington meeting a retiring address on "The Psychology of the Labor Question," and he will preside at the meeting to be held this week in St. Louis.

In the years to come it is his hope that he may be permitted to live in Worcester, Mass., a well-known educational center, and there, as president of the university to which he has been called, pass the remaining years of his life in giving from the rich stores of his accumulated knowledge and experience to those who shall have the honor of listening to the wisdom from his lips. Fortunate, indeed, will be those who shall have that privilege.

PREVENTING FROST ON SHOW WINDOWS IN WINTER.

During winter weather many shopkeepers experience more or less difficulty in keeping their show windows free from the ice that in low temperature tends to defeat the object of the display. No doubt all of the devices for keeping glass clear of ice, published from time to time in the journals, have received a fair test, with varying satisfaction. A writer in one of the foreign drug journals, apparently a druggist who has experienced the rigors of high latitudes, insists that none of the ordinary schemes are of much use, and that the only certain remedy for the opaque deposit of solid water is a double layer of glass with a sufficient airspace between. He states that applications of glycerine, alcohol, and other solutions are of no avail in extreme weather and that, in any case, they must be so frequently renewed that they become extremely troublesome. In the northern portions of Russia, where zero weather is sufficiently common, experience has taught the owners of show windows that the only effective protection is a three-inch air space between two panes of glass. The outer sash is rendered as nearly tight as possible by calking the chinks and pasting strips of paper over the crevices. The glass is then carefully cleaned and dried on a clear, mild day, and a second sash, fitted with the same care to prevent all circulation of air, is inserted about 3 inches within the first. The double panes are said to obstruct the view very little. The physical cause of the deposit of moisture and ice upon windows is the difference in temperature between the surface of the glass and the air bearing a relatively high proportion of moisture, which comes in contact with it. As long as the glass is as warm as the circulating air, there will be no deposit, nor when its temperature is higher than the dew-point of the moist air. Warm air is able to carry a much larger proportion of water than cold air, and the problem therefore resolves itself into a question of keeping the glass warm or the air dry.

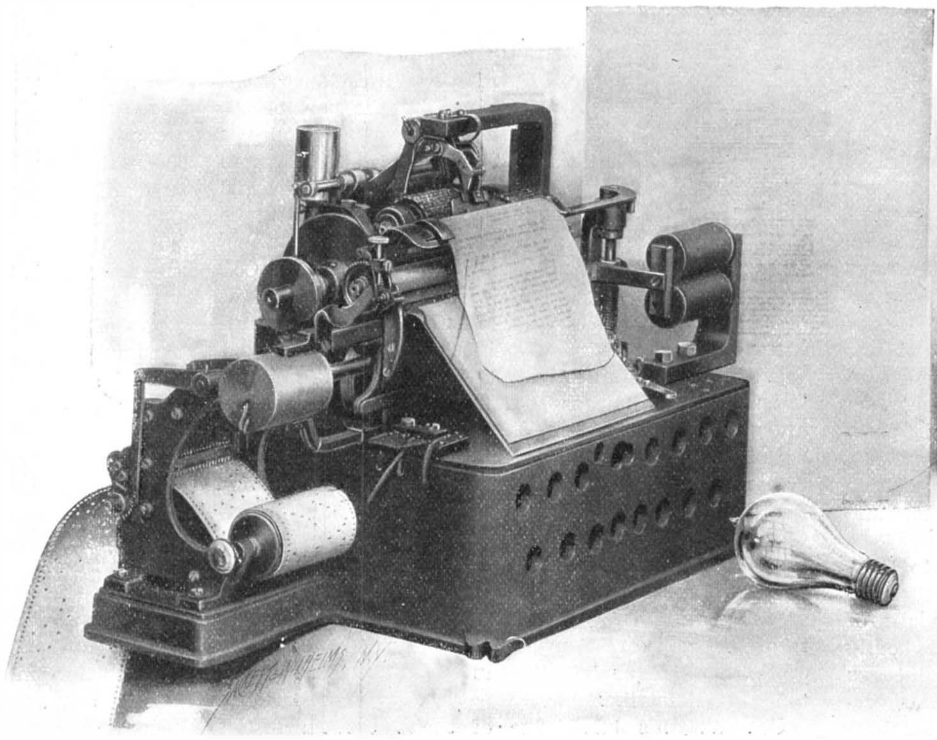
A small electric fan in the window two or three feet away seems to answer this purpose well. Probably the moisture is all dried off, hence leaving nothing to freeze; anyway, the glass is perfectly dry and clear.

DISPERSION OF FOGS BY ELECTRICITY.

Sir Oliver Lodge has tried at Liverpool to disperse fogs, using for this purpose a Wimshurst influence machine which discharged by means of a bundle of points into the air. A very high potential is necessary, and to increase the surface a large gas flame was used to supplement the points. On one occasion the discharge of electricity from the flame was sufficient to keep a clear space of fifty or sixty yards radius in a dense fog. Although these experiments were promising, the Wimhurst machine did not seem suitable for everyday use, and there was no other generator which would give a sufficiently high direct voltage to do the work. To overcome this difficulty, Sir Oliver now uses the rectifying properties of the Cooper Hewitt mercury vapor lamp . . . This arrangement gave him unidirectional sparks two or three inches long, and was very effective in laboratory experiments. To dispel the fog in a circle of fifty or sixty yards' radius is a noteworthy performance, but the general application of this method seems to be rather far off. The cleared area will have to be extended much more than sixty yards from the discharge station before the system can be of use in harbors or at sea, thus necessitating the use of very high voltages, such as are at present impracticable. There are, however, waterways—such as the Manchester Canal or the Chicago River, in which the channel is narrow and the traffic very great—where a system of dispelling fogs only slightly better than this would be very useful. It is to be hoped that Sir Oliver will carry on his work and will be able to report much more successful experiments before long.

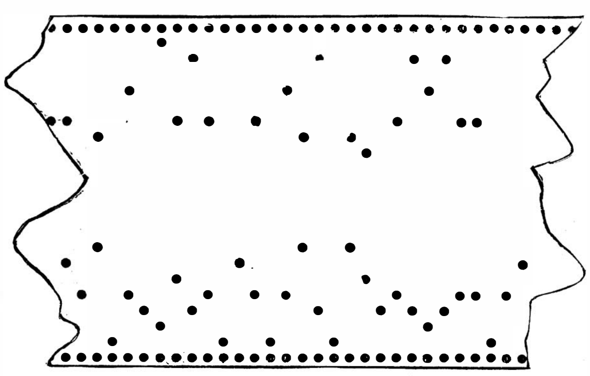
AN INGENIOUS MACHINE WHICH GREATLY SIMPLIFIES THE PROCESS OF PRINTING.

The discovery a few years ago that aluminium was a good substitute for lithographic stone furnished a great impetus to the art of lithography. The flexibility of the metal plate permitted it to be used on rotary presses, whereas the stone could only be used on the flat press. Not only pictures, but reading matter was impressed on the plates, so that books and newspapers were printed by the lithographic process. Briefly described, the process consists of printing the matter with greasy ink on a prepared sheet. This is then pressed down on the aluminium plates, transferring the design thereon. A solution of acidulated gum arabic is flowed over the aluminium plate, and is absorbed by the bare portions while the acid combines with the grease of the design to produce a fatty aluminium salt which has a great attraction for ink. In the press the plate is first moistened, by means of a roller, with water which adheres to the gum surface, but is repelled by the greasy design, while the ink roller which follows inks only the greasy design, because the moistened portions repel the ink. The impressions taken from the plate correspond perfectly to the original design.



MACHINE WHICH PRINTS THE CHARACTERS ON THE TRANSFER PAPER.

A few years ago it occurred to Mr. Walter S. Timmis, a Brooklyn inventor, that the process could be much simplified by providing a small mechanism, something like a typewriter, to print the original transfer sheet, and such a machine he set about to design. At the very outset of the undertaking he was met with the problem which has baffled many another inventor in the typesetting field, namely, that of justification, or spacing the words to exactly fill out the line. But Mr. Timmis bravely attacked the difficulty and succeeded in overcoming it by means of a wonderfully ingenious mechanism. With the justification problem solved, the remainder of the task was comparatively easy, and the result of these labors is shown in the accompanying illustrations.



THE PERFORATED TAPE.

The "Lithotype," as the invention is called, comprises two separate machines, one which perforates a strip of paper, and the other which prints the transfer sheet under control of the perforated tape. The first machine is provided with a keyboard of a hundred keys. On depressing a key two electrical contacts are made which close the circuits of two of the electromagnets in the perforator mechanism shown at the right. The two magnets thus actuated attract their respective armatures which operate corresponding punches to perforate the paper. The perforator mechanism comprises twenty electromagnets which may be operated in a hundred different combinations to correspond with the keys of the keyboard. After each combination is perforated the paper strip is moved forward a unit's distance, presenting a fresh surface to the next combination. The justification mechanism is shown, in our illustration, between the perforator and keyboard. Normally this is set to allow for a nine-units space between each word—a space equivalent to one and a half ems and obviously much greater than would ordinarily be required. In other words, a certain portion of the length of the line is reserved for spacing. This reserved portion varies, of course, with the number of words in the line, being equal to nine units times the number of spaces required. As the perforation of the strip continues, in time a point will be reached where the aggregate length of the words in the line exceeds this variable spacing reserve, and thereupon the selector arm begins to move. The selector arm, which may be seen in the illustration, moves over two series of contacts, one representing units of space, and the other tenths of units. When the reserve begins to be encroached upon, a calculating device determines the width of each encroaching character struck and deducts this from the normal reserve. At the same time the selector arm is automatically swung about until it lies over the contact representing the quotient of the remaining reserve divided by the number of spaces required in the line. As soon as the selector arm begins to move, the operator adds to his line sufficient characters to complete his syllable or word, and then touches the line key, which produces a line-closing perforation in the paper strip. As the last character in the line is struck, the selector arm is moved over the contacts representing the amount of space which must be used between each word to completely fill out the line, and when the line key is struck a switch is closed connecting the justifier contacts with the electric circuit and the selector arm is pressed against these contacts, which cause a corresponding combination of perforations to be punched in the paper strip.

After the desired matter has been recorded upon the tape, the latter is passed through the second machine. In this machine two series of contact fingers bear against opposite faces of tape, and the fingers make contact with each other through the perforations as the tape travels between them. The tape is passed backward through this machine; that is, the end of the line is first to pass between the contact fingers. Consequently, the first contact made is that of the justifier.

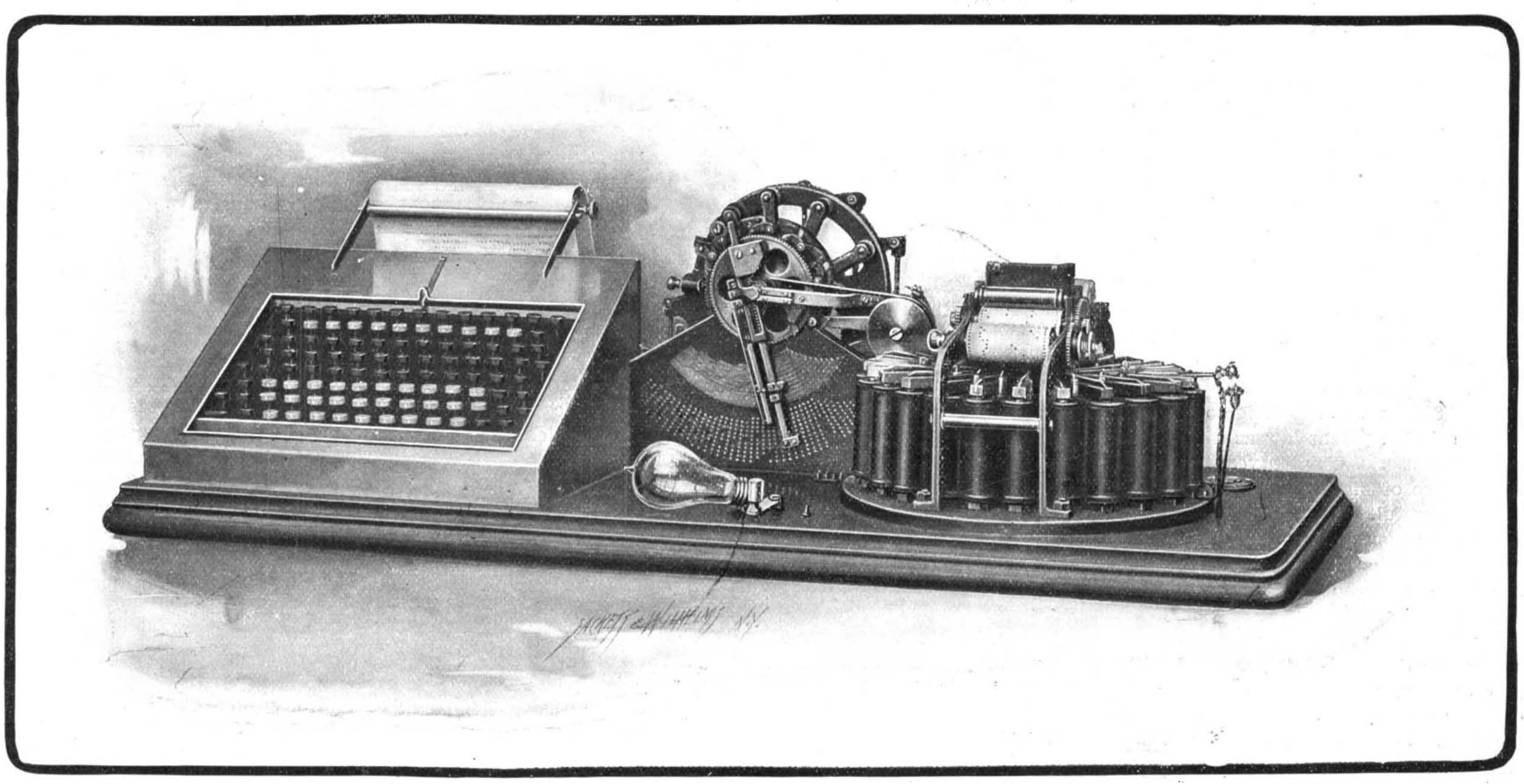
In a new machine which is being perfected, the tape passes directly from the perforator through the type-printer without being passed backward. Patents on this machine, however, are still pending, and we are not at liberty to describe the mechanism at this time.

> The process of printing from a flat surface is vastly interesting, but probably familiar to not more than one person in a thousand. It is done on the simple principle that oil or grease and water won't mix. The design to be printed from lithographic stone or aluminum plate is defined in ink the basis of which is grease. Over the rest of the plate a roll, moist with water is passed, and when the surface of the plate comes in contact with the paper nothing prints except that portion previously marked out in grease. The process, hitherto confined exclusively to lithograph work, may now by the use of the aluminum plate be made available for use on fast web-perfecting presses such as are used now by modern newspapers.

A FACSIMILE OF PRINTING DONE BY THE MACHINE.

The justifier contacts close the electric circuit to the justifying mechanism, setting the latter to give the proper spaces in the line. The characters are printed on a transfer sheet of paper, by means of a type sleeve, which is given two movements, one a rotary movement, and the other a horizontal axial movement. When a character contact is made, the type sleeve starting from normal is operated by two springs, one tending to move the sleeve through a semi-rotation,

(Continued on page 118.)

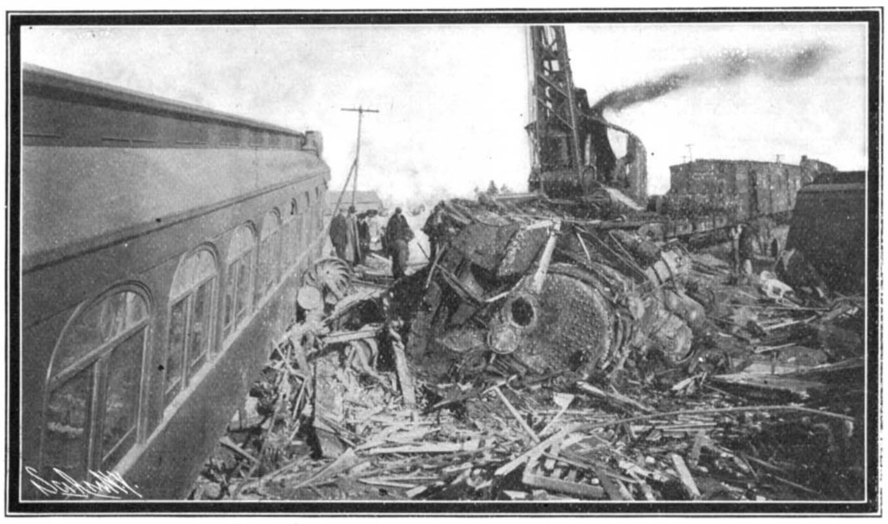


MACHINE WHICH PERFORATES THE TAPE AND CALCULATES THE SPACES REQUIRED TO JUSTIFY THE LINES.

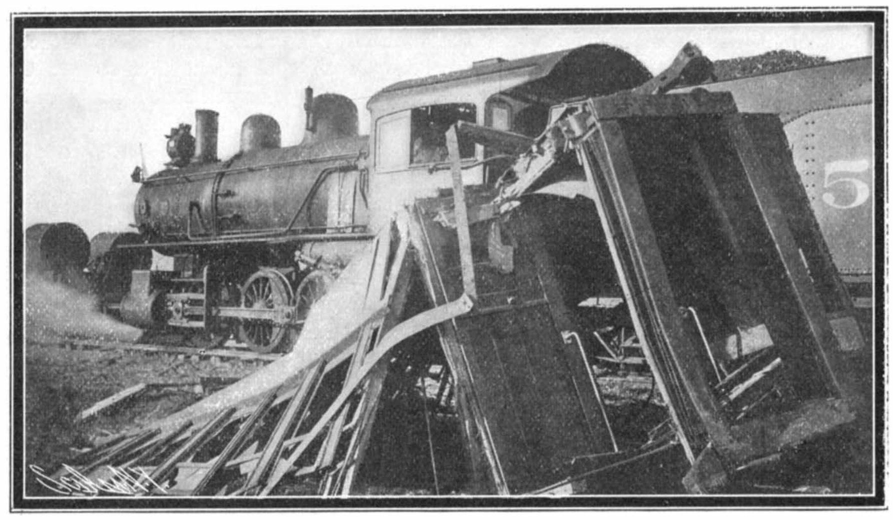
PULLMAN CARS IN RAILROAD ACCIDENTS.

It is during the Christmas season, and for a few weeks before and after, that experience has taught us to look for a great increase in the number of railroad accidents. We thought that last year was a painful record; but it has been exceeded by the list of horrifying disasters that have marked the past two months. We present illustrations of a wreck that occurred recently on the Frisco system at Godfrey, a small station near Fort Scott, Kansas. The collision took place early in the morning of December 21, 1903. It seems that the brakeman on a freight train which was standing on a siding at Godfrey had been sent out to flag the "Meteor," a fast passenger train, which was due at the time. The express thundered up to the little station at a speed of about 60 miles an hour, and seeing all clear, the engineer carried his train through with the throttle well open. The brakeman either failed to do his duty, or his signal was not seen, and the express crashed into the freight, with the result that twelve persons were killed and a larger number were seriously injured. The wreck of the train was almost complete. The engine was stripped of everything that could be torn away, cab, fittings, smokestack, etc. The tender was completely wrecked, as were the mail car, the baggage car, and the smoker. It is significant, as will be noticed from one of our engravings, that although the first-class coaches and the baggage and smoker were so badly wrecked, the Pullman showed its usual resisting qualities, to which we referred a few weeks ago in this journal. It will be seen that the particular car shown in our illustration has all of its windows intact but one, which is slightly broken.

A correspondent, Mr. D. N. Byerlee, of Hood River, Oregon, has this to say on the subject of the safety of Pullman cars: "If you will but consider that the mail, baggage, and day coaches act as a sort of cushion between the Pullmans and the engine, you will realize the saving to the Pullmans and the greater than ordinary damage that will result to the day coaches and their passengers. This is really the fact. Keep the Pullman cars off the trains and the loss of life will be reduced to a minimum. But if, as your note would indicate, you would build the entire train as the Pullmans are, you will not have overcome the difficulty. With no light cars to crush and deaden the impact the shock would be so great, coming to a dead stop from a speed of say 60 miles an hour, that almost every passenger would be killed. I do not believe the remedy is so much in the strength of the cars as in the manner of operating the road. If all the cars were built like the Pullmans it would equalize the death rate, and perhaps lower it somewhat. But when we have a perfect block system and our government enacts such stringent legislation as holds in Mexico and enforces it as rigidly as they do in Canada, we shall hear of very few casualties indeed. Twenty-one years' experience and observation in railway service confirms me in the belief that 90 per cent of the casualties are due to carelessness and recklessness, and this certainly is criminal." We fully agree with our correspondent that the position of the Pullmans at the rear of the train conduces largely to the immunity of Pullman passengers from death or serious injury; but it by no means follows that were the case reversed, and the Pullmans placed in the middle or at the front end of the train, they would telescope and crumple up with the same fatal effects that occur in first-class day coaches. As a matter of fact, the Pullmans, by their position at the rear of the train, are occasionally called upon to take the full brunt of a rear-end collision. Recently one of the leading engineers on the Rapid Transit subway in New York described to the editor an instance of this very form of accident. He was in a day coach in the middle of a train, at the rear end of which was the private car of a well-known manufacturer of air-brake apparatus, which while stopped by signal outside the Harrisburg station, was run into by a heavy Chicago and New York express. The private car received the full shock of the collision and proved strong enough to transmit it to the train ahead, pushing the cars together and causing the two day coaches ahead of it to telescope, with a result of 50 per cent fatalities or injuries to the occupants of the two cars. No one was killed, or even seriously injured, in the private car. This was a case where the Pullman, after mitigating the shock by the amount of its own inertia, was strong enough to transmit what was left of it to the train ahead without suffering serious injury itself. The point made by our correspondent that, if all cars were built as strongly as the Pullman, the passengers would be killed by the shock of suddenly arrested motion, is, we think, very much open to question. They would be badly bruised, and limbs would be broken perhaps; but there would be none of the grinding, crushing, and tearing of limb from limb that marks the telescoping of two cars.



The Wrecked Engine and One of the Pullmans of the Express; the Latter is Practically Uninjured.



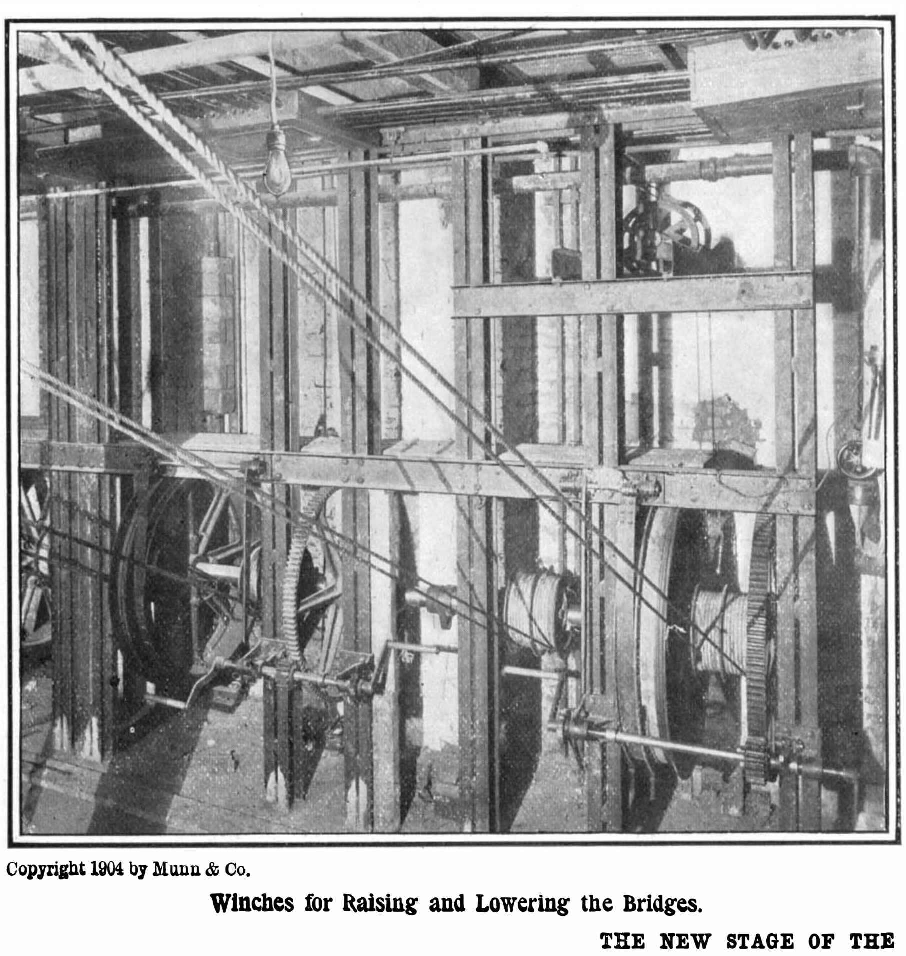
Vestibule and Portion of Side of Day Coach.

RESULT OF A COLLISION AT SIXTY MILES AN HOUR.

At the same time our correspondent unquestionably hits the nail upon the head when he attributes the loss of life not so much to the weakness of the cars as to the careless manner in which our roads are operated. As long as trainmen consider that rules relating to the running of trains are elastic and subject to modification at the will of the individual employe, they will continue to slaughter people in the brutal manner that has characterized the past few weeks. In the older countries the railroad cars, compared with our day coaches, are mere eggshells in strength, and yet we know that during the last year of operation on the roads of one European country, not a single passenger was killed. Judging, however, from the slow progress that we are making, it will be many years before our trainmen have learned to render our block system effective by implicitly obeying them; and until that time has come, we certainly think that it would be advisable to build our cars so that not even combined stupidity, carelessness, and willful neglect of signals can wreck them.

THE NEW STAGE OF THE METROPOLITAN OPERA HOUSE.

"Bayreuth," "Parsifal"—what splendid names to conjure with! Now, thanks to the new stage of the Metropolitan Opera House, we have our own Bayreuth



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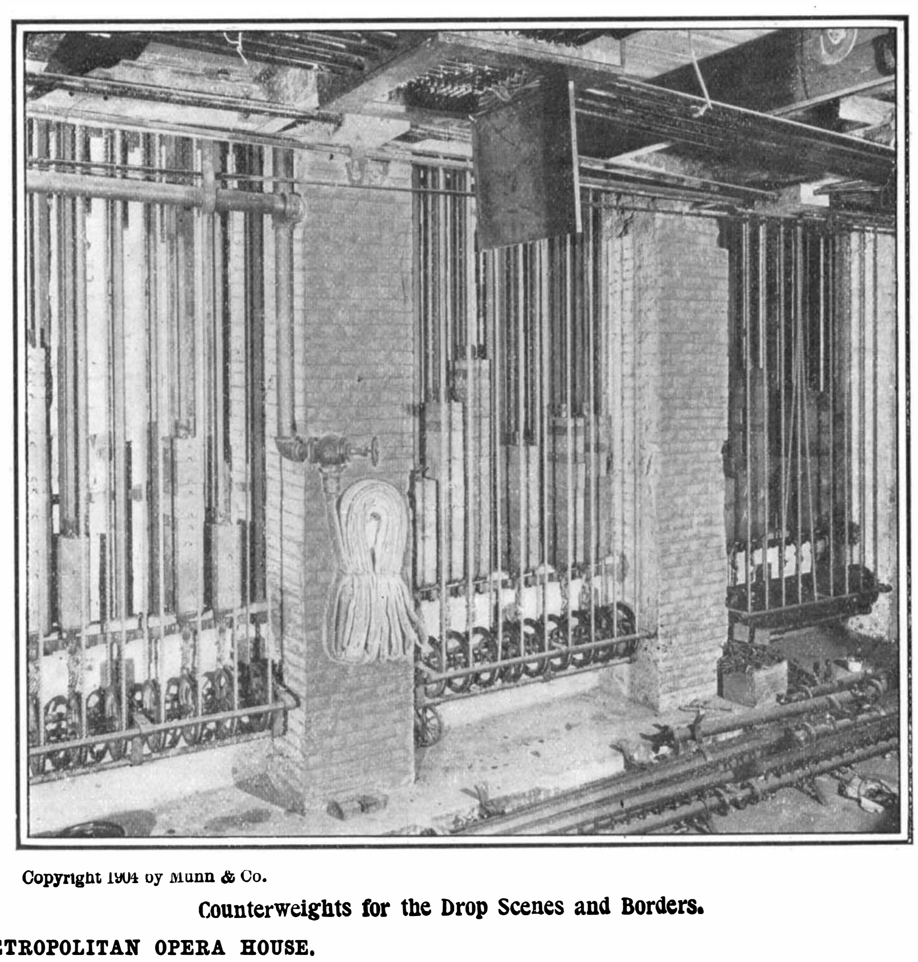
Winches for Raising and Lowering the Bridges.



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Counterweights for the Drop Scenes and Borders.

THE NEW STAGE OF THE METROPOLITAN OPERA HOUSE.

in New York, where we can give the "solemn festival play."

There is absolutely no reason why "Parsifal" should not be produced in New York rather than in a small, uncomfortable, and highly expensive Franconian town. The Wagnerian idea is to carry the book, the music, the scenery, as a concrete proposition. He wrote the words and the music, designed the whole stage setting, and was his own conductor and stage manager, so we have a case of undivided responsibility. The musical world trembled when it was suggested that "Parsifal," the Holy of Holies, was to be performed in New York; but it has been done, and in the opinion of some critics as well done as at Bayreuth, or even better.

"Parsifal," more than any other of Wagner's operas, depends upon the appeal to the mind through the eye.

The *mise en scène* of this imposing pageant requires great resourcefulness on the part of the stage director. When it was decided to give "Parsifal," a new stage became imperative, and the services of Technical Director Carl Lautenschläger, of Munich, were secured, and in conjunction with Mr. Theo. G. Stein, the architect, a modern stage was installed, capable of making quick changes and transformations. It was their aim to build a stage which would also minimize the amount of labor and render hitches and accidents almost impossible, and that they succeeded admirably is shown by the enthusiasm which the scenic and mechanical effects provoked. The first visit to a stage is always a revelation; the vast size of the room, the rising and dropping scenery, the under-stage mechanism, the lights and the orderly confusion, all tend to cast a rosy light on the theatrical life.

A few generalities are in order. The audience really sees a very small portion of the stage, for behind the curtain is a rectangular structure much higher than the roof of the auditorium. This great height is rendered necessary in order to raise the hanging scenes bodily, without resorting to the necessity of rolling them up. Everything above the arch of the proscenium is termed the "flies." The stage proper is the rectangular platform on which the players or singers stand. The sides of the stage are termed the "wings," and here the singers and ballet enter through the various so-called "entrances," the number depending on the number of "wings." The stage is divided widthwise into sections, and these sections of the stage floor can be raised above or lowered below the stage, depending on their construction, so that whole scenes can be raised or lowered as the case may be, or mountains or other high places built up in a short time. Great depth of cellar is necessary in order to permit of whole scenes being lowered. The top of the stage is known as the "gridiron" or "rigging-loft;" it consists of a slotted floor adapted to carry sheaves for the ropes which serve to support the drop scenes, borders, and gas battens which formerly carried the gas lights and now serve to carry the electric lights. To insure uniform motion and to distribute the weight, there are five ropes to each scene or border, and they pass over pulleys ranged at equal intervals across the width of the gridiron. There are 63 sets of ropes in the new Metropolitan Opera House stage, and the weights to be borne are all counterweighted so that the cloths can all be worked from the first fly gallery as easily as a dumbwaiter. The counterweights are inclosed to prevent accidents. Twenty-eight flymen now do the work of sixty.

In "Parsifal" it is necessary to have two elaborate transformation scenes, and this is accomplished by means of panoramas, four in number, situated in the wings and secured at the upper end to the first fly gallery. The panoramas are huge spools 36 feet long, and the painted canvas is reeled from one spool on one side of the stage to the other. The panoramas are suspended from a trolley serving to carry the weight of the canvas in its width-wise passage along a wire. With the aid of the panoramas, it is possible to produce the remarkable change from the woodland scene to the stately Hall of the Grail Knights, while Gurnemanz and Parsifal appear to be walking the entire distance. The movements of the various panoramas are accurately timed and the effect is good.

We now come to the under machinery, which is elaborate, but still very simple. We have already referred to the "bridges" or movable sections of the stage. At the Metropolitan, the first four are adapted to sink, carrying the scenery, properties, etc., with them; they can also be used to raise whole scenes, saving interminable waits. When a bridge is to be used to raise scenery which rests on its deck or floor, the floor of the stage must be removed. Instead of being taken up in sections like trap doors, ropes are attached underneath that portion of the floor of the stage which is superimposed over the bridge. These ropes pass over pulleys and then to winches. The flooring corresponding to the length of the bridge is taken out in two sections, one right, one left. This is accomplished by means of two pieces of the flooring which are depressed slightly at one end, allowing the two sections of flooring to store themselves in grooves underneath the fixed floor of the wings. The bridge is now raised by two men operating a winch. The bridges are heavily counterweighted so that the labor is comparatively light. The bridges are 42 feet 9½ inches long, 3 feet 8 inches and 2 feet 8 inches wide. Their depth is 21 feet. In the magic garden of Klingsor, the entire kiosk and scenery is let down into the cellar by the bridges, producing an awful scene of destruction. It is prefaced by a short scene which shows us the magician's tower, and we have selected this scene for the drop scene shown. The back drop and borders are raised, while the "practicable" (to use stage parlance) staircase is lowered. The construction of the bridges is such that a trap can be inserted anywhere while they are down, a great improvement over the old fixed traps where you know in advance exactly where Mephistopheles will go down or Hamlet's father's ghost come up. Special movable traps run in the spaces between the bridges and can be located at any point.

The side-scenes, or wings, are also worked mechanically. They are secured to movable trolleys or chariots which run on the floor of the first story of the cellar. This enables the stage to be kept clear and also facilitates the rapid and accurate setting of scenes. The three bridges at the back are counter-weighted and are adapted to rise up 23 feet above the stage to imitate rocks, etc. They can also be run up in sections and fulfill a very useful purpose. While it may appear that all these devices are very simple, yet they are interesting for the reason that everything, even to the panoramas, is worked manually. Herr Lautenschläger has built some very complicated stages, including six revolving stages. He is inclined to think that a stage like the present, or a revolving stage, is best adapted to the needs of grand opera. A revolving stage is to be built at an early date in New York city.

AN INGENIOUS MACHINE WHICH GREATLY SIMPLIFIES THE PROCESS OF PRINTING.

(Continued from page 116.)

and the other to draw it axially from the right to the extreme left. A series of ten pins are arranged at the left end of the type roll, and a similar series is arranged at the right end, the former serving, when raised, to limit the axial movement and the other cooperating with pins on the axis to limit the rotary movement. As stated above, each character is represented by two perforations on the tape; one of these makes contact with a corresponding pin at the right, and the other with a corresponding pin at the left. Now, if, for example, the eighth pin at the right were raised, and the third at the left, the sleeve would rotate three character spaces and slide axially eight character spaces, bringing the predetermined character on the sleeve in line with the printing hammer of the machine. The latter is thereupon actuated to strike the paper against the sleeve and make the required impression. This done, the type sleeve is restored to normal position by two cams and is ready for the next operation. At the same time the carriage which carries the transfer paper is moved laterally a distance corresponding with the width of the character just impressed. As soon as a word is completed, a space perforation is encountered on the tape which causes the carriage to move the distance predetermined by the justifier. And herein lies another very ingenious little mechanism. The carriage moves only in even multiples of a unit; whereas the justifying mechanism is measured in tenths of units. For example, a space of 3.4 units might be required between each word. In this case the first space would measure three units, and an accumulator device would retain the fraction of unit space. The next space would again be three units and .8 would be retained in the accumulator. The third space, however, would measure four units and .2 would be retained in the accumulator. Thus, the operation would continue, the accumulator retaining the fractions of space until they accumulated to an entire unit, when that unit would be applied to move the carriage an extra unit of space. At the end of the line the accumulator is restored to normal, the carriage is returned by the line trip and moved up one space for the next line, and the spacing mechanism is reset for the new line by the new justifier combination of perforations. These operations, though seemingly slow, are nevertheless very rapid. The machine illustrated has been operated at 10,000 ems an hour, or twice the speed at which the average operator manipulates a keyboard. Thus, the transfer machine can handle the output of two perforator machines. Mistakes of the operator can be corrected by pasting strips of paper with the corrections thereon over the faulty matter on the transfer paper.

The general advantages offered by the lithotyping process may be briefly summed up as follows: It does away with the use of type and the process of stereotyping. It makes use of light aluminium plates as against heavy stereotype metal on the presses. The life of the plate is unlimited, whereas the stereotypes must be changed at every 40,000 impressions. In the Lithotype, fonts may be changed simply by slipping on a new type wheel on the printer. A number of small rolls of tape will contain the perforations for a whole book and may be very conveniently stored or mailed. The machine is very compact and takes up little room. We show an ordinary sixteen candle power incandescent globe in each of the illustrations to indicate the size of the machine.

The Commerce of the United States and Russia.

Exports from the United States to Russia in the year just ended aggregated practically 20 million dollars. This is more than double the amount of our exports to Russia in 1901, the year in which duties were advanced upon merchandise from the United States entering Russia, and is also double the average for many years preceding that date. Imports from Russia have also greatly increased since that time. In 1903 they were $10,907,315, against $7,263,874 in 1901. Thus the total commerce between the United States and Russia in the calendar year 1903 exceeds 30 million dollars, and is double that of 1901, the year in which such alarm was felt with reference to our commerce with Russia, and is three times as great as in 1893.

This increase in the trade with Russia is especially marked when compared with the growth in trade with other European countries. Comparing conditions in 1903 with those of 1901, it may be said that exports to Europe as a whole show a slight decrease, while those to Russia, as already indicated, show an increase of more than 100 per cent. To the United Kingdom our exports in 1903 are 55 million dollars below those of 1901; to Netherlands, the reduction in exports, as compared with 1901, is more than 12 millions, and to Belgium, more than 5 millions. To France our exports in 1903 show a slight increase, and to Germany an increase of nearly 40 million dollars; but in each case the percentage of gain is small, compared with that in our exports to Russia, which show a much larger gain proportionately than those to any other European country, while in our imports from Russia a material increase is also shown.

The chief growth in our exports to Russia, in the two years in question, has been in cotton, agricultural implements, copper and its manufactures, and naval stores. In iron and steel there has been a slight reduction, and in flour a considerable reduction. Raw cotton, of which our exportations to Russia in the fiscal year 1901 were less than 2½ million dollars, showed in the fiscal year 1903 a total export to that country of over 8 millions. Agricultural implements have grown from $1,692,597 to $3,636,145; copper and manufactures thereof, from $790,724 to $1,364,272, and naval stores, from $281,616 to $432,792. Iron and steel, which in the fiscal year 1901 amounted to $1,636,894, was in the fiscal year 1903 $1,198,139; and flour, which in the fiscal year 1901 was $1,261,122, was in 1903, $1,028,590.

The Arrival of Smithson's Body.

The coffin containing the body of James Smithson, the founder of the Smithsonian Institution, who died many years ago in Genoa, was removed from the dispatch boat "Dolphin" on January 25 and carried to the Smithsonian Institution, where it will remain until Congress authorizes its final burial in the grounds of the Institution.

The party that witnessed the transfer included Acting Secretary Loomis, as the personal representative of President Roosevelt; Sir Henry Mortimer Durand, the British Ambassador; Senators Cockrell, Frye, and O. H. Platt; Representatives Hitt, Adams, and Dinsmore; J. B. Angell, of Michigan; J. B. Henderson, of this city; Prof. S. P. Langley, secretary of the Smithsonian Institution, and Dr. Alexander Graham Bell. The coffin was draped in the American and British flags. As it was lowered from the "Dolphin" to the caisson, the United States Marine Band played "Nearer, My God, to Thee." Troop F, 15th Cavalry, served as escort. At the Institution the body was formally received, and the Rev. Dr. R. H. McKim, of Washington, delivered a eulogy of Smithson.

Wireless Telegraphy in Germany.

Wireless telegraphy is rapidly coming into commercial utility in Germany, and large numbers of "spark messages," as such telegrams are called, are transmitted daily. There is a service in operation between Denmark and Prussia, while two German steamers running between Kiel and Korsoer are equipped with instruments and maintain continuous communication with both the German and Danish land stations. The system employed is the Slaby-Arco. Private messages are accepted at the two offices at Bülk near Kiel, and the other on the Isle of Fehmarn. A fee of 17 cents is charged for every message transmitted from one station to the other, irrespective of the number of words it contains, and it is thence dispatched to any part of Germany or Denmark at a cent per word.

Correspondence.

Mammoth Tooth.

To the Editor of the SCIENTIFIC AMERICAN:

I notice in your issue for January 23 a description of a mammoth's tooth. I have recently received the tooth of a mammoth which was discovered at Austin, Texas, while a well was being dug. It was found 45 feet below the surface. The laborer struck it with his pick-ax, in excavating it, and broke it. The tooth weighs 12 pounds. It is 13 inches long, 7 inches broad at the center, and it is 4 inches thick. It makes an excellent curio. J. S. BROWN.

Galveston, Texas.

About the New Method of Gathering Turpentine.

To the Editor of the SCIENTIFIC AMERICAN:

I note in your issue of January 2 the article relating to the "new method of gathering turpentine," invented by Dr. Charles H. Herby, and by him "given to the public."

Eleven years ago I experimented with detachable receptacles to catch the "dip" in lieu of the ordinary "box" cut in the trees, trying a number of substances and forms of receptacles.

My experiments were made at the McQurre place at Adiel, Ga. The object which I sought was mainly to secure a better grade of rosin after the first year's working of the trees.

A "virgin" tree yields "window-glass," water-white rosin, which brings a high price. The second, third, and fourth year's working of trees yields poorer and poorer grades of rosin, because of the tannic acid, which accumulates in the old boxes in the trees, and the fourth year (the last in Georgia) rosin hardly more than pays for the barrels and handling.

By the use of the detachable boxes, I hoped to secure a high grade of rosin through the working of trees, and also save some "dip," which is lost in the usual way of gathering—dipping from the box in the tree into a large bucket with a wooden paddle.

While the theory seemed good, I found it entirely impracticable to apply it. It is impossible to construct a receptacle which will come anywhere near answering for the different forms and sizes of surfaces to which they must be attached.

The "dip" will run by and to the ground. I even tacked a metal basin to a specially-prepared surface, without entirely preventing the loss of "dip."

The "dip" or gum adheres to the inside and outside of such a receptacle, gets hard, and cannot be removed by any feasible process in the wood.

In short, this plan is impracticable. Moreover, I found that at least one man had made the same kind of experiments some three years before I attempted it.

GEORGE W. COLLIN.

Bridgeport, Conn., January 8, 1904.

New Automobile Records on the Ormond-Daytona Beach.

As a beginning of the promised lowering of automobile speed records at the race meet in Florida last week, William K. Vanderbilt, Jr., lowered Henry Ford's record made on the ice by two-fifths of a second. Mr. Vanderbilt drove his recently imported 90-horsepower Mercedes racer, and he covered the mile in 39 seconds, or at the rate of 92.31 miles an hour. One of the fastest races that was run on the same day, January 27, was a 15-mile match between H. L. Bowden and S. N. Stevens, each of whom drove a 60-horsepower Mercedes car. Bowden beat Stevens by 11 seconds, covering the 15 miles in 10:18, or at an average speed of about 87 miles an hour.

The great feature of the second day was the mile championship race, consisting of three heats. There were seven machines in this race, but one of which—the Winton Bullet No. 2, driven by Barney Oldfield—was of American make. The other six were Vanderbilt's Mercedes, Bowden's Mercedes, Stevens' Mercedes, Brokaw's Renault, Shanley's Decauville, and La Roche's Darracq. The first heat was won by Vanderbilt in 48 4-5 seconds, with Bowden second in 49 3-5, and Shanley third in 55 4-5 seconds.

In the second heat, the Winton 8-cylinder machine forged to the front and made the fast time of 43 seconds (83.72 miles an hour). Mr. Stevens was second in 45 2-5 seconds, and Mr. Brokaw's Renault came in third in 48 3-5 seconds.

The third heat was also won by Oldfield in 46 3-5 seconds, while Mr. Vanderbilt finished second in 49 3-5 seconds. The mile championship for 1904 therefore goes to the American racing car built on distinctly American lines, i. e., with a horizontal motor instead of one of the vertical type.

The first heat of the five-mile invitation race for gentlemen amateurs was won in 5 minutes, 18 3-5 seconds, by Mr. James L. Breeze on his 40-horsepower Mercedes.

The second and final heats were not run off till the following day, when they were won by Mr. Vanderbilt in 4:38 1-5 and 3:34 3-5 respectively. The first heat of the five-mile free-for-all race was won by Oldfield in 3:48 4-5, but his machine broke down just as he finished. The second and third heats went to Mr. Vanderbilt in 3:40 and 3:31 3-5 respectively. The latter time is equal to an average speed of about 85½ miles an hour. Mr. Vanderbilt also won the one-mile race for gentlemen drivers in 47 3-5.

A one-mile motor bicycle race was a feature of the third day's sport, and was won by G. H. Curtis, on a machine of his own make, in 56 1-5 seconds. The concluding race, a five-mile handicap, was won by S. B. Stevens from scratch in 4 minutes and 2-5 of a second.

The races on the fourth and concluding day were over ten-mile and twenty-mile stretches. The times made will be given in our next issue.

THE HEAVENS IN FEBRUARY.

BY HENRY NORRIS RUSSELL, PH.D.

The finest part of the evening sky at this season lies south and west of the zenith, where we find several of the brightest constellations in the heavens.

At our accustomed hour of 9 o'clock in the middle of the month, Gemini is almost overhead, a little south of the zenith. Its two bright stars, Castor and Pollux, about 5 deg. apart, are the principal feature of the constellation, and two roughly parallel lines of fainter stars extend from them toward Orion.

Below Gemini lies Canis Minor, whose principal star, Procyon, sends us more light than Castor and Pollux combined. Still lower is Canis Major, with the magnificent Sirius, six times as bright as Procyon, and surpassing fourfold any other star that we ever see. Below Sirius and to the left is the rest of the constellation, which contains one star almost as bright as Castor, and two or three others not much fainter, though they do not appear nearly as bright to us as Castor does, on account of the great absorption which their light suffers in passing obliquely through our atmosphere.

Canopus, the brightest star in the heavens after Sirius, can be seen low on the horizon, a little to the right of Sirius, by observers south of latitude 35 deg.

To the right of Procyon, and a little below it, appears Orion, the brightest of all the constellations, with two stars of the first magnitude and several of the second. Higher up and farther west is Taurus, with the red Aldebaran, and the cluster of the Pleiades farther west. North of this, and west of the zenith, is Auriga, whose brightest star, Capella, ranks next to Sirius among those now in sight. Following down the Milky Way we come to Perseus, then Cassiopeia, and finally Cepheus, well down below the pole.

Aries lies below Perseus on the left. The southwestern sky is dull, being occupied by Eridanus and Cetus, which have few conspicuous stars.

East of the meridian the most prominent groups are Ursa Major and Leo. The former is coming up on the right of the pole, the latter is quite high up in the east. The long regular line of Hydra rises from the southeastern horizon, and extends almost to Procyon. Parts of Virgo and Boötes have risen, but their brightest stars are still invisible. Draco, below Ursa Major, is the only other prominent constellation in sight.

About 3½ deg. southwest of Capella (in the direction of the Pleiades) lies a star—Epsilon Aurigæ—which recent investigations show to be an uncommonly interesting object. It has been known for many years that the star is variable. It is usually a little below the third magnitude—fully as bright as the brighter of the two stars which lie 3 deg. south of it—but on several occasions it has been seen by competent observers to be of the fourth magnitude—decidedly fainter than either of them.

It has been supposed that these fluctuations in brightness were irregular. However, Dr. Ludendorff, of the Potsdam Observatory, who has recently made a careful discussion of all the available observations, finds that the epochs of minimum brightness have occurred at regular intervals of a little over twenty-seven years—in 1821, 1848, 1875, and 1902.

About a year before the epoch of minimum, the star begins to decrease in brightness, and in seven months it has lost about half its light. Then for about ten months it remains constant, and then increases again, recovering its original brightness in seven months more. During the remaining twenty-five years of the period there is little evidence of any change in the star's brightness.

This variation is exactly similar in character (though of very much longer period) to that of the well-known Algol variables, and it is natural to attribute it to the same cause, namely, the eclipse of one of a pair of binary stars by the other. This hypothesis is strongly confirmed by the fact that spectroscopic observations, also made at Potsdam, show that the star is a binary of long period, both of whose components are bright. The relative orbital velocity of the two stars appears to be at least as great as that of the earth around the sun.

Although not enough data have yet been published to enable the dimensions of the system to be calculated with any reliability, a rough estimate, based on the assumption that the true orbital velocity is a little greater than that of the earth, may be of interest.

It would appear that the system consists of two stars, about equal in brightness, one of which is more than twice the diameter of the other. When the small star is eclipsed behind the large one, all its light is cut off, and we have a minimum. When the small star is in front of the large one, it cuts off only a small fraction of its light, and there is not enough difference in the amount of light which reaches us to be noticeable.

The period of revolution of these two stars is about twenty-seven years, and their distance apart is on the average about equal to that of Neptune from the sun. The smaller star is about 350 million miles in diameter, and the larger one about 850 million miles, or about 400 and 1,000 times the sun's diameter. The combined mass of the two stars is, however, only about thirty-five times that of the sun, so that they must be of an excessively tenuous constitution.

It should be borne in mind that the above numbers can give at best merely an idea of the general nature of the system, and may be very far indeed from numerical correctness. However, this exceedingly interesting system is now under careful observation, and we may hope that in a few years it will be possible to say definitely whether this theory of its variation is correct, and, if so, how large the stars really are.

THE PLANETS.

Mercury is morning star in Sagittarius and Capricornus. On the morning of the 10th he reaches his greatest elongation, and is nearly 26 deg. west of the sun. He is, however, so far south that he will not be very easy to see, although he rises nearly 1½ hours before the sun. By the end of the month he rises only half an hour before sunrise, and can no longer be seen.

Venus is also morning star, in the same constellations as Mercury, but twelve or fifteen degrees west of him, so that she rises about an hour earlier. Though steadily growing fainter, she is still the brightest of the planets.

Mars is evening star in Aquarius and Pisces, and can be seen shortly after dark, as he sets about two hours after the sun. He is more than 200,000,000 miles from us, and is consequently inconspicuous, being only about as bright as the pole star. Jupiter is likewise an evening star. On the night of the 25th he is in conjunction with Mars, being half a degree south of him. The two planets can easily be seen just after dark, a little to the south of west. Saturn is in conjunction with the sun on the 1st, and is practically invisible throughout the month. At midnight on the 25th he is in conjunction with Mercury, at a distance of about three-quarters of a degree. By a singular coincidence, this conjunction takes place on the same day, and at the same hour, as that of Jupiter and Mars. In this case, however, the two planets are so far south, and so near the sun, that they can hardly be seen.

Uranus is morning star in Sagittarius, and rises at about 3 A. M. on the 15th. Neptune is in Gemini, and crosses the meridian at 8:36 P. M. on the same date.

THE MOON.

Full moon occurs at 11 A. M. on the 1st, last quarter at 5 A. M. on the 8th, new moon at 6 A. M. on the 16th, and first quarter at 6 A. M. on the 24th. The moon is nearest us on the 1st, and farthest away on the 15th. She is in conjunction with Uranus on the 11th, Venus on the 12th, Mercury on the 13th, Saturn on the 15th, Mars at 2 P. M. on the 18th, Jupiter at 10 P. M. the same day, and Neptune the 26th. The conjunctions with Jupiter and Mars are decidedly close. As seen from the northern United States, the moon passes north of both planets at a distance less than her own diameter.

Cambridge Observatory, England.

Another Mastodon Found in New York.

Near Hornellsville, N. Y., part of a skeleton of a great mastodon has been dug up. Some laborers were excavating near the village of Belvidere for the Pittsburg, Shawmut, and Northern Railway Company, and when about six feet down, one of the men struck what looked like a large bone. The foreman rescued the bone after it had been broken in two by the pick of a workman. Dr. Johnson, who is said to have been once connected with the Smithsonian Institution, pronounced it to be portions of a mastodon's rib. Further excavation brought to light three ribs and four vertebræ, making in all a section of the animal's back about eighteen inches long. Each of the vertebræ is 6 inches in width. These seem to be by far the largest mastodon bones of their kind ever discovered.

Curie's Refusal of the Medal of the Legion of Honor.

Prof. Curie has declined to accept the medal of the French Legion of Honor, despite the fact that the government offered it to him of its own free will, and not because of the solicitations of any friends of the Curies. The refusal comes all the more as a surprise, since Prof. Curie accepted the Nobel prize not so very long ago.

MAKING ASBESTOS FIRE CURTAINS AND FIREPROOF FABRICS.

BY A. FREDERICK COLLINS.

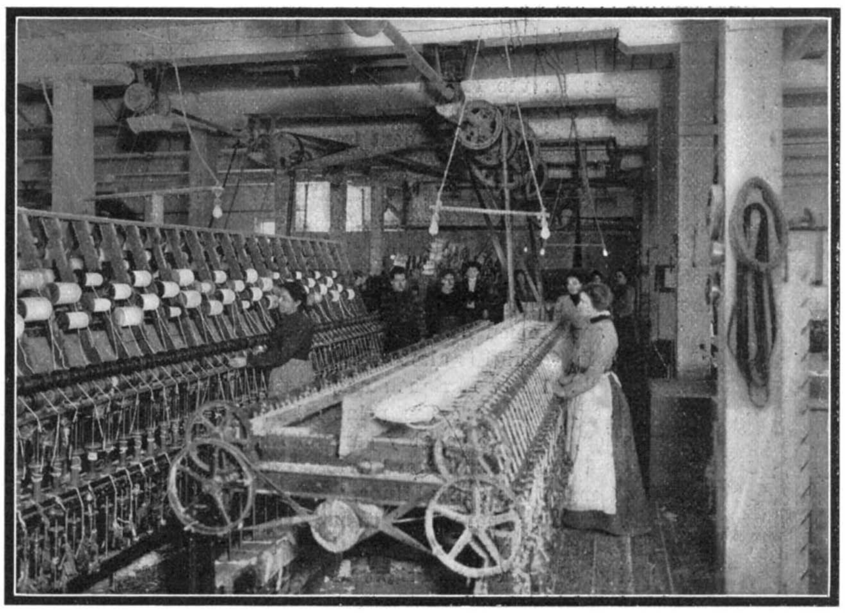
With all the inventions and improvements in methods and apparatus for fire-fighting, it would seem that the quenching of accidental fires would be a comparatively easy matter; but experience has shown that after a certain critical burning point has been reached, the best-directed efforts fail. If the extinguishing of fire has not developed into an exact science, the art of building construction has; and it is now possible to make not only buildings absolutely fireproof, but all their interior furnishings as well. A building of steel, brick, and fireclay offers but little protection from fire to the occupants if its interior is furnished in woods, silks, and cottons, and it is these inflammable products that are often placed where ignition is most easily possible. But these materials may be easily substituted by heat-resisting, chemically-prepared fabrics, or what is better, by products of asbestos, a mineral composed of flax-like fibers, which may be woven into cloth, spun into rope, made into paper, or compressed into a form that possesses all the qualities of wood except ignition. The purpose of this paper is to describe some of these processes.

Asbestos is one of the most remarkable substances found in nature, and is classified by geologists as a peculiar species of the hornblende family of minerals. Its composition is chiefly silica, magnesia, alumina, and ferrous oxide, and consequently unconsumable, hence its name. The fibers formed by the chemical combination above given are perfectly smooth, and in this respect are different from all other known fibers.

Paradoxically, it is the link which completes the chain between the vegetable and mineral kingdoms, and is in fact a mineralogical vegetable possessing the curious properties found in both, for it is at once fibrous and crystalline, elastic and brittle, heavy as a rock in its crude state, yet as light as thistledown when treated mechanically.

Added to this, its fibers, soft, white, and delicate, have, by their inherent quality of indestructibility, withstood the action of the elements since the world began; and through all the countless ages, during which the hardest rocks surrounding it have been reduced, this mineralogical mystery has remained intact, having successfully resisted the assaults of fire, acids, and time. Asbestos is found widely distributed throughout the world, although the principal supply of crude asbestos suitable for the manufacture of fireproof cloths and curtains comes from Canada, about seventy-five miles from Quebec.

The Italian mineral has a fine, silk-like fiber, but is lacking in the essential characteristic of strength. The product obtained from South Carolina has a soft, woody, yellowish fiber, which quickly powders under pressure. The South African asbestos, as one might naturally infer, is of a dark slate or black color, with exceptionally long, strong fibers, but owing to its stiff and horny texture, it cannot be manufactured into a fine fabric, hence the superiority of the Canadian asbestos, and its large consumption in the United States.



Weaving Asbestos Cloth.

The mining of asbestos differs radically from the mining of other minerals, since no shafts are sunk, but excavations are made in the open, somewhat after the manner of a stone quarry. Canadian asbestos, however, is found in narrow veins or seams about an inch and a quarter in thickness, and embedded in rock which is easily severed from it. The strata of asbestos, which may be vertical or horizontal, are found in practically detached deposits, and are as elusive as those of zinc-bearing ore, and can only be determined by exploring for them.

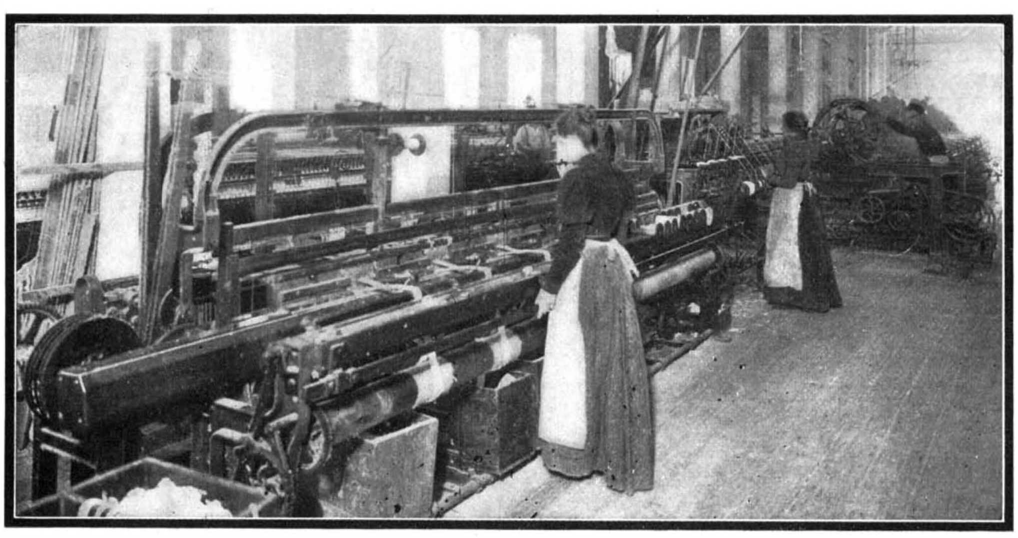
The rock to which the mineral is attached shows on fresh fracture a serpentine mineral of a green shade containing finely-divided particles of chromic and magnetic iron. The asbestos on cleavage presents a brilliant, dark-green surface by reflected light, but the fibers after they are detached are perfectly white. The act of separating the mineral from its matrix of rock is termed "hand cobbing," and after this process the mineral is shipped to various factories in the United States.

The process of manufacture begins by placing the asbestos mineral in a chaser mill, a machine comprising a rotating edge-wheel revolving at the end of a radial arm in a trough, which crushes the mineral, dividing the fibers without destroying them. The result is a snowy mass of mineral wool ready for winnowing, a method of removing the minute particles of rock still clinging to the fibers very much like the winnowing of grain; this is done by means of a blast of air, which separates and blows away the foreign matter, leaving the fibers in a refined state and in proper condition for the third stage of manufacture.

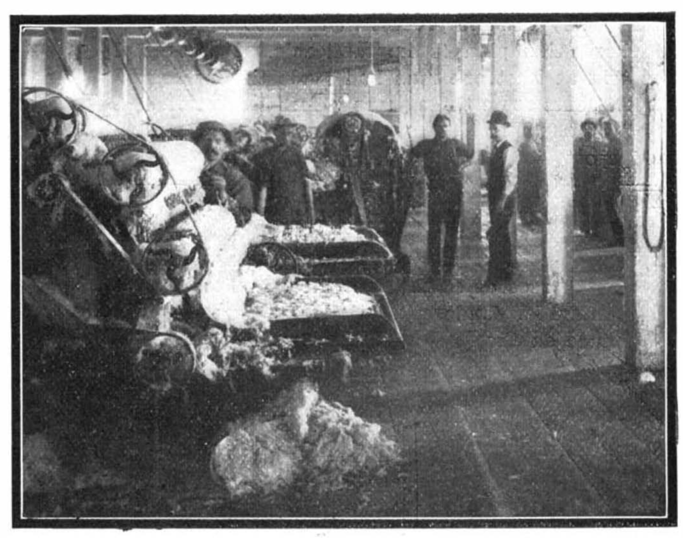
This is termed air fiber raising, and as the name implies, the fibers are raised by a current of air produced by a blower of large dimensions through a vertical pipe inclined at a small angle. The object of this procedure will be obvious, when it is stated that the air blown across the fibers causes those of coarser texture to be deposited in a compartment near the bottom of the pipe. The medium fibers will be projected a little higher, and these will fall into a second compartment. The finer fibers will be blown to a higher point, and there collected, while the dust will be carried to the top and deposited.

The fibers are in this way sorted into different lots according to their texture, and are ready to be made into articles for which they are best adapted. The fluffy stuff now goes to the carding room, just as though it were genuine wool sheared from a sheep or

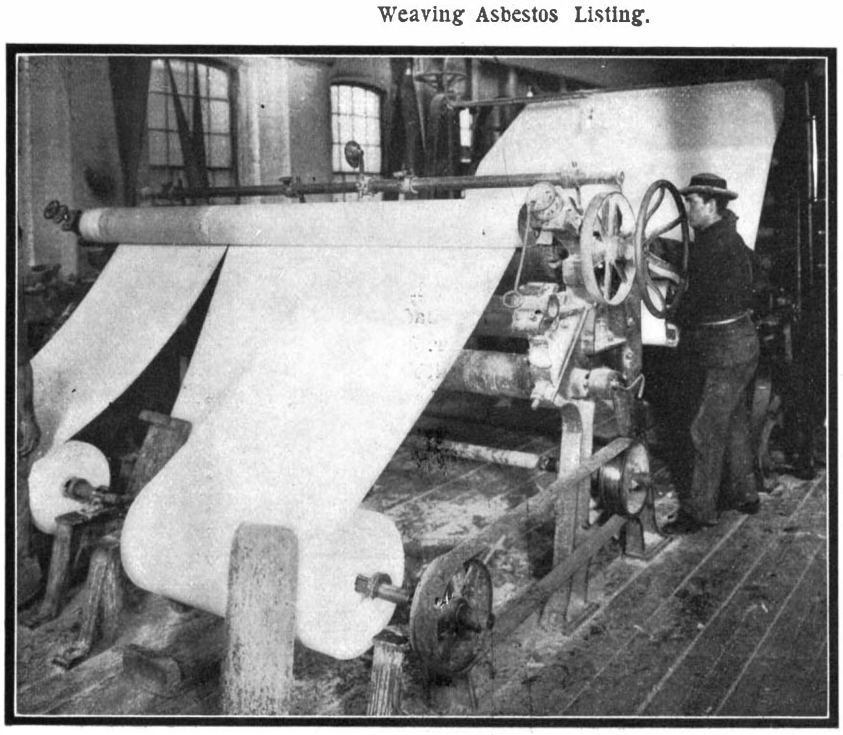
(Continued on page 122.)



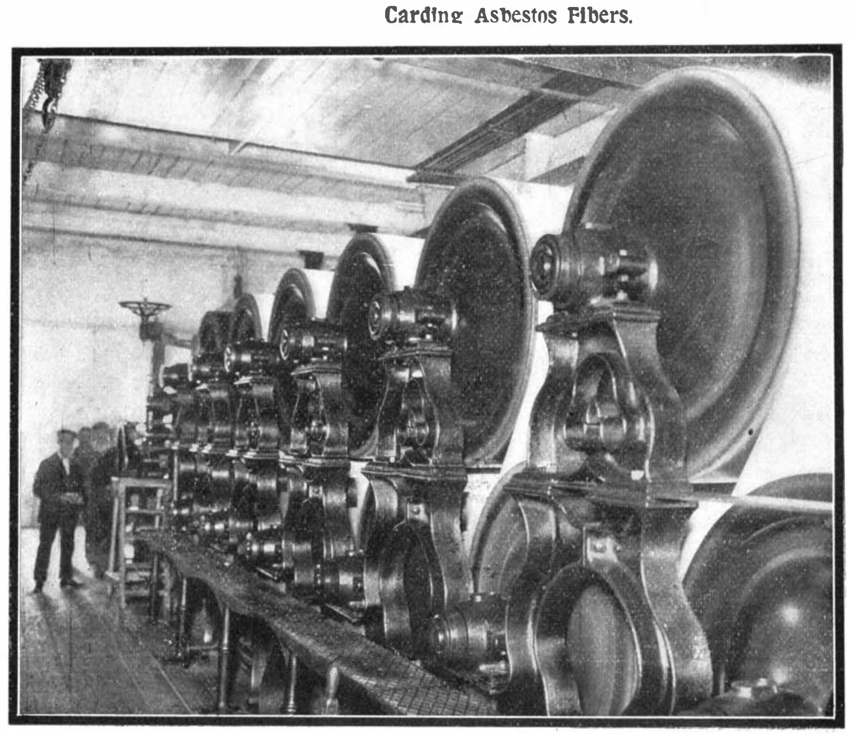
Weaving Asbestos Listing.



Carding Asbestos Fibers.



Cutting Asbestos Paper.



Manufacturing Asbestos Paper.

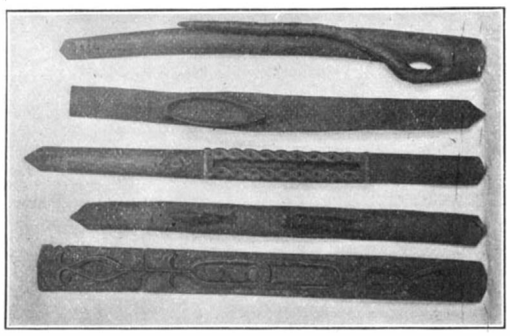
HOW ASBESTOS CURTAINS ARE MADE.

THE ABORIGINES OF JAPAN.

BY WALTER L. BEASLEY.

Probably one of the most interesting ethnological exhibits at the forthcoming St. Louis Exposition will be a native village and several family groups of the

Ainu Women With Tattooed Mustaches.



Mustache Lifters.

A Coat Made of Bark.

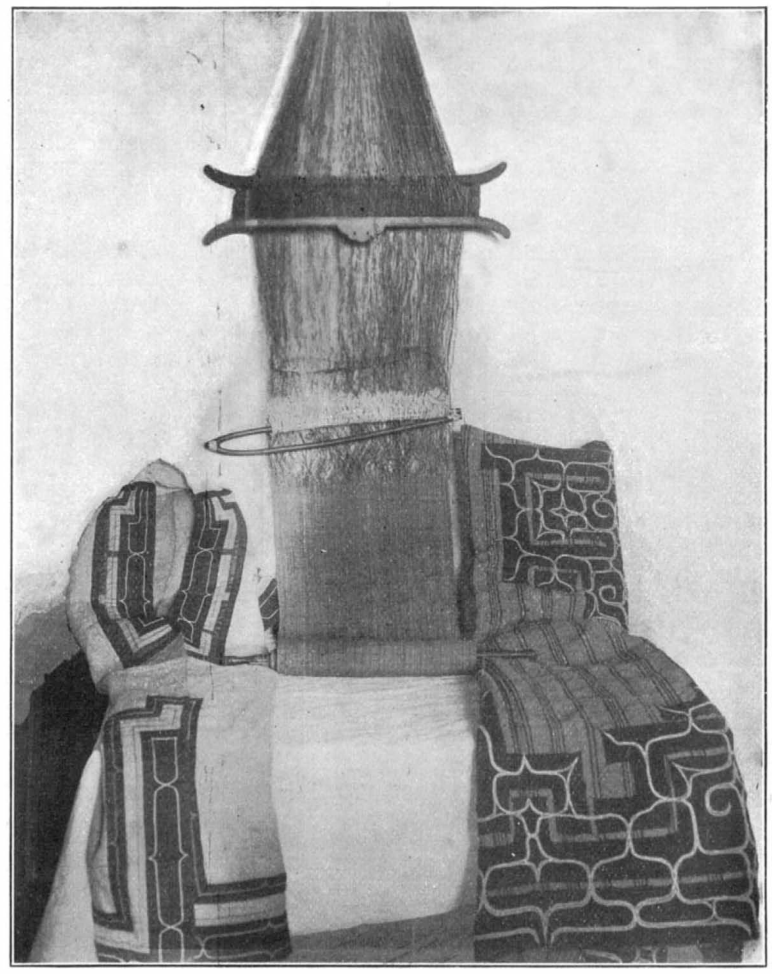
Hairy Ainus of Yezzo of Japan. Prof. Frederick Starr, of the University of Chicago, leaves shortly for the Orient to secure typical representatives of this mysterious and little-known race, who will be seen in this country for the first time. They are one of the few peoples who still remain a puzzle to the anthropologists. They have no written language, no record of any kind to throw light upon their past. They are classed as the aborigines of Japan, and were found living upon the island when the Japanese arrived there. The Japanese conquered and drove them northward to the cold and less hospitable regions. They now dwell on the island of Yezzo, just north of Japan. A few own the Kuriles, while a portion have emigrated across to the Russian penal settlement of Saghalien. The men are noted for the extraordinary growth of hair, which covers their bodies, as well as for their long beards. Owing to their primitive ways, and peculiar religious and ceremonious observances, they afford an excellent subject for study. An extensive and picturesque collection of Ainu dress and ceremonial objects has recently been received and installed at the American Museum of Natural History, obtained by Dr. Berthole Lauffer, an Asiatic explorer, and partly by gift of Arthur Curtis James, Esq.

The Ainus' dress, religion, and mode of life are almost the same as those existing hundreds of years ago. The people are subjects of Japan, but have no voice in government, and are simply left to themselves. They have no ambition, and have not introduced into their industrial life any of the progressive methods of their near neighbors, the Japanese. They number about 16,000, a mere remnant of a once numerous and barbarous race. They subsist chiefly by hunting and fishing. The bear is still pursued and shot by means of the primitive bow and poisoned arrow, though the Japanese are endeavoring to enforce a law against this method.

An Ainu house consists of a framework of poles having the roof and sides thatched with reeds, with a small hole left in the roof for the smoke to escape. The completion of one of these huts is considered a gala occasion, and marked by a house-warming feast, at which all the relatives and others who helped to build the same are invited. Cakes of millet are passed around, and a big tub of *saké* or rice wine is placed in the center of the room.

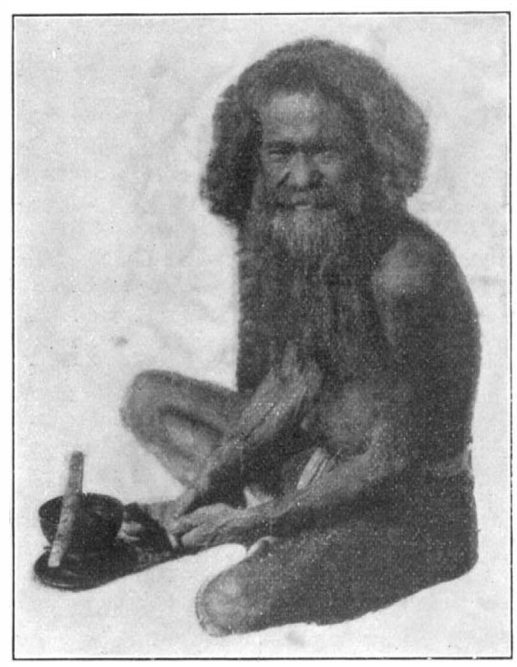
One of the odd objects used by Ainu men are long wooden sticks extensively ornamented, called mustache lifters. These serve a double purpose, being used in religious ceremonial worship; when so employed, they dip one end in the *saké* bowl, and offer a few drops of wine to the gods whom they desire to pray to, while in ordinary use they are utilized to keep the long beard out of the cup while the person is drinking. They are from twelve to fourteen inches long, and carved in various designs, and are highly treasured by their owners, who do not care to part with them.

Young women are more prepossessing than the men, and are much sought by the Japanese for wives. They practise, however, the custom of tattooing their lips so as to imitate mustaches, thus producing a strange effect to their features. The tattooing is said to be somewhat painful. It is done by degrees, requiring about a year to put the finishing touches on. The tattoo is obtained from bark of the birch, a pile of which is burnt under a kettle, until the bottom is well blackened by a thick coating. With a knife the woman makes a few incisions on the part to be tattooed, after which she takes some of the soot upon her finger, and rubs it well in the gashes she has



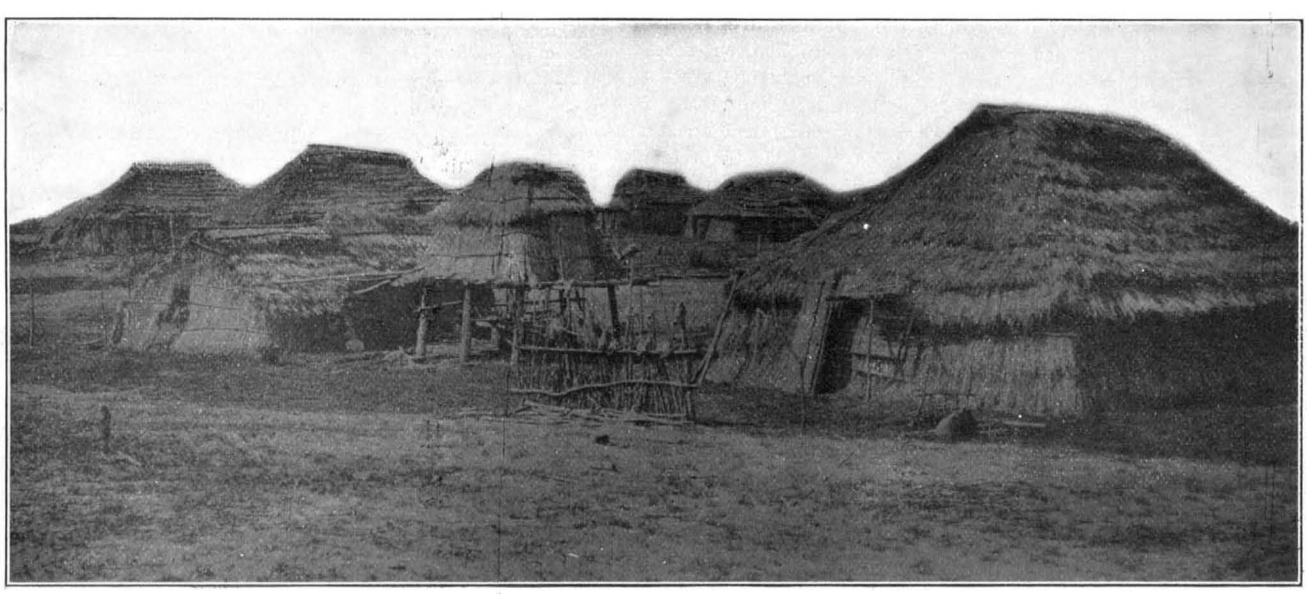
Native Loom, Showing Roll of Bark Cloth and Garments.

made. Several applications result in two dark-blue bands, which will last for five or six months before being renewed.

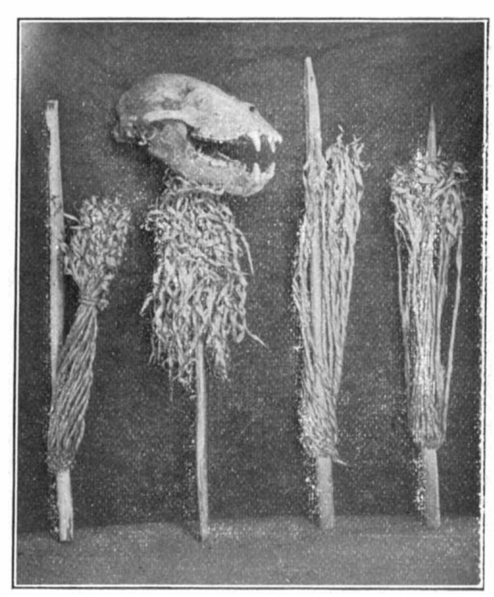


Hairy Ainu of Yezzo, Japan.

One of the most curious and sacred of all the Ainu belongings is the "*inao*," or wooden prayer sticks, which hold the most important place in their religion



Ainu Thatched Huts.



Prayer Sticks.

THE AINUS, A PRIMITIVE PEOPLE OF JAPAN.

The people believe in a great many gods and deities, good and bad, who reside in and control the forces of nature. The inao are pieces of whittled willow wood, with the shavings left attached to the top. They are symbolic offerings in prayer, presented to the distant gods. Some are shaved upward, and others backward. They are hung up in the windows, doorways, and looked upon as charms, safeguards, and evils. They are also placed near springs, river-banks, storehouses, by the fireside, and in fact in every domain where the particular god is supposed to dwell. Near each hut is a small plot, which might be called the Ainu church or temple, for it is his special place of worship. This consists of a number of inaos or poles, upon which are placed the skulls of animals, which have been killed in a hunt or sacrifice, especially the bear. The men, old and young, with solemn faces, sit before these weird-looking objects and offer sacrifices, pour out libations of wine, and utter prayers to the gods, and implore them to reward the supplicant with success in hunting.

The material for the garments of both sexes is made from the inner bark of the elm tree, which is put into water to soak and to soften, after which it is taken out, and the fiber divided into threads and balls. It is then woven into narrow rolls of cloth on a primitive loom. The garments are quite rough, and have a faded brown color. The women are somewhat expert in executing fancy needle-work, and in their arrangement of patterns and designs, the embroidery and decoration is done with Japanese colored thread, upon the groundwork of their own elm-bark fabric. In winter the women sew bear, deer, and wolf skins over the elm fiber for greater warmth. The Ainu bear hunters undoubtedly outclass the best civilized sportsmen in bravery and courage. The latter consider one hundred yards off with a modern Winchester a safe distance for a shot for such an animal. The Ainu method, on the contrary, is as unique as it is thrilling and dangerous. The bears spend their winters in caves. To rout them out, long poles are pushed inside; if one shows himself in fair view, he falls severely wounded by the poisoned arrow. Often they are smoked out. When a bear is first shot, he savagely and furiously attacks his enemy. At close quarters, the Ainu discards his bow and arrow, awaiting one final onslaught. The wounded and enraged beast stands upon his haunches, ready to pounce upon his assailant. If the Ainu be a brave and experienced hunter, he watches his chance to make the final and fatal thrust. At the right time he rushes into the animal's embrace, and plunges his knife into his body. But he does not always escape without a reminder of the encounter. Some of the less venturesome hunters employ another method. Armed with a long, sharp-pointed spear, they await the charge, and keep the points of their weapons well hidden and covered by a piece of cloth under the arm. The animal seeing the hunter evidently without a weapon, makes a wild dash for him; quick as a flash, the hunter merely steps aside, and the beast falls upon the spear, which penetrates far into his body.

The most important ceremony of the year is the great bear feast, held in September and October. The bear is universally worshiped, and is looked upon as one of the most honorable representatives of their various gods. To give a bear festival is considered a great honor, and is likewise quite expensive, owing to the large amount of *saké* the host is required to serve. The young cub in the interval, before he is to be sacrificed, is kindly cared for and given the best food and fish obtainable, and is treated with great affection by the master of the household. For a year or more he is the "star boarder" of the family, and shares in all of the luxuries of his master's table. The ceremony is quite lengthy, and lasts several days. A few of the main features are here set forth. For the feast, the host several weeks ahead sends out invitations to his relatives and distant friends. It is the gala social event of the whole season, and the favored ones come arrayed in their best ornamented bark clothes, the women dress up their husbands in the most gaudy and showy garments, while they in turn appear in bark gowns, adorned with large earrings, necklace of glass balls with large copper pendants, and with a new coat of tattoo over their lips. It is said that the bear festival is one of the two occasions when the Ainu men and women wash their faces and hands, the other being at funerals. After general greetings have been exchanged, the host and his visitors inspect the cage quarters of the bear, after which they adjourn to the interior of the house, where the drinking of *saké* and prayer offerings are made. The mustache sticks are dipped into the *saké* and the guests throw several drops into the fire and other sacred places. After this the *saké* is quaffed in long draughts by the women and men, the beards of the men being held up with the mustache sticks. One of their number is delegated as a spokesman to go to the bear, and advise him of his forthcoming execution. This person sits down before the cage, and tells Bruin that he is about to be sent to his forefathers. He craves pardon for what he and his fellows are about to do, and hopes that he won't be angry, comforting him by saying that a great many inao, plenty of wine and millet cakes will be sent along with his body on its last journey. After this he is taken out of the cage by a noose fastened around his neck, and led around, that he may enjoy a farewell bit of freedom. He is then made a target of by the men, who proceed to tire and wear him out by shooting him with blunt-headed and wooden arrows. Then comes the crucial moment for poor Bruin. He is seized and thrown down, and after being rendered helpless, two long poles are used to end his torture. One is placed under his throat, and the other on the nape of his neck, and he is gradually choked to death. After this his form is spread out on a mat before the sacred hedge or praying place, lamentations and dancing are held, and food and drink placed before him. The men seat themselves before the mat, and again libations of *saké* are offered and consumed, which the women join in drinking, and also dance in a hilarious fashion. Soon the effects of the *saké* are shown upon the men, who usually fall upon the mat in a stupor. On the next day the bear is cut up, and certain parts distributed to the guests, who participate in it. The head is then stuffed with inao shavings, and placed upon a pole stuck in the sacred hedge. This is also accompanied by dancing, weeping, and drink-offering. Thus the bear is consigned to his fathers, and the guests disperse to their various homes, and the village settles down in quietude for another year. A great diversity of opinion exists among anthropologists as to the origin and relationship of the Ainus to other peoples. They have no linguistic affinity to any neighboring or distant nations. Baelz, a foreign investigator, owing to their rather white skin and non-savage appearance, advances the theory that they were formerly allied to a branch of a European Caucasian race, which became divided and separated by encroachments of Mongol-Turkish invasions. Prof. Franz Boas, however, considered the foremost American authority, disagrees with this statement, and is of the belief that they probably belonged to the East Siberian and Asiatic tribes. The accompanying illustrations are reproduced through the courtesy of the American Museum of Natural History.

THE MAKING OF ASBESTOS FIRE CURTAINS AND FIREPROOF FABRICS.

(Continued from page 120.)

pure cotton fresh from the plant on which it grows, instead of a mineral substance that in its original state was mined like a lump of anthracite coal.

A carding machine, similar to that employed in preparing wool, cotton, or flax fibers before spinning, has been adopted by the manufacturers. The problem of mechanically combing these fibers was no small one, and the carding takes place in a machine having a large central rotating cylinder covered with card clothing, that is, strips of leather set with projecting wires termed teeth. Around the main cylinder there are a number of smaller cylinders, also provided with card clothing, which engages the teeth of the central cylinder rotating in the reverse direction.

This machine straightens out the fibers and lays them parallel; after passing through the first breaker, they are fed into a second carding engine or breaker, which is set to a finer gage than the preceding. A third and last carding process takes place in a machine called a finisher or condenser, when all the irregularities are eliminated, and the fibers are stripped from the final cylinder by means of a fly-comb, and are converted into unspun threads, when they are delivered on a traveling apron or endless band, and are gathered into rows by reciprocating scrapers; they are then condensed, and the process is continued in the coiling cans.

In spinning the yarn, the rovings are delivered to the spindles on a carriage, which then recedes, when the fibers are twisted, and returns when the spun asbestos yarn is wound on the spindles. The spinning frames do not draw the yarn, and no strain is placed on it until after it is twisted. This brings the manufacture of the fireproof material to a point where it is to be woven into cloth, packing, or other forms; for asbestos is used for divers other purposes than those appertaining to theaters.

While adulterated asbestos may be used in some of the mechanical arts, for theatrical hangings its purity should be 100 per cent; it then forms one of the safest barriers against the calamity of fire. As a matter of fact, much of that which is termed commercially pure asbestos cloth contains from five to twenty per cent of combustible matter, but absolutely pure American-made cloth may be obtained, where price is not a primary consideration.

Not only is purity essential in asbestos cloth where used for protection against fire, but strength as well; and after asbestos is subjected to a high temperature, it has a tendency to powder, when, owing to its weight, it may break through, and its utility be impaired.

One of the leading manufacturers has made an improvement in weaving asbestos cloth for theater curtains; it consists of two strands of asbestos spun around a strand of high-temperature-melting brass wire, so that the wire is completely embedded and concealed. These asbestos metallic strands form the warp, so that the threads run the long way of the cloth when finished. The weft, or filling-in cross threads, is made of plain, pure asbestos.

Such a curtain will stand well under a severe high-temperature test without breaking. The illustrations show clearly the different mechanical processes for converting the mineral into the finished cloth. Not only theater curtains, but set scenery of all kinds may be constructed of asbestos. Scenic artists find it more difficult to paint, but the finer textures may be utilized for this purpose; and although asbestos cloth does not take colors as satisfactorily as cheese cloth and burlap, yet its use should be provided for wherever audiences are to be assembled.

Flooring and woodwork in general may be easily replaced by compressed asbestos fiber board, and it has been shown that the latter may be stained, polished, and finished to as high a degree as wood. All the upholstery should be of pure asbestos cloth, and carpeting is also made to take the place of the combustible vegetable and animal fibers now used so extensively. One of the peculiar properties of asbestos carpeting is that the longer it is in service, the tougher it becomes.

Asbestos is utilized in the arts in many other forms than cloth; it may be worked into a pulp, and a fireproof paper is obtained. This paper is now used on roofs, between walls, flooring, etc. Fireproof rope three-eighths inch in diameter for the suspension of curtains and other uses is made having a tensile strength of 1,650 pounds per foot. High-grade asbestos plaster is fireproof, soundproof, and hangs together with great tenacity when subjected to water.

Asbestos mineral with rock as it comes from the mine costs $200 per ton, but after it is stripped the long fibers are worth $1,500 per ton. When these are made into cloth it sells for $3 per square yard; when made into curtains, the sewing is done with asbestos thread.

The Current Supplement.

The current SUPPLEMENT, No. 1466, opens with an excellent description, illustrated by several large engravings, of the construction of Globe Island Bridge, Sydney, New South Wales. Electrical engineers will read with interest an article in which the results of the German high-speed railway trials are critically analyzed. The article on the Edison Portland Cement Works is concluded. The summary of the grants made by the Carnegie Institution is concluded. Mr. Samuel P. Langley, Secretary of the Smithsonian Institution, presents an interesting biography of James Smithson, the founder of the institution that bears his name. The article is particularly timely, inasmuch as Smithson's body has been transported from Genoa to Washington, in order that it may rest in the grounds of the Smithsonian Institution. Mr. W. A. Del Mar attacks the problem of melting sleet on a third rail, and shows what the prospects of success are of heating the rail. A new panoramic telescope has been exhibited in Germany, which gives to the man behind the gun an opportunity of completely examining a field of 360 degrees without moving either himself or the eyepiece of the instrument. The instrument is described in full. The Paris Automobile Show description is continued.

Transatlantic Turbine Liner.

The "Victorian," the first of the Allan Line's new turbine steamers for the Atlantic service, is fast nearing completion in Clarke & Co.'s shipbuilding yard at Belfast. She will probably make her first visit to Canada during the fall of this year.

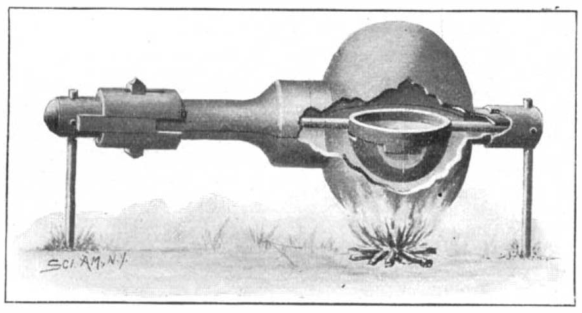
Turbine steamers in cross-Channel service have proved a great success, chiefly because of insuring more comfort to passengers in rough weather, but great modifications and alterations in the system had to be devised to suit Atlantic requirements.

While the French submarine boat "Narval" was leaving Cherbourg Harbor recently, she came into collision with a tugboat which was traveling at right angles to the course of the submarine. The officer of the latter observed the approaching tug, and immediately reversed his engines, the "Narval" at the time making a speed of five knots. Although the momentum of the submarine was thus considerably reduced, she struck the tugboat with sufficient force amidships to force her nose through the hull of the latter to the extent of 16 inches, and the tug ultimately foundered, when the nose of the "Narval" was withdrawn. This accident affords a conclusive estimate of the strength and power of these submersible craft for ramming purposes, when driven at full force against another craft; and, according to French Admiralty experts, opens new possibilities concerning naval tactics.

Patent Department

COOKING DEVICE FOR CAMPING PURPOSES.

In the accompanying illustration we show a device which will be found very convenient for camping

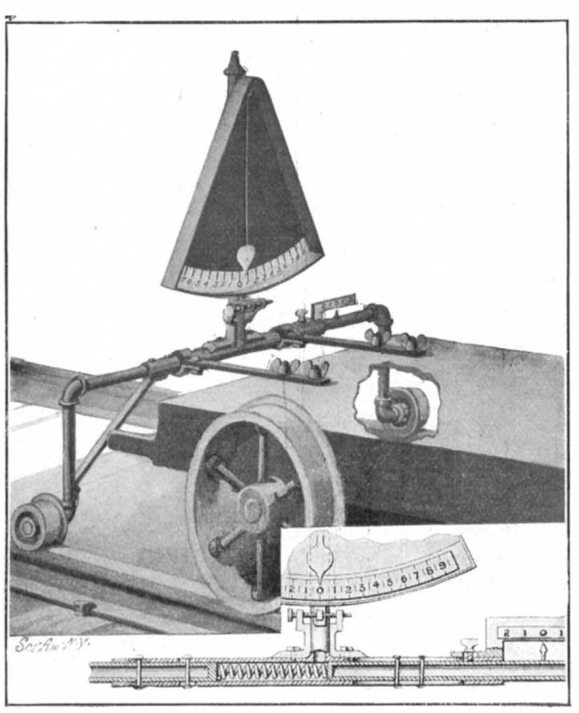


COOKING DEVICE FOR CAMPING PURPOSES.

parties, as it provides a simple means for frying, baking, or otherwise cooking food, and furthermore may be readily packed up and stored away when moving camp. The device consists of two bowl-shaped sections which may be fitted together to form a closed chamber within which the food may be cooked without coming in contact with the flames of the camp fire. Within the chamber is a pan on which the food to be cooked is placed. The pan is provided with handles at each end, which pass through tubular openings formed by trough-shaped extensions on the bowl-shaped section. The handles of the pan at their outer ends are formed with enlarged portions, on one of which a flange is formed which fits over the bowl extensions at that end, firmly locking them together. At the opposite end the bowl extensions are locked together by a sleeve which is slipped over them; this sleeve is held in place by bolts passing through slots therein and threaded into the handle of the pan. The device is supported on stakes which are driven into the ground and at their upper ends enter sockets in the enlarged portions of the pan handles. The longer handle is made tubular so that when the device is not in use the stakes may be packed therein. A cap is provided to close the end of this handle. When desired the device may be taken apart and the bowl sections used as saucepans. It will be observed that a bowl is secured under the pan. Water may be placed in this bowl to furnish the necessary moisture for the food that is being cooked. The inventor of this device is Mr. James Henault, 1428 West 12th Street, Los Angeles, Cal.

AUTOMATIC TRACK GAGE.

The automatic track gage which is illustrated herewith may be readily attached to the ordinary handcar in such a manner that the exact elevation of curves and the variations in the distances apart of the rails of a track may be accurately and quickly ascertained. In other words the exact state of the track, both as to gage and level, may be observed at a glance by the operator of the machine. The gage comprises an inverted U-shaped frame to the ends of which flanged wheels are journaled. These wheels are adapted to run on the tracks in advance of the handcar to which the gage is attached by means of two bars. The horizontal bar of the frame consists of two members which are connected by a tubular sleeve slipped over their inner ends. One end of this sleeve is connected with one

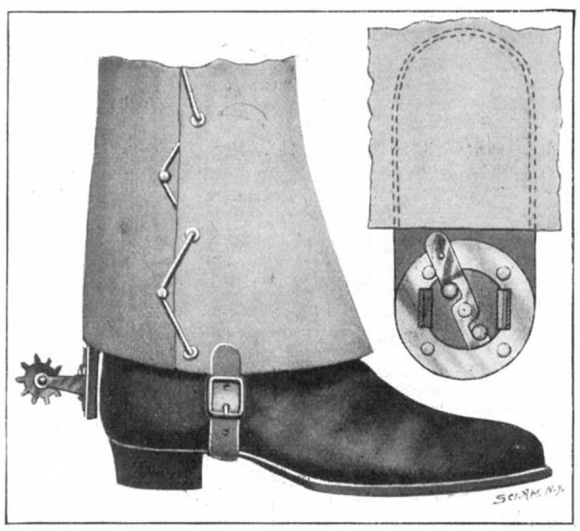


AUTOMATIC TRACK GAGE.

of the arms by a brace bar, as shown in our illustration. The other arm is secured to the sleeve by bolts which pass through slots in the sleeve, thus permitting a limited sliding movement of the arm in the sleeve. A coil spring in the sleeve exerts a constant outward pressure on this arm and a pointer on the arm indicates the position of the arm on a gage scale attached to the sleeve. Centrally secured on the sleeve is a standard bearing a segmental dial or measuring scale. A heavy pendulum pivoted at the upper end of the standard bears a pointer which, when the device is level, lies directly in line with the zero mark on the dial. In operation any irregularities in the track will be immediately indicated either on this dial or on the gage scale. If the track is not level, the pendulum will swing to one side or the other indicating exactly how much out of true the track is; while if the width between the rails of the track varies from the standard the movable arm will either be crowded inward or permitted to move outward correspondingly, and indicate the variation on the scale. The gage scale and the dial are each made adjustable so that they can be accurately set to bring the zero marks in line with their respective pointers. The inventors of this device are Messrs. Thaddeus Ellis and George H. Purvis, of Lester, Wash.

SPUR ATTACHMENT FOR LEGGINGS.

A recent invention provides an improved detachable spur attachment for leggings such as are used by cavalrymen and other horsemen. The device is so arranged as to permit ready and convenient removal of the yoke and rowel from the legging whenever the horseman so desires. As shown in our illustration, the design of the spur attachment is very simple. A strap of stiff leather is secured to the legging at the rear, preferably on the inside. A portion of this strap projects below the legging, and carries a metallic disk on which the yoke is removably secured. Thus the



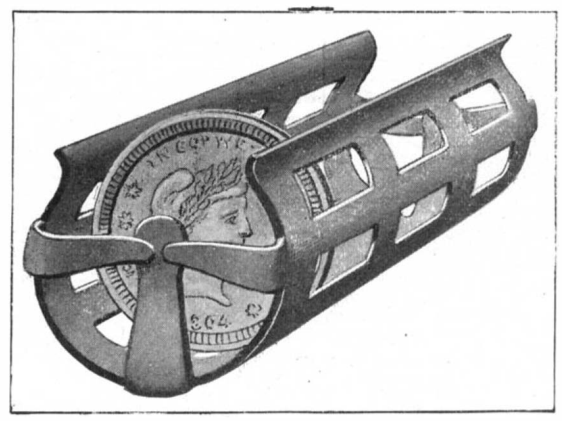
SPUR ATTACHMENT FOR LEGGINGS.

spur is held at about the same position with respect to the foot that spurs are ordinarily held. In our detail view the rowel and part of the yoke have been broken away, to clearly show the simple locking means used for holding the yoke to the disk. It will be observed that two pins are secured to the disk, and project through openings in the base plate of the yoke. A lock bar is fulcrumed centrally on the outer face of the base plate, and is adapted to be swung into engagement with notches in the pins. One end of the lock bar is extended to form a handle. A pin secured to this extension snaps into a registering aperture in the disk when the bar is in locked position. Now, if for any reason the horseman should find it desirable to remove the spur, he needs simply to swing the lock bar out of engagement with the pins, when the yoke and its rowel may be detached from the legging. The inventor of this improved spur attachment is Capt. William Carey Brown, First U. S. Cavalry, of Fort Clark, Texas, Brackettville P. O.

A HANDY COIN HOLDER.

A simple little device has been invented by Mr. Adna G. Bowen, of 401 West 124th Street, New York city, which is adapted to hold coins of a predetermined number. This improved holder is so arranged as to closely fit both new and worn coins. This is an important point, for it is a well-known fact that a number of new coins makes a much higher pile than the same number of old coins, and heretofore it has been necessary to make three sizes of coin holders for every denomination.

As shown in our illustration, the body of the clip is cylindrical in form and has an opening along the top, throughout its entire length, of about 150 degrees in width. It is made of spring metal, which yields when the coin is pressed endwise into the holder, and after the coin has passed into the cylinder body, the spring metal sides close over the coin, and hold it from falling out of place. At the ends of the holder tongues are provided, which give sufficiently to allow the coins to pass into the body of the holder, yet are sufficiently strong to compel the same to stand upright in mass. These tongues normally incline inwardly to a sufficient degree, and have sufficient spring to



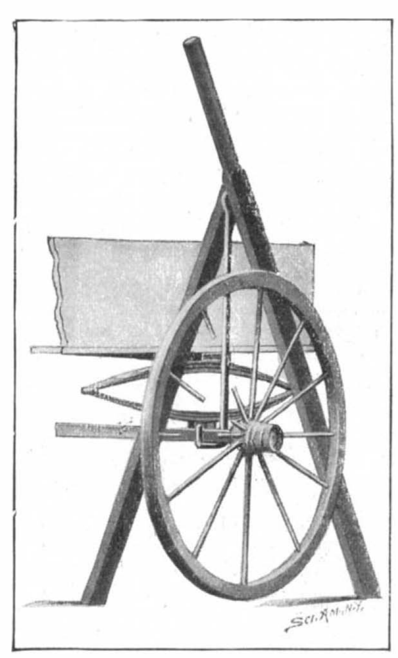
A HANDY COIN HOLDER.

take up any variation in the thickness of the quantity of coins interposed between them.

LIFTING JACK.

A recent invention provides a very simple device for lifting the axles of vehicles, to permit removal of the wheels. A glance at the illustration will reveal the construction of the device, and the method of operating it to lift the axle. It comprises two wooden bars and a swinging or suspension bar, which are all pivoted together at a common point by a single bolt. The longer one of the wooden bars is provided with a handle, by which the device may be operated. The hanger piece consists of a flat metallic bar bent to form a foot piece at its lower end. It is loosely suspended from the bolt between the bars, being spaced apart from the latter by means of washers to permit free movement. In using the lifting jack, the wooden bars are placed astride of the axle. The freely-moving hanger falls against the axle, and quickly adjusts itself to any height of the axle when it is lifted, so that when the handle of the longer bar is pulled backward or forward, according to the position in which it is placed, the hook of the hanger is brought upwardly against the axle, and lifts the wheel clear of the ground, after which a movement of the hand or foot of the operator presses the shorter bar into engagement with the ground, and firmly secures the jack in position. When the axle is thus suspended, it is so securely held by the jack that a chance lateral movement of the vehicle or a forward or backward movement of ten or twelve inches may be made without loosening or dropping the axle, because the swinging hanger adjusts itself to the position of the axle. In fact, the hanger prevents the vehicle from moving down a slight incline, such as a slanting washing floor. The bars of the jack are of sufficient height to permit the device to be easily adjusted to an axle without stooping or requiring the operator to pass between the wheels and the body or the shafts of the vehicle. The Rev. M. M. Moore, Sr., of Santa Barbara, Cal., is the inventor of this improved lifting jack.

A dispatch from Winnipeg, Manitoba, says that Hugh Mann, brother of D. D. Mann, vice-president of the Canadian Northern Railroad, was accidentally killed on September 11 near Erwood, N. W. T., while superintending the operation of a new track-laying machine of which he was the inventor and which was being used for the first time.



AN IMPROVED LIFTING JACK.

RECENTLY PATENTED INVENTIONS.

Hardware.

BRACE.—A. S. E. METCALF, Driscoll, N. D. In this patent the invention relates particularly to improvements in a combined brace, chuck, and wrench, the object of the inventor being the provision of a device of this character having a wide range of adjustments for holding bits and drills and for removing nuts of various sizes.

Miscellaneous.

MEANS FOR CONSTRUCTING CISTERNS OR THE LIKE.—W. SKINNER and C. LINDSEY, Wellington, Kan. Though applicable to the building or erection of various structures of masonry, the improvements are intended more especially for use in the construction of cisterns, sewers, caves, and the like; and the principal object is to provide means for this purpose which are both effective and reliable in use or operation besides being quickly applied and removed and also possessing capacity for long and repeated service.

BOTTLE-STOPPER.—A. BUCKMAN, Brookview, N. Y. Though applicable to nearly all forms of bottles employing a cork or similar stopper, the improvements are intended more especially for use in connection with beer and similar bottles, as well as medicine-bottles and the like. One of the principal objects is to provide a cork or stopper with means permanently applied thereto by which the stopper may be readily extracted from the mouth of the bottle without the use or aid of a corkscrew.

TIME HAND-STAMP.—W. F. BARTHOLOMEW, New York, N. Y. This inventor's object is to provide a stamp arranged with interchangeable dates, a fixed time dial-stamp, and a movable pointer-stamp, together with a face-indicating device to permit of quickly and correctly setting the pointer-stamp to allow of correctly stamping the date and time on letters, receipts, sale slips and other matter.

SUSPENDING ATTACHMENT FOR GAME BAGS, ETC.—G. F. CLARKE, Toronto, Canada. The purpose in Mr. Clarke's invention is to provide an attachment for suspending a game or other bag from the shoulders and body of a person so as to support the receptacle upright and hugged closely to the body in a perfectly secure manner, leave one shoulder and both arms free, and prevent displacement of the bag when the wearer assumes a leaning, kneeling, stooping, or crouching position, or when walking, or bicycling. The improvement is applicable to haversacks, school bags, and cartridge bags.

DEVICE FOR USE IN SHARPENING PENCILS.—W. S. DOE, Jersey City, N. J. In this instance the object is to provide a device for use in sharpening pencils and the like which is simple and durable in construction, not liable to get out of order, and arranged to permit the use of an ordinary knife to cut down the wood and core of the pencil to give a fine regular finish to the sharpened end.

WATER-TANK.—J. T. DONAHOO, Edgar, Neb. The improved tank in the present case is so constructed as to resist great pressure from without or within, and while it is adapted for general use it is particularly designed by the inventor for employment in connection with an air forcing and pressure apparatus.

BRACKET.—J. GARDNER, Lismore, New South Wales, Australia. The invention is an improvement in locking angle-brackets for use on writing desks in schools, warehouses, etc.; also for shelves for displaying goods at any angle, for steps, trestles, folding wheelbarrow-legs, stools, and other locations wherein an adjustable bracket is desired.

JAR-CLOSURE.—O. N. HOFFMAN, St. Johnsville, N. Y. This invention refers to closures for fruit-jars or other similar receptacles, and has for its object to provide details of construction for a closure which are very simple, easy to apply and release, and that will effect a reliable air-tight fastening of a fruit or other jar after filling the same and dispense with the use of tools to close or open the jar.

FOLDABLE STOOL.—W. B. S. HUSSA, West Hoboken, N. J. Mr. Hussa's invention relates to improvements in foldable stools; and his object is to provide a construction in which all of the parts may be packed in a hollow member which in the assembled condition of said parts forms an essential part of the stool structure, whereby the article may be easily carried in the hand or pocket.

WOOD-HOLDER.—J. E. WALLIN, Tacoma, Wash. The object of the invention is to provide a novel portable device for holding a billet of wood in an upright position to enable the cutting of shavings therefrom to use as kindling material in the starting of fire to ignite larger wood in a stove or range.

Designs.

DESIGN FOR A GLOVE.—F. SCHMIDT, New York, N. Y. This ornamental design for a glove comprises a double U-shaped herring-bone stitching of three rows on the back of the glove. The open end of the design extends to the knuckles and the under end about on a line with the base of the thumb.

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.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 5049.—For makers of castings for a small steam engine, for driving a small generator of 10 volts.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 5050.—For manufacturers of supplies for making rubber stamps.

AUTOS.—Duryea Power Co., Reading, Pa.

Inquiry No. 5051.—For manufacturers of very light motors.

For hoisting engines. J. S. Mundy, Newark, N. J.

Inquiry No. 5052.—For the address of the manufacturers of the Universal American accordion pleating machine.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 5053.—For dealers in second-hand engine lathes.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 5054.—For the address of the manufacturers of the Spencer automatic damper regulator.

American inventions negotiated in Europe, Felix Hamburger, Equitable Building, Berlin, Germany.

Inquiry No. 5055.—For manufacturers of machinery used in cider-making plants.

Edmonds-Metzel Mfg. Co., Chicago. Contract manufacturers of hardware specialties, dies, stampings, etc.

Inquiry No. 5056.—For machinery for extracting fiber from flax straw.

Inventions developed and perfected. Designing and machine work. Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 5057.—For manufacturers of a complete apparatus and machinery for making concentrated acetic acid.

FOR SALE.—Patent on finest spike and bolt puller in existence. No. 714,107. For particulars write W. L. Harris, Central City, W. Va

Inquiry No. 5058.—For parties to manufacture a registering face for a water meter.

Empire Brass Works, 106 E. 129th Street, New York. N. Y., have exceptional facilities for manufacuring any article requiring machine shop and plating room.

Inquiry No. 5059.—For manufacturers of gasoline lamps.

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 5060.—For manufacturers of large earthen vats.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 5061.—For makers of all kinds of slot machines.

FOR SALE.—SCIENTIFIC AMERICAN, twenty volumes from 1872 to 1881, two volumes to a year, in perfect condition. Make us an offer. David Kahnweiler's Sons, 437 Pearl Street, New York.

Inquiry No. 5062.—For makers of flat steel or phosphor bronze springs, similar to clock springs, of special dimensions.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 5063.—For makers of Mrs. Teller's cooking knife and of hardware specialties for the mail order trade.

Wanted—Revolutionary Documents, Autograph Letters, Journals, Prints, Washington Portraits, Early American Illustrated Magazines, Early Patents signed by Presidents of the United States. Valentine's Manuals of the early 40's. Correspondence solicited. Address C. A. M., Box 773, New York.

Inquiry No. 5064.—For manufacturers of or dealers in diamond drilling machines, also for parties doing such work.

SOUTH AMERICAN AGENCY WANTED.—Reliable party resident in South America desires to represent or act as selling agent for manufacturing or export firms. Address A. M.,
122 Front Street, New York.

Inquiry No. 5065.—For manufacturers of steel flumes.

The Imperial and Royal Austro-Hungarian Embassy has received a new supply of the publication referring to the international competition for prizes offered by the Austrian Government for plans for best boat-raising works in the construction of the Donau-Oder Canal. Parties interested in the mentioned competition can obtain a copy of said booklet at the Embassy's office 1304 Eighteenth Street,
Washington, D. C.

Inquiry No. 5066.—For makers of machinery for making paper pulp from wood. also for dealers in pulp.

Wanted—A waterproof cement for use on fabric and leather, which will be strong, will set readily, and can be used without much heat.
Address A. C., Box 773, N. Y.

Inquiry No. 5067.—For a large hydraulic press capable of pressing 500 pounds to the inch on the platen; size of platen 5 x 3 feet, 6 feet preferred; also power pump for same; for makers and second-hand dealers in such.

Inquiry No. 5068.—For addresses of manufacturers of goods of all kinds.

Inquiry No. 5069.—For makers of electrical vibration apparatus for massage, etc.

Inquiry No. 5070.—For tin cans of from 1/8 to 1 pound in size, also for parties to print and glue wrappers on such.

Inquiry No. 5071.—For apparatus for the destructive distillation of wood.

Inquiry No. 5072.—For makers of portable band saws for sawing logs into stave wood.

Inquiry No. 5073.—For makers of wrought iron fences and gates, also chairs for use in summer gardens.

Inquiry No. 5074.—For addresses of gas, mineral oil, gasoline, motor, etc., firms of America.

Inquiry No. 5075.—For makers of metal, celluloid and aluminium novelties.

Inquiry No. 5076.—For manufacturers of or parties making cutting or grinding machines for brick.

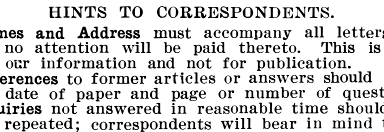
Inquiry No. 5077.—For makers of an electrically heated iron used by veterinary surgeons to burn the legs of horses.

Inquiry No. 5078.—For dies and machines for embossing photographic cards, also a beveling machine for all kinds of cardboard.

Inquiry No. 5079.—For makers of machinery for handling peanuts, including hulling, etc.

Inquiry No. 5080.—For machinery for making lead pipe of the size of 1/2 inch upward.

Inquiry No. 5081.—For makers of steel hooks and eyes, such as used on waistbands.



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.

(9304) H. F. S. says: 1. In your issue of January 2, in Notes and Queries, No. 9264, you say that water can only be pulled 33.9 feet with a siphon, in which I agree with you; but it has been disputed in our town. One man claims he raised water out of a well 70 feet deep, from the bottom; took all the water out. Now is this possible by just running an air-tight hose up out of the well and down a hill below the level of the bottom of the well? A. Water cannot be raised higher than stated in question 9264. The story of the man with the hose needs explaining by the man who told it. 2. Please explain why water will siphon at 700 deg. F., as you stated in query No. 9264. A. The 700 deg. F. was a misprint; it should have been 70 deg.

(9305) J. H. R. asks: Will you please inform me how the degrees of very high temperature are measured, say temperature of 2,000 deg. or 3,000 deg.? How is it ascertained at what temperature iron will melt? A. The instruments by which high temperatures are determined are called pyrometers. There are many kinds of these. Some depend upon the pressure of a gas held at a constant volume while heated; others utilize the calorimetric value of the heat acquired by a refractory metal, such as platinum or nickel, while exposed to a high temperature; others employ the change in electrical resistance of platinum when heated, and some use the light radiated from a highly heated material to determine its temperature. This last method is used to determine the temperature of a Bessemer converter. Finally, fusible substances such as Seger's cones are employed to determine the temperature of an oven in which pottery is baked. We have published at different times twelve articles in the SCIENTIFIC AMERICAN SUPPLEMENT upon pyrometers, which we can send for 10 cents each. The whole matter is fully treated in a recent book, "High Temperature Measurements," by Bondouard, which we can furnish for $3 by mail.

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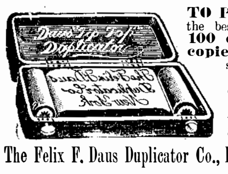

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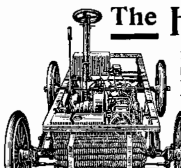

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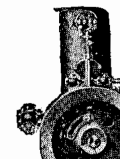

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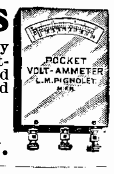

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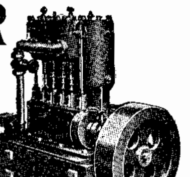

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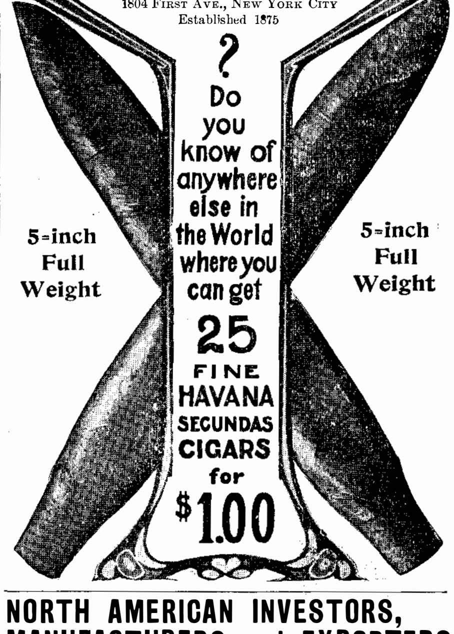

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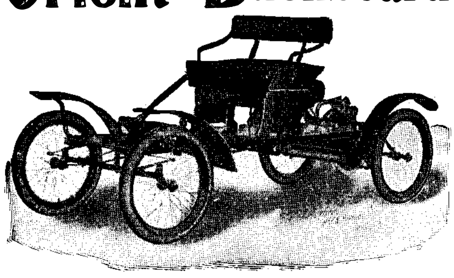

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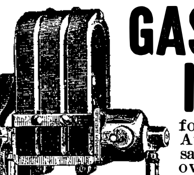

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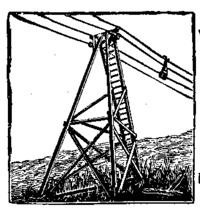

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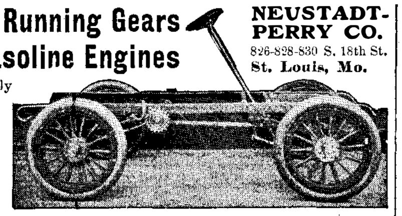

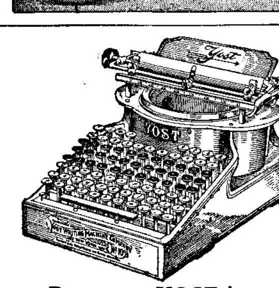

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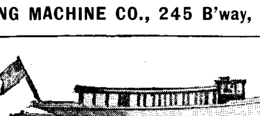

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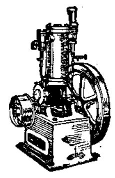

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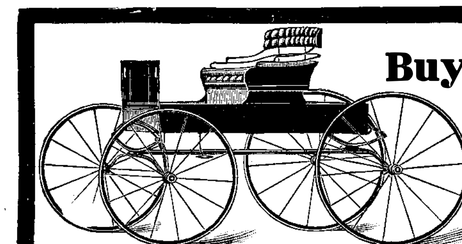

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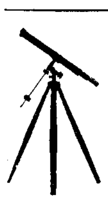

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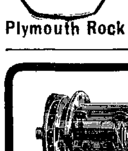

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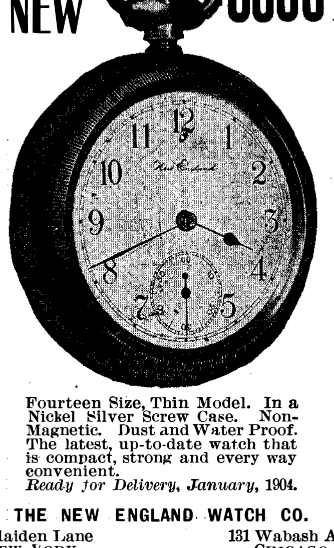

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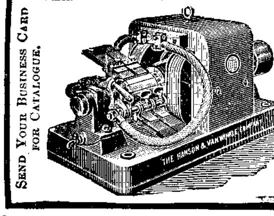

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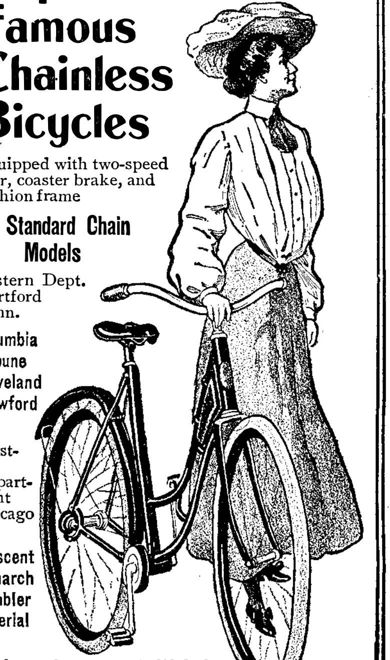

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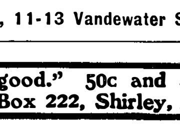

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