SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., - - Editors and Proprietors

Published Weekly at

No. 361 Broadway, New York

TERMS TO SUBSCRIBERS

One copy, one year for the United States, Canada, or Mexico $3.00
One copy, one year, to any foreign country, postage prepaid. £0 16s. 5d. 4.00

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (Established 1845)	$3.00 a year
Scientific American Supplement (Established 1876)	5.00 "
Scientific American Building Monthly (Established 1885)	2.50 "
Scientific American Export Edition (Established 1878)	3.00 "

The combined subscription rates and rates to foreign countries will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.

MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, OCTOBER 1, 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.

WARSHIP CONSTRUCTION IN GOVERNMENT YARDS

The fact that the first large battleship to be constructed in a government yard has been built in the same time as that required to construct a sister ship in what is probably the best equipped private yard in the United States, is a matter that is giving the Navy Department no little satisfaction; for it has disposed effectually of the popular belief that warship construction in a government yard was necessarily tedious, costly, and poorly done.

How it has come about that such an impression exists is a question that takes us back to the day of the building of the "Maine" and the "Texas." Both of these vessels were long in construction, the cost of which was very high; but this is explained by the fact that when they were built, our navy yards were suffering from very serious political interference, and were burdened with a large number of employees who had gained their entrance to the yards through political influence, and regarded their positions as of that kind in which a minimum amount of work is to be done for a maximum amount of pay. To turn out efficient work under such circumstances, especially in the difficult art of warship construction, was a simple impossibility—as the various naval constructors soon found out to their sorrow. Moreover, when the "Maine" and the "Texas" were built, steel warship construction was in its infancy in this country, and the navy yards were but poorly equipped for the task, much of the plant being quite out of date.

To-day, however, we have changed all that. Thanks largely to the energy and courage of the late Chief Naval Constructor, our navy yards have been entirely emancipated from political control, new drydocks, buildings, and plants have been built and installed, until to-day our best yards, and notably that at Brooklyn, are in first-class condition, and capable of turning out the very best work.

The Bureau of Construction and Repair, as soon as it felt that it was in condition to handle warship construction to advantage, began to urge strongly upon the Secretary of the Navy the advantage of constructing some of our new ships in government yards. The principal arguments in favor of such a course were, first, that the private builders, who were showing a great lack of diligence in the prosecution of their contracts for new ships, would be stimulated to greater activity if they knew that ships were being built in government yards, and a new standard of expeditious work thereby set up. Another, and not less important object aimed at, was to insure that the full working staff of the navy yard would be constantly employed at all seasons of the year. Hitherto the navy yards had labored under the great disadvantage that when the regular repair work was completed, it became necessary to discharge a large proportion of the working force. The mechanics thus set free scattered in search of work, and in the following season, when repair work became active, it was necessary to gather a new force, which had to become acquainted with the plant and the general working of the navy yard before the best results could be secured. Now, it was judged that by having one or more new ships always on the stocks, the necessity for discharging any of the force, when repair work slackened, would be removed, inasmuch as it could be transferred to new construction.

It is now nearly two years since the new regulations were put in force, and it was decided to put them to a searching test by ordering the construction at the Brooklyn navy yard of one of the largest battleships ever built for any navy. At the same time, the contract for a sister ship was placed at the private yard of the Newport News Shipbuilding Company, one of the most completely equipped plants in the world.

The results have exceeded the most sanguine expectations of the Navy Department, for, in spite of the disadvantages under which the Brooklyn navy yard labored, owing to the fact that it had to build entirely new ways and erect a large cantilever traveling crane before the keel of the vessel could be laid, the "Connecticut" has been built in about the same time, namely, eighteen months, as was the "Louisiana," while both the time of construction and the cost of the vessel have been considerably less than was estimated at the time the order for the vessel was given—and this in spite of the fact that the hours of labor are shorter, and the pay is higher in government than it is in private shipyards.

The Scientific American has always been a strong advocate of the policy of building some of our new warships at government yards, and therefore it gives us particular pleasure to congratulate the naval constructors on the excellent results that have been achieved in the case of the "Connecticut." The effect of the new policy on the private shipbuilding firms of the country has been everything that could be desired. There has been a notable acceleration in the rate of construction, the "Louisiana" having been launched in eighteen months from the date of the laying of the keel, no less than 7,000 tons of steel being worked into her hull at that period. This is a great improvement on any previous work, the best record previous to this for a battleship being about two years' time, and this for a vessel of smaller size and less importance than the "Louisiana." It is to be hoped that the good results that have been attained will encourage Congress to allot a certain portion of every shipbuilding programme to government yards, and that not only New York, but League Island, Boston, and other leading government yards will be given their share of the work.

THE CHALLENGE CUP MOTOR-BOAT CONTEST.

The races for the Gold Challenge Cup of the American Power Boat Association, which are being run off as we go to press, have proved that the development of the motor boat in this country has progressed to a point at which it can compare in point of speed and reliability with the fastest of the European craft. In saying this it is but fair to state, however, that many of the boats are carrying engines of foreign make, and to this extent the performance is robbed of much of its purely American character. In the lines of the boats, and the design of their propellers, however, both elements of the highest importance as affecting the speed, even of these diminutive craft, the contestants are the product of our own builders.

In the first day's race, intended to be over a 32-knot course from the Columbia Boat Club House, West 85th Street, up the Hudson and back, but actually measuring 27.25 knots, the best performances were those of the winner, Mr. W. K. Vanderbilt's "Mercedes VI.," and the "Vingt-et-un," which made the highest speed over the course. The "Challenger," which has just returned from her unsuccessful quest of the Harmsworth Cup in England, was the scratch boat, and she allowed "Vingt-et-un" 10 minutes 17 seconds; "Speedway," 19 minutes 20 seconds; "Mercedes," U. S. A., 20 minutes 5 seconds; "Macaroni," 26 minutes 56 seconds; "Mercedes VI.," 31 minutes 12 seconds; "Shooting Star," 31 minutes 29 seconds; "Flip," 32 minutes 17 seconds; "Marcirene II.," 56 minutes 55 seconds; and "Josephine," 59 minutes 17 seconds. The first to cross the line was to be the winner. The "Mercedes VI.," steered by Mr. Vanderbilt, proved so speedy that she was the first to overtake the mark boat, which had to drop anchor at once, in order to furnish a turning point. The "Mercedes VI." finished first, covering the course at a speed of 23.07 miles an hour. The "Vingt-et-un," which finished fifth, made the best speed, averaging 24.76 miles an hour. The second race was run off in a nasty sea, and many of the smaller boats shipped so much water that they had to stop to bale out, the "Mercedes VI.,'" which was the first around the mark, being one of these. The "Vingt-et-un" came through in splendid style, thanks to her high freeboard, and careful handling, covering the course at an average speed of 25.36 statute miles per hour. This performance is particularly gratifying because of the fact that she carries an American-built engine. This speed brings the American record within less than a mile of the 26.25 miles an hour recently made at Monte Carlo by the "Trefle-a-Quatre." In both races the "Challenger," as the result of some defect in her thrust block, did not go over the course.

WATER VERSUS STEAM POWER.

Steam power is going out of fashion. Water power is coming in. Electrical transmission is working the change. Carried to its possible results, this utilization of water powers means the extinction of the steam engine. Such a complete victory for water power in many cases is by no means improbable. An example is ready at hand. In Niagara Falls, a city of large and varied manufacturing interests, not a single steam engine is at work. This instance is not as exceptional in its conditions as might be thought. Great as is the power of Niagara Falls, the cost of development per unit of plant capacity is quite as large as that on many another river. On the other hand, the price of steam coal at Niagara Falls is much below that in New England and many other parts of the country.

Results in the extinction of steam power plants at Niagara Falls are exceptional in degree rather than in kind. In hundreds of villages and towns throughout the country steam engines have been almost, if not altogether, displaced by electrically-transmitted water power. In scores of cities steam engines of the largest sizes have been shut down, and their work taken up by electric power from distant waterfalls. The steam plants thus rendered silent and useless are not designed for any particular line of industry. Some stand in former power houses of electrical supply and railway systems, that are now operated from sub-stations with transmitted water power. Idle steam plants in such locations may be seen at Montreal and Albany, Buffalo and St. Paul, Salt Lake City and San Francisco. In some such cases, as at Buffalo and Montreal, the steam plants are not started even at times of maximum loads on the electric systems. Others of these idle steam plants are in large cotton mills, as at Montreal, where the electric motors that are doing the former work of the steam equipment have an aggregate of thousands of horse-power. Large machine works furnish other illustrations of steam plants that have been put out of service by transmitted water power and electric motors. In one such case, at Concord, N. H., the shops of the railway that hauls all of the coal entering the city are operated by electric motors of about 550 horse-power total rating, and the steam plant that formerly did the work is permanently out of use. Another case, this time in Buffalo, shows the substitution of electric water power for steam in a plant for the manufacture of pumps, where the horse-power required is over two thousand. So the list might be indefinitely extended to include grain elevators and malt houses, flour and cereal mills, rubber works and iron foundries, ore smelters and chemical works, and almost every sort of manufacturing industry that requires mechanical power in large or small units. No loads are too great to be operated by transmitted water power, and none are too small for efficient driving with electric motors. The sewing machine making shirts, and the heavy machinery employed in the construction of steel ships, are alike moved by the transmitted energy of distant, falling water.

With factory loads as well as electrical supply and railway systems shifting from steam to water power, the amount regularly transmitted to cities is already large and is rapidly increasing. Portland, Me., and Springfield, Mass., each receive more than two thousand horse-power electrically transmitted from waterfalls. At both Manchester, N. H., and Hartford, Conn., the corresponding figures are more than three thousand. About ten thousand horse-power goes alike to Schenectady, N. Y., and San Francisco, Cal. St. Paul, Minn., gets approximately four thousand horse-power, Albany, N. Y., fully as much, and Los Angeles, Cal., more. Montreal leads the list of centers for transmitted water power with nearly thirty thousand, and Buffalo is a close second with much more than twenty thousand horse-power, at times of maximum load. The city of Niagara Falls itself is so close to the electric generating stations that its supply of energy may be said to be distributed rather than transmitted, but the amount utilized there is nearly seventy thousand horse-power. To this striking example of great industries built up about an electrically-developed water power may be added that of Shawenegan Falls, Massena, and Sault Ste. Marie, near each of which thousands of electrical horse-power are distributed to manufacturing plants.

Without the aid of electrical transmission and distribution this displacement of steam by water power could never have taken place on its present great scale. Even at water-power cities the distribution and the application of energy to manufacturing plants is accomplished much more readily by electrical means than with the water itself. It is largely for this reason that many water powers previously unused are now becoming centers of industry. The great majority of manufacturers, however, cannot be drawn away from the centers of population, even by the advantages of cheap water power, and for them the choice is necessarily between steam plants and transmission from distant waterfalls. This choice is based on commercial rather than on sentimental or even sanitary reasons. Electrical energy transmitted from water powers displaces steam in manufacturing plants, not so much because the former is cleaner, safer, and more conducive to good health, as because it is cheaper. Perhaps the most remarkable feature of the electrical development of water power is the fact that the energy can be transmitted ten, scores, and even hundreds of miles, and then delivered in large units at prices below the cost of power from coal. Of course, the distances over which water power can be profitably transmitted vary much with the conditions at both the generating and the receiving ends of the line, but experience has amply shown that a transmission of some length may be made to advantage from almost every water power of considerable size. As the cost of fuel goes up, the distance of profitable transmission for water power increases, but even very cheap fuel sometimes fails in competition with transmitted water power. Even free fuel could not hold its own against transmitted water power in all cases, because the labor cost of operation is much higher in a steam than in a water-power plant. For illustration of these facts, to some extent, it is only necessary to consider the case of Buffalo, where the price of steam coal sinks sometimes as low as $1.50 per ton, and water power is delivered from a distance of 23 miles. As an example of the rates for transmitted energy from water falls that have enabled it to displace steam power, the flat charge of twenty-five dollars per horse-power year may be mentioned. This charge for power, 24 hours per day and 365 days in the year, is made to large consumers by several transmission systems, and is constant for the number of horse-power covered by the contract without regard to the time during each day that it is actually consumed. If the purchaser of electric power on this basis can use it only 10 hours per day and 300 days per year, or 3,000 hours, his rate per horse-power hour amounts to 0.83 cent for the energy actually consumed. Where the power can be used 24 hours per day and every day in the year, the flat rate of $25 per horse-power year amounts to only 0.29 cent per horse-power hour. Who would shovel coal for this money?

THE HEAVENS IN OCTOBER.

BY HENRY NORRIS RUSSELL, PH.D.

We may begin our survey of the sky this month by going out about 9 o'clock on any clear evening in the middle of October, facing south, and looking up about two-thirds of the way from the horizon toward the zenith. The constellation directly before our eyes will then be Pegasus. Its characteristic feature is a large square of second magnitude stars, which has now nearly reached the meridian. A number of stars on the right also belong to the constellation.

Below this is the extensive but inconspicuous Aquarius, south of which, and in line with the western side of the great square of Pegasus, is a solitary bright star, Fomalhaut, in the otherwise unimportant constellation of the Southern Fish. Still farther south, and almost on the horizon, is Grus—the Crane—a constellation conspicuous in the southern skies, whose two brightest stars just rise above the horizon of New York.

West of Aquarius is Capricornus. The bright object in this constellation is the planet Saturn. It contains no very bright stars, the most conspicuous ones being a little pair to the right of Saturn, both of which appear double in a field-glass.

From the northeastern corner of the great square of Pegasus, a line of stars of about the second magnitude extends to the left, parallel to the Milky Way. The first two of these are in Andromeda, and are both of some interest. The second in order—Gamma Andromedæ—is a fine double star, whose green companion is again divided by powerful telescopes into a close pair in rapid orbital motion.

The first of the two—Beta Andromedæ—serves as a pointer to one of the most interesting objects in the heavens—the Great Nebula of Andromeda. This can be seen, even with the naked eye, as a faint patch of light on the line from Beta Andromedæ through the faint star to the northward, produced about as far again. With a field-glass it appears as a dull patch of light, very different in appearance from the neighboring stars. A larger instrument shows more detail, but it is left to photography to show that the visible part of the nebula is but a portion of a magnificent spiral system, covering an area of sky about as large as the full moon.

Photographs of this nebula have been so frequently published that they are probably familiar to most of our readers. No satisfactory explanation of the remarkable form of this nebula, and the many similar ones, has yet been suggested.

Farther to the left, beyond Andromeda, is Perseus—a group of fairly bright stars in the Milky Way—and lower still is Auriga, with the brilliant star Capella.

The planet Jupiter is by far the most conspicuous object in the southeastern sky. The small triangle of stars above it marks the head of Aries. The lower southeastern sky is occupied by Cetus—a very large but rather uninteresting constellation. A polygon of stars below Jupiter marks the monster's head, and its body extends a long way to the westward, including one conspicuous star, which stands very much alone about 30 deg. west of Fomalhaut.

Taurus is near the eastern horizon, with Aldebaran just risen, and the Pleiades higher up.

Following the Milky Way west from Perseus, we first reach the familiar zigzag of Cassiopeia, pass next through the scattered stars of Cepheus, and so reach Cygnus—a constellation full of interest. Its brightest star—Alpha Cygni—is remarkable for its enormous distance from us. The most careful measurements fail to show any sensible parallax, and we may conclude that the star is so remote that its light must take hundreds of years to reach us, and that it is probably thousands of times brighter than our sun.

A contrast to this enormous orb is afforded by the little star 61 Cygni, which may be found as follows: Alpha Cygni is at the head of a cross of stars lying in the Milky Way. If we complete the quadrilateral formed by the top and the eastern arm of the cross, we come upon a triangle of faint stars. The southernmost and faintest of these—just comfortably visible to the naked eye—is 61 Cygni.

This has long been known as a remarkable star, both because it is double, and especially on account of its very large proper motion, which would carry it over a distance equal to the moon's apparent diameter in about 350 years.

It was one of the first stars investigated for parallax, and the first for which a definite positive result was obtained. The value first found by Bessel for its distance has been but slightly altered by the results of later observers, and it appears that its distance is about 500,000 times that of the sun. At this distance the sun would appear about as bright as the pole-star does to us, so that it is evident that the two components of 61 Cgyni are by no means as bright as the sun.

Below Cygnus, in the Milky Way, is Aquila, marked by the bright star Altair, with a fainter one on each side. North of this, and west of Cygnus, is the still brighter star Vega, in Lyra.

Hercules is below this in the northwest. Draco lies between Hercules and the pole, and Ursa Major is low on the northern horizon.

THE PLANETS.

Mercury is morning star in Virgo, and is at his greatest elongation on the 1st, when he is 18 deg. west of the sun. This distance is less than the average, because the planet is almost at the nearest point in his orbit to the sun. On this account he receives more than the average amount of light, which compensates for his closeness to the sun by making him appear brighter, so that he is as easy to see as usual.

During the first week of the month he rises at about 4:30 A. M. almost due east, and is well visible before the dawn interferes.

Later in the month he gets nearer the sun, and is not easy to see. On the 20th he is about 4 deg. north of the bright star Spica Virginis, but the conjunction will be hard to observe.

Venus is evening star in Libra and Scorpio. She is gradually getting farther from the sun, but is still south of him, and hence inconspicuous, because she sets so early—about 6:30 P. M. on the 15th. She is still 140,000,000 miles from us, and is only one-quarter as bright as at her best.

Mars is morning star in Leo. At the beginning of the month he is quite near Regulus, and moving slowly southeastward toward Beta Virginis. He rises at about 2:30 A. M. on the 15th, and within a few minutes of this time all through the month.

Jupiter is in Aries, and is in opposition on the 18th. He is visible all night long, and is the most conspicuous object in the sky.

Some unusually interesting configurations of his satellites occur during this month. On the 1st, the second and third satellites are eclipsed, while the first travels across the planet's disk. On the 3d, the first and second satellites and their shadows transit across the planet at the same time, affording a very interesting sight. With a telescope of fair size, it is possible to notice the differences in the size of the satellites and their shadows, and in their rate of motion.

The first satellite comes on later, but makes up about half its delay during the transit. The phenomena last from 7 to 11 P. M., and so are at a very convenient time for observation.

The same thing happens again on the evening of the 10th, beginning at 10 P. M. This time the second satellite comes on first, is overtaken by the first, and leaves the planet last. The two satellites are very close together all the time.

On the 12th, before 7:15 P. M., Jupiter has but one visible satellite, the first and third being in front of the planet, and the second behind it. The same phenomenon occurs about 9 P. M. on the 19th. There are other eclipses and transits of the satellites during the month, but they are less interesting.

Saturn is evening star in Capricornus, crossing the meridian at 8:30 on the 1st and 6:30 on the 31st.

Uranus is evening star in Sagittarius, setting at about 8:30 on the 15th.

Neptune is morning star in Gemini, and crosses the meridian at about 4:30 A. M. on the same date.

THE MOON.

Last quarter occurs at 9 A. M. on the 2d, new moon at midnight on the 8th, first quarter at 1 A. M. on the 16th, full moon at 6 A. M. on the 24th, and last quarter again at 6 P. M. on the 31st.

The moon is nearest the earth on the 8th, and farthest away on the 20th. She is in conjunction with Neptune on the 2d, Mars on the 6th, Mercury on the 7th, Venus on the 10th, Uranus on the 13th, Saturn on the 17th, Jupiter on the 23d, and Neptune again on the 29th. None of these conjunctions is close, but on the 27th there is an occultation of the first magnitude star Aldebaran. As seen from Washington, the star disappears at 7:28 A. M. and reappears at 8:26. It will be daylight at the time, but the occultation can be observed telescopically.

At Sea, September 14, 1904.

SCIENCE NOTES.

W. M. Watts has previously shown that there appear to be two distinct kinds of connection between the spectra of allied elements and their atomic weights. In the case of zinc, cadmium, and mercury, and of gallium and iridium, the differences between the oscillation frequencies of certain lines of the one element are to the differences between the oscillation frequencies of the other element as the squares of their atomic weights. In applying this method, some uncertainty exists as to the correspondence of the lines in the different spectra; but it is possible, by accumulating evidence of this kind, to obtain indications as to the probable atomic weight of radium from a comparison of its spectrum with those of mercury, barium, and calcium. By selecting appropriate lines, it is possible to deduce for the atomic weight of radium the values 226.32, 226.42, 225.21, 225.32, 226.52, from the first type of relationship, and the values 225.05, 223.47, 220.36, 223.13, 227.39, and 224.63 from the second type of relationship. The mean of all these results is 224.89, the experimental value being 225. While the spectroscopic evidence now adduced is not of a very certain character, it serves to throw doubt upon the calculations by which Runge and Precht deduced the value 258 for the atomic weight of radium, and indicates that the analytical value is not incapable of being reconciled with the spectroscopic evidence.

In a paper recently presented to the Académie des Sciences, Dr. Charles Repin brings out a new method of acting directly upon the blood and freeing it from toxic substances which it may have absorbed. By a special apparatus which he uses, he literally washes the blood by drawing off the serum and replacing it by an artificial serum formed of a saline solution. In this way the corpuscles are furnished with a fresh liquid and the serum containing the poisonous substances is eliminated from the body. To carry this out, the blood, which is taken by aspiration from a punctured vein, is at once mixed with eight or ten times its volume of a saline solution. The mixture is sent into a centrifugal separator which is so arranged that all the blood corpuscles are collected at one point. They are taken from the separator by a pump which re-injects them into the system at once. The apparatus is entirely automatic and works continuously. It extracts the plasma with all the toxic products and replaces it by an artificial serum. No harm is done to the corpuscles, which do not suffer from their short passage to the outside. M. Repin's method has been applied at the Pasteur Institute. The apparatus is operated by a horizontal shaft which revolves at a high speed. The shaft carries four arms projecting at right angles and each arm has a conical chamber mounted on the end. The shaft and chambers are traversed by a system of tubes which allow three functions to be carried out: First, the blood mixture is brought into the chamber; second, the globules are separated and provided with the right amount of liquid for re-constituting the original volume; third, the surplus of the diluting liquid is drawn off. The apparatus contains a number of details which are necessary to prevent coagulation of the blood and make it work successfully. These will no doubt be illustrated in a succeeding description. By simply passing the blood through the apparatus, all the operations are carried out automatically and the re-constituted blood is returned to the system, after having been washed entirely free from the toxic matter it may have absorbed. Dr. Repin is now demonstrating the physiological effects of this method.

Dr. P. L. Sclater writes an account in Knowledge of the cape jumping hare, an animal so rarely seen in London that the animal from which the artist, Mr. Goodchild, has drawn the illustration is the only one which has ever been brought alive to England. The spring-haas, or cape jumping hare, is nocturnal, or, at any rate, crepuscular, in its habits. It lives in small communities on the open veldt, both in the plains and in the mountain ranges, and makes large and deep burrows in the ground, whence it emerges toward sunset, being rarely seen in the bright daylight. When chased in the open it proceeds in great bounds like a jerboa or kangaroo, for which its highly developed hind legs are admirably adapted, and is even said to move faster up hill than down. Its food is entirely of a vegetable nature, and consists of roots and green stuff of all sorts. Its flesh, according to Le Vaillant, is very good to eat, and in his day was much appreciated by the Hottentots and Kaffirs.