THE PACIFIC OCEAN TELEGRAPH.

The latest advices from the Tuscarora and the party engaged in surveying the bed of the Pacific ocean, to find a suitable route for the cable, report progress from Yokohama, Japan, along the shores of the Kurile Islands and of some of the Aleutian group, and thence across the Kamchatka Sea. "For 1,000 miles from Yokohama," says a correspondent of the *Tribune*, from which journal we take the illustrative diagram, "the depths ranged from 300 to 2,270 fathoms. The greatest slope within the distance is from lat. 40° 01' N., long. 142° 57' E., to lat. 41° 09' N., long. 144° 01' E., being 161 feet to the mile. From lat. 47° 44' N., long. 154° 15' E., the depth gradually increased to 3,754 fathoms at position lat. 50° 19', long. 159° 39', a distance of 260 miles, giving a slope of about 60 feet. Just before entering the Aleutian group, a most remarkable depression was ascertained. It was in lat. 52° 06' N., long. 171° 15' E., and its depth was 4,037 fathoms (24,222 feet), while the preceding and succeeding casts, each only 29 miles distant from this one, were in 2,460 fathoms (14,760 feet) of water, which gave a slope of 326 feet to a mile, the greatest as yet found by us since our departure from San Francisco. From the position of this great depth to one about three miles from the island of Atchka, lat. 51° 58' N., long. 174° 31' E., a distance of 125 miles, the water shoaled to 332 fathoms, being at the rate of 187 feet to a mile, and from that position to Tanaga Island the depth ranged from 200 to 1,800 fathoms, with but one heavy slope of 250 feet between lat. 51° 08' N., long. 178° 35' W., and lat. 51° 28' N., long. 177° 57' W. This is nearly as much as the greatest slope found between Honolulu and Yokohama. This route thus far is not impracticable, so far as the plateau goes.

Ooze similar to that previously found, and grayish black sand, gravel, and lumps of lava, were found along the Kurile Islands, and grayish black sand, gravel, and sponge in the Aleutian group. After sighting the Agatton island, the line was run skirting along the shores to the island of Tanaga. From this point it will be run to the northward, to the island of Ounalaska. The deductions from aerial temperatures in connection with currents, corroborate previous observations upon the latter. In lat. 51° 39' N., the counter current which sets to the southward and westward along the shores of Kamchatka and the Kurile Islands, extends to long. 164° E., with a surface temperature of 42° Fah., from which point to long. 174° E., in the same latitude, there is the Kamchatka current, which is a branch of the Japan stream, setting up through Behring's Straits. This stream has a surface temperature in this latitude of from 46° to 47° Fah."

As will be seen by the sectional view of the ocean bed, the course is along a range of submarine mountains, which (in the Kurile and Aleutian Islands) occasionally rise above the surface of the water. The ocean currents are very numerous, and their temperatures vary widely.

The Tuscarora completed this course, and put into Glory of Russia Bay, Tanaga, one of

THE ALEUTIAN CHAIN OF ISLANDS.

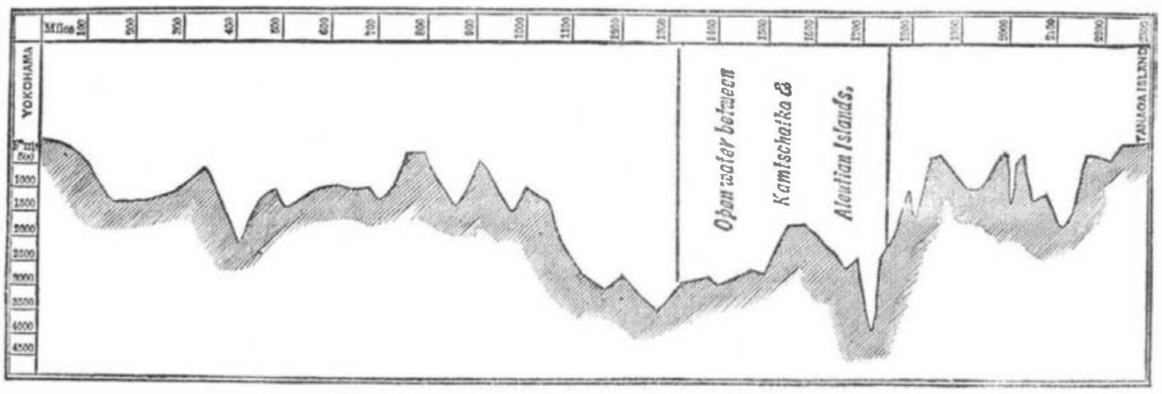
During the summer months, which are supposed by the natives to be a delightful season of the year, the islands are continually vailed in obscurity by fogs; and, in approaching them, cautiously feeling the way, there is a danger presented by strong, treacherous currents, as well as lack of confidence as to their positions. During the nine winter months, or from September to June, the winds are extremely violent. "After having waited patiently for nearly three days for a sufficiently clear day that would permit us, at even a ship's length, to see land, we, on the 19th, were fortunate in sighting the island of Tanaga in the morning, and at 6 P. M. anchoring safely in 10 fathoms of water in Glory of Russia Bay, which is proposed as an intermediate station for the cable. At an elevation of 2,650 feet, but a short distance back from the beach, upon the mountain side, is a glacier of considerable extent, which was visited by several of our officers. The short stay prevented any measurements of its rate of movement. The soil is spongy, owing to continued dampness, and of course destitute of trees or bushes, and inhabited solely by fowls of the air. There is here a

FINGAL CAVE,

with its basaltic columns, which is scientifically interesting. But, taking everything into consideration, should this place be selected as an intermediate station, the operator whose headquarters it will be is not likely to regard it as a paradise. Although the practicability of the northern route is beyond dispute, the labor, uncertainty of success, and dangers involved, in even the passage of a steamer over the route just sounded by us, cause me to apprehend no small difficulty in an attempt to lay down a submarine cable.

Then consider the exertion of dredging for a broken cable in waters either clouded in a fog or beneath a gale, compared with those to be experienced on the southern route. Again, there is the submarine valley of over 4,000 fathoms depth just to the southward of the Aleutian Islands, through which the cable will have to pass. In laying the cable here, at least six and a half or seven miles of it will be suspended from the stern of the vessel, the weight of which the cable may be of insufficient strength to sustain, even if at the time the most favorable weather prevails. To sum it all up, the most obvious advantages in favor of the northern route are the smaller amount of cable required, and its being mostly within our own possessions.

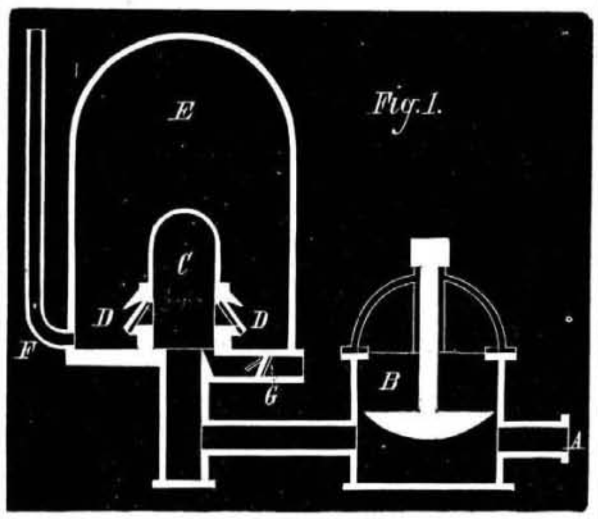
We arrived at Ounalaska on July 29; everything most satisfactory to date, as far as the accomplishment of our work is concerned. A line will next be run back to Tanaga island outside, or to the southward of the islands; then from here to where we left off last fall, and then to San Francisco, where the work will be completed."



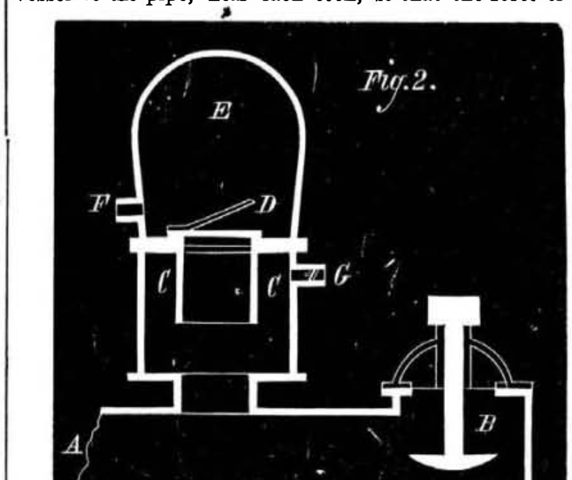
BED OF THE PACIFIC OCEAN ALONG THE TUSCARORA'S COURSE.

THE HYDRAULIC RAM.

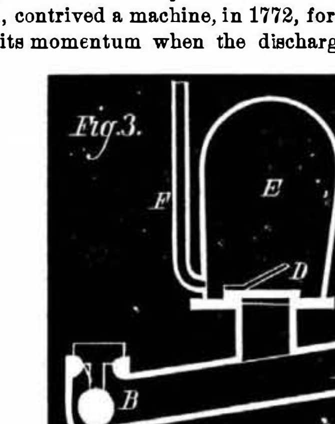
Many of our readers, on shutting the cock in a water pipe where there was considerable pressure, must have observed that the sudden arrest of the motion of the water caused a shock, sometimes producing sound and jarring the pipe.



Indeed, the water pipes in houses have often been burst by suddenly shutting off the water from a basin, and plumbers frequently provide against this accident by attaching an air vessel to the pipe, near each cock, so that the force of the

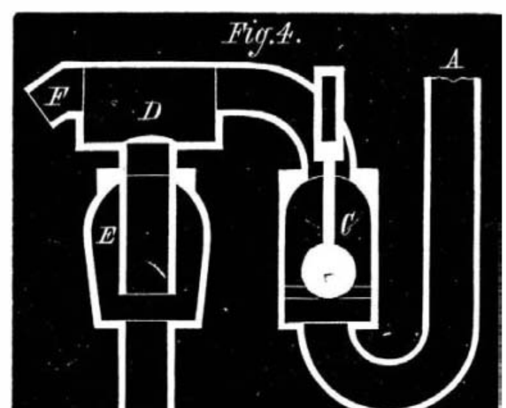


blow may not be suddenly arrested. Whitehurst, an Englishman, contrived a machine, in 1772, for raising water by utilizing its momentum when the discharge was suddenly



stopped. Machines on a similar principle are constructed to-day, for use in cities where the pressure in the mains is deficient. For instance, there are many buildings in the lower part of New York in which the pressure in the mains will not raise the water to the upper stories. Most of these buildings have tanks into which the water is forced by hand or steam power; and some of them have machines like those of Whitehurst, which are set in action every time water is drawn and shut off in the lower stories.

In 1796, Montgolfier, whose connection with the invention of balloons is well known, contrived an automatic machine for performing continually the work that Whitehurst's machine had done when controlled by hand. The Montgolfier ram, as at first constructed, is shown in Fig. 1; and Fig. 2 represents another form of the machine, embodying the same principles, and somewhat easier to build. The two figures are lettered alike, so that a description of the action of one will apply to the other. Water from a source higher than the ram flows through the pipe, A, and the discharge valve, B, being open, runs to waste. Some resistance being offered to its passage through the waste outlet, the water closes the valve, B; and its motion in this direction being suddenly arrested, it has sufficient force to open the valves, D D, and rise some distance in the delivery pipe, F. When the force is expended, the valve, B, again opens, and the former operation is repeated. It will be observed that, when the valve, B, closes, the air in C and E is compressed by the force of the water. When the force is expended, the air in C expands again, and presses back the water in the pipe, A, so that the valve, B, can more readily open, and the air in E also expands, forcing the water up the delivery pipe, F. Thus the air in C tends to make the valve, B, open more quickly than it otherwise would, after the water has exerted its force in the pipe, F, and the air in E makes the delivery more regular and continuous. The air in these vessels is liable to diminish in quantity, since water absorbs it under pressure. The entering water brings some air along with it, to make up the deficiency; but as this supply is frequently insufficient, a small air valve, G, opening inwards, is fitted, which admits air into the ram, whenever the pressure in the vessels falls below that of the atmosphere. A simpler and cheaper form of ram is shown in Fig. 4, which is the kind generally built by pump makers. It will be seen that it has no air vessel for aiding the opening of the waste valve, B, and no valve for supplying any deficiency of air in the chamber, E. It is frequently found



necessary, for the successful operation of this form of ram, to make a small hole in the pipe, A, so that air will be drawn in by the running water. It would be easy to render these rams more efficient by the addition of a casting that would change them into machines of the kind represented in Fig. 2, as will be rendered plain by an inspection of Figs. 2 and 3. The air valve, G, Figs. 1 and 2, is so low down that if the ram should become submerged it would admit water. An improved ram, patented a few years ago in France, has the air valve elevated to a considerable distance so as to overcome this difficulty.

The hydraulic ram, or, rather, a modification of it, is also employed to draw water from lower points. This form of the machine is sketched in Fig. 4. The pipe, A, leads to a source of supply higher than the ram, and connects with the place which is to be drained. The distance from the end of the pipe, A, to the valve, D, must not be greater than the hight to which water will rise in a vacuum—that is to say, 34 feet,—and for successful working, it should not exceed 26 feet. The action of the machine is as follows: The valve, C, being open, water flows through the pipe, A, and is discharged at F. When sufficient velocity is acquired, the valve, C, closes; and the water continuing to flow through F, a vacuum is formed behind it, so that water is drawn through the pipe, B, and valve, D, and discharged at F. Then the valve, C, again opens, and the same cycle of operations is repeated. E is an air chamber, aiding the continuity of discharge, as in the former cases.

The hydraulic ram finds various applications in industrial pursuits. It is largely employed for raising water into dwelling houses and farm yards. It was used at the Mont Cenis tunnel, working under a head of 85 feet, to compress air to five atmospheres for the purposes of ventilation and power. It will work under extremely low heads, and will raise water to almost any desired hight, and, when properly proportioned, is reasonably efficient. The efficiency is not, however, a matter of great importance in many cases. For instance, a man may have a spring on a hillside, at considerable distance from his house, which is at a much higher elevation. The expense of pumping this water by steam power might be very great. But with the hydraulic ram, whose first cost is very slight, the only considerable outlay will be for the delivery pipe; and if the connections are properly made, no further expense need be incurred.

In setting a ram, if it is in a locality where the water in it would be frozen in winter if it were exposed, it should be carefully covered and protected; and the same precautions should be observed with the pipes.

To produce the best effect, the length of the pipe from the source of supply to the ram should be from 25 to 50 feet, for ordinary cases, with heads of from 8 to 15 feet; and in general, it may be stated that the length of pipe should be about 3 times the head. The hight to which the water is lifted should not exceed 15 times the head from the source of supply to the ram. If the delivery pipe is very long, the head required, to overcome the friction, should be estimated at so much additional head. The diameter of the receiving pipe is ordinarily made from 2 to 3 times that of the delivery pipe. For the best effect, the diameter of the receiving pipe should be about $\frac{1}{10}$ of the head from the source of supply to the tank; but very much smaller dimensions are commonly adopted.

Large rams, under favorable circumstances, give an efficiency of from 60 to 70 per cent of the power of the water; but small machines, under ordinary conditions, only utilize from 40 to 50 per cent. An example to illustrate these principles is appended. A hydraulic ram, working under a head of 10 feet, delivers 5 U. S. gallons of water per minute to a hight, including the friction of the pipe, of 100 feet, and 100 gallons run to waste in the same time. What is the efficiency of the ram? A gallon of water weighs 8·34 pounds, so that the useful work of the ram is the raising of 41·7 pounds 100 feet high in a minute, or it is 4,170 foot pounds. The total work that could be realized from the water (105 gallons falling 10 feet in a minute) would be the raising of 875 7 pounds 10 feet high in a minute, or 8,757 foot pounds. Hence the per centage of efficiency (which is found by multiplying the actual work by 100, and dividing the product by the total work of which the water is capable) is 47 6+.

A correspondent asks to what hight he can raise water with a ram, with a head of six feet, allowing $\frac{9}{10}$ of the water to run to waste? Assuming that the ram has an efficiency of 45 per cent, to find the hight of delivery: Multiply the head by the efficiency, and divide by the proportion of water raised. Thus: Head, 6, multiplied by efficiency, 0·45, gives a total of 2·7. Divide this by proportion of water raised, 0·1, and the hight in feet to which the water will be raised is 27.

Those of our readers who are using hydraulic rams may easily determine data by which they can calculate the efficiency. If any do so, we shall be pleased to receive the results of their calculations. As many prefer to work examples by algebra, the analytical expressions for the preceding rules are given below. Let h=hight above source of supply to which water is raised; H=hight of top of source of supply above waste outlet; L=length of pipe from source of supply of ram to waste outlet, in feet; D=diameter of pipe, in feet; W=pounds of water flowing per minute; w=pounds of water lifted per minute. Let E=per centage of efficiency, L=about 3 H, $D=\frac{H}{10}$, and h not more than 15 H; and for best effect, E=from 60 to 70, under most favorable circumstances, from 40 to 50, ordinarily. Then

$$E=\frac{100\times w\times h}{W\times H}.$$

Correspondence.

Notes from Washington, D. C.

To the Editor of the Scientific American:

As foreshadowed in your last, Commissioner Leggett has resigned, and Mr. Thacher has been appointed in his place. This having made vacant the Assistant Commissionership, General Ellis Spear, of the Board of Examiner in Chief, has been appointed to this position, and his place is to be filled by the promotion of Major Hopkins, who now occupies the position of Examiner in Interference cases. It was rumored that Commissioner Leggett's son-in-law, Mr. Seymour, was to be appointed Examiner of Interferences, but I believe it has finally been decided to have a competitive examination for this office.

The number of patents issued for the last three months has somewhat fallen off, the whole number, including reissues and designs, being 3,229, against 3,344 for the corresponding term of last year. If the designs and reissues are omitted, the numbers are, for the last three months 2,849, and for the same months last year 3,061. The number of patents issued during 1873 was 11,616, and for the nine months of the present year, 9,488, which shows a slight gain, on the whole, over the monthly average of the preceding year.

Congress at its last session, although reducing the army at large, did not reduce the signal service, but permitted it to retain its full complement of 450 men, and, to give steady employment to this force, provided for the construction of telegraph lines on our western frontiers under the direction of the Chief Signal Officer. One of these lines begins at Dennison, in Texas, and ends at Brownsville, in the same State, connecting a string of military posts with the civilized world. The total length of this line is 1,250 miles, and it crosses the famous "Staked Plaia" for hundreds of miles. The plain is utterly destitute of timber and water, and passes through the heart of the country which is now the seat of Indian hostilities, from which it will be seen that the difficulties to be overcome by the builders are of no ordinary magnitude.

Another line, ordered to be built under the same auspices, starts at Prescott, Arizona Territory, and extends through Camp Verde to Camp Apache in the same territory, a distance of about two hundred miles, connecting with the line built by the War Department last year from Prescott to San Diego, which has been since transferred to the Signal Office.

Besides these lines, the Signal Officer has a line from the office in this city to Cape Hatteras, and another to Sandy Hook, Long Branch, and Barnegat, N. J.; and the latter is being extended to Cape May. By this means a continuous line will run from Cape May to Sandy Hook, and the cautionary signals are to be so arranged that a vessel passing within sight of the coast can always have notice of an approaching storm in time to run into the nearest harbor. A signal station has recently been established on Thatcher's Island, off Cape Ann, Mass., connected by a cable with the mainland, one and a half miles distant. Further extensions of the service are contemplated as soon as Congress can be induced to make the necessary appropriations, and it is probable that the entire Atlantic and lake coasts of the United States will soon be protected by the telegraph, and in constant communication with this city.

A commission has been appointed by the commandant of the navy yard to examine and test a new system of caulking boiler seams, the invention of Mr. James Connery, chief of the boiler department of the Baldwin Locomotive Works, to whom letters patent were granted therefor on May 12, last. The invention consists simply in using a caulking tool having a convex end, which produces a smooth concave indentation in the edge of the overlapping plate, and avoids the danger, almost inseparable from the old fashioned tool, of making a groove or cut in the under plate, whereby its strength is much weakened, and a starting point formed which will readily rend upon any unusual pressure being brought to bear.

Washington, D. C. OCCASIONAL.

Lunar Acceleration: Its Cause.

To the Editor of the Scientific American:

As has been the case with other theorists and their theories, so with me and mine. Few scientists have hitherto admitted the retrograde motion of the sun in space, and one or two have even had courage enough to say: "It is not true," and so also with other of my theories. I make all objectors and objections welcome of course. Candid, honest exchange and interchange of opinion is what this world needs; and it seems to me that this is as powerful and potent a way as any to reach the truth. My object in writing this article is not only to show your readers the fact that lunar acceleration is not of increased motion in the moon, as some eminent scientists have supposed, and that it is owing to increased velocity in the sun; but also to present a fresh, undeniably demonstrative proof of solar retrograde motion. And as the subject, even to scientific men and great thinkers, is not so easily grasped and comprehended as many are apt to suppose, I will, with your permission and indulgence, thus simplify and explain it in as short and concise a manner as I can.

Seated in imagination at the zenith, and looking down upon our solar system, we see it all in action as we see a working machine. And when we look upon the vast area of the solar orbit, and behold the sun, as it were, slowly tracing his retrograde way all round the ecliptic, on the border or periphery of his orbit, and liken it to a vast and by far the largest wheel in the celestial machine: and when we look upon the orbit of each planet, being likewise respectively a wheel, a wheel having its center in the sun, and the planet sitting on its (the wheel's) periphery: and when we remember that the motion of the great wheel is retrograde, and that of all the smaller wheels direct, and that every smaller wheel is carried gradually retrogressively by virtue of the motion of the largest one: I say, when we see and remember all this of our great solar planet-wheeled system, we cannot but see that every second, minute, or degree of space retrograded by the sun must yield correspondent phenomena to or upon every other wheel or planet. And so also the motion of one planet or satellite around another must yield its phenomenon. Thus premised, I now proceed to show, from real astronomical data and discovery, that increased and increasing velocity of the sun is certainly the origin and all of so-called lunar acceleration.

To begin: The data which astronomical writers give regarding the motion of precession is substantially as follows: The stars appear to move directly (annually) about 50¼", or about 1° in 71⅔ years; and the equinoctial points, of course, recede that much in the same time. This recession of the equinoxes, *versus* precession of the stars, is owing to the retrograde motion of the sun; and from the said motion comes, likewise, recession of eclipses; for eclipses, when we take them in cycles, do recede round the ecliptic as the equinoxes do, and at the same exact rate too. At such a rate of motion, the sun would require some 25 800 years to move round the ecliptic or to complete his orbit; and if his rate of motion was ever the same, there would be no acceleration, so-called in lunar motion. It is because this motion of the sun is ever on the increase that the phenomenon alluded to arises.

As proof of the increase of solar motion, the writers alluded to tell us that precession is constantly increasing at such rate as amounts to 218 years less every 90° or quarter revolution, and say that, owing to the said increase, precession will complete a revolution in about 24.992 years, instead of the number of years above given. This increase, I claim, is the increase exactly of solar motion. And now I am going to show, not only that it produces lunar acceleration, but also that its result is in absolute accordance with the discovery and deduction of some of the most profound astronomers who ever lived.

Halley and some other eminent astronomers found, when comparing the present time of eclipses with that given by the most celebrated of ancient Egyptian and Chaldean astronomers, that, to make both agree, it is necessary to allow a lunar acceleration per century of about 11 seconds. Thus, then, we have the amount of lunar acceleration per century, as set forth, and no doubt perfectly correctly, by the wisest and most able of past astronomers. See how our theory works hand to hand in the matter, and proves them correct.

The increase of solar motion is equal to 218 years less every quarter or 90° of the orbit. The whole will be run in 24.992 years, thus: For the first quarter, 6,575 years; for the second or present quarter, 6,357 years; for the third, 6,139 years; for the fourth, 5,921 years; in all, 24,992 years. Taking the mathematical amount of increase, or the 218 years, out of the past 6,575 years, we find that it is almost 1° for every 30°, 2° in 60, and 3° in 90°, or about $\frac{1}{30}$ of the whole. We have therefore three degrees of solar retrograde advance, and of course three degrees of so-called lunar acceleration, since a point of time seven hundred years beyond the birth of Adam, and of 51′ 26″ since the birth of Christ.

Now as the earth in her diurnal motion moves through the whole 360° in 24 hours, through 90° in six hours, 3° in twelve hours, and through 51′ 26″ in 3 minutes and 26 seconds; it follows that since the year 1 (Christian era) the moon has accelerated the earth about three minutes and twenty six seconds, *versus* the earth's retardation, which is equal to 51′ 26″ since the birth of Christ. Need I tell your readers that three minutes and twenty-six seconds, of lunar acceleration since the birth of Christ, is equal to 11 seconds per century? That is just what it is. Consequently the phenomenon of lunar acceleration is not of the moon, nor in the moon, but of the sun. It is not an acceleration of the lunar motion, but clearly and positively acceleration in the sun.

Thus wise, accurate, and profound astronomy and despised rejected theory meet, kiss, and fall into one. Yet, strange to say, the present learned astronomic world cannot see it. It must, though, no doubt, soon. JOHN HEPBURN.

Gloucester, N. J.

The Sczaroch.

To the Editor of the Scientific American:

The idea of making a projectile contain a part of the powder charge, and thus causing two explosions of the charge instead of one, originated with Mr. James Rose, of the Ashford Railway Works, in England, in the year 1854 Drawings were made and submitted by him to several prominent English engineers, and to at least one government, in that year. There are several engineers in this city to whom I have, during the last five or six years, shown sketches of such projectiles. JOSHUA ROSE.

279 West 12th street, New York city.

Stevens Institute of Technology.

The Stevens Institute of Technology has commenced its third college year with a new class of over fifty in number —double the number that it was originally proposed to admit as a maximum. The large space necessarily devoted to its laboratories, workshops, and drawing rooms compels this restriction of numbers. The aim must consequently be to educate a limited number of young men of more than average ability, keeping the standard so high that the quality of educated material given to the engineering profession by that college may compensate for the comparatively small number of its graduates.

The indications are that the authorities will soon be compelled to raise both the requirements prescribed for candidates for admission and the charges for tuition.

No student of good habits, of intelligence and high general character, and capable of taking a high position in this class has ever yet been denied instruction because of poverty, and it is not probable that this generous policy of the trustees of Mr. Stevens' noble bequest will be changed.

The museum, the mechanical laboratory, the collections in the department of engineering and other cabinets, are continually receiving important additions, principally from our most successful and most intelligent manufacturers. Such contributions are of most practical value, and must aid the Faculty in their work in a very important degree.

The Saw Premium at the Cincinnati Exhibition.

The prize offered for the best circular saw at the Cincinnati fair, $100 in gold, was awarded to Messrs. Emerson, Ford, & Co., of Beaver Falls, Pa. There were nine contestants, and the work done by each saw was remarkable for excellence and rapidity. A Cincinnati contemporary says that Messrs. Emerson & Co.'s solid tooth saw, "when it struck the test log, showed its real metal. It took in the situation most beautifully, making the sparks fly gaily at every entrance into the tough poplar, but was steady and kept right down to actual work all the time, making sixteen good boards, 10x20, in two minutes and forty-four seconds, on 3½ inches feed, and coming out cool as a cucumber. The oak log was then placed upon the carriage, and the saw proved that its appetite had merely been sharpened by the poplar. It cut twelve oak boards, 12x15, in one minute and forty-three seconds, all No 1. lumber. This is the crowning feat of the test so far."

Messrs. Emerson, Ford, & Co. were also awarded the silver medal for the best saw exhibited.

GERMAN SILVER FOR CASTING.—Copper, 50 lbs.; zinc, 20 lbs.; nickel, best pulverized, 25 lbs.