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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 822.

For the Week Ending October 3, 1891.

Price 10 cents. For sale by all newsdealers

REAL AND IMAGINARY SPEED OF STEAM YACHTS.

There seems to be ground for the fear that stories about steam yacht speed, like fishermen's tales, will become the synonym for exaggeration. There was good illustration of this recently. The Norwood, a tight little steam launch of uncommon speed, crosses the bow of and runs away from the Sandy Hook twin screw steamboat Monmouth, and is heralded far and near with making extraordinary speed, variously estimated at between 24 and 25 miles an hour. Then the Vamoose, designed by a rival builder, does the same for the Hudson River steamboat Mary Powell, and is credited with the same or even more speed than the Norwood. The builder of the Norwood informs the public that his craft, while on a trial trip on a Massachusetts river, made 30 miles an hour for two consecutive hours before witnesses, whose names and confirmatory statement be appended. As to the Vamoose, it is declared in cold type that "The contract called for a speed of 25 miles per hour, and while in her two trials she did not quite reach this speed, her owner is confident that she can make between 26 and 27 miles an hour under favorable conditions."

Perhaps she can. Perhaps her rival can do the same, or even better. We hope to see each of them realize the maximum that is expected. But, putting aside hopes and promises, let us set to work to discover just what each has done up to the present time in these waters, and then we can put a peg in at that point, and thus be able to determine hereafter just what improvement is made.

The steamboat Monmouth, which the Norwood outran on the course between the Narrows and Sandy Hook, is not much faster than the old St. John. When she has a strong ebb tide with her she makes the 21 miles run from New York to Sandy Hook in about 55 minutes, which, if we estimate the speed of the current at 2½ miles an hour, gives a speed of something less than 20 miles an hour for the Monmouth. Thus a craft whose engines could be worked up for a short spurt of 20·5 miles could readily overhaul and pass the Monmouth if starting, as the Norwood did, close astern. As to the 30 miles an hour during the trial trip in Massachusetts waters, the witnesses, there is reason to believe, were altogether unused to making tests for speed and very much exaggerated what they saw, though no doubt without any intent to deceive.

It is, indeed, curious how easily an inventor and his friends can deceive themselves as to the speed of a boat. We remember sending an expert to test a steam yacht once which was alleged to have made 26 miles an hour, and the best that could be forced out of her proved to be 15 miles an hour.

As to the alleged race between the Vamoose and the Hudson River steamboat Mary Powell, in which the former readily overhauled the bigger craft, we have been informed by the Powell's master that she was not at that time racing, nor ever does engage in such contests while on her regular trips with passengers aboard. We are satisfied that this is really the case, and, moreover, it is evident that with a boatload of passengers running from side to side, the craft meantime listed heavily to port or starboard, she could not make even ordinary speed. Again, the Mary Powell, as is well known, has never, since rebuilding, been as speedy as formerly, and it is not likely that she was making more than 18 or 18½ miles an hour when the Vamoose came up. Hence to beat the Powell, loaded with freight and passengers while running her regular trip, can scarcely be considered a remarkable feat for a steamer built by one of the cleverest designers in the country with a special view of speed.

If the speed of these two boats is to be reckoned by what the inventor or owner says they can make or by circling harbor and river traffickers presumably speedy, there is no limit to what the imagination may picture. But if performance is that amount of actual work that can be sustained by statistics, neither the Norwood nor Vamoose has yet shown much better speed than 20·5 or 21 statute miles an hour.

SHOP RULES.

The majority of shop rules, although intended to secure orderly conduct, efficient service and a harmonious forwarding of the work in hand, quite as frequently interfere with superintendence as assist it. Rules often fail where they set forth facts and penalties relating to common honesty, order, disobedience, and the willful, malicious, or accidental destruction of property, or relate to defects in work. The instances where the rules do not fit will be found to be the great majority of cases, and arbitrarily to force the rules to fit such cases, or to force the cases to fit the rules, is much harder work than it would be if the management were left free to decide for the right unhampered by any rules whatever. No business or body of men can be managed by the blind application of set rules, any more than a fleet of ships can be steered by one rudder. Every craft obeys its helm, but yields according to its peculiarities of build and motive power; so every man can be ruled if his peculiarities be understood and a reasonable allowance made for them. If a concern could possibly have a full and complete set of rules to meet every case and every variety of fault, and to cover every interest of the business, and be fair to every employe, these rules could not execute themselves. They would not be a satisfactory equivalent for an energetic superintendent or a faithful foreman. The responsibility of superintendence cannot be evaded by the printing of rules.

Here are two rules that indicate about all that need be said in a general way to the employes of any concern, and that leave the management free to consider every case on its whole merits.

RULES.

1. In consideration of the fact that each and all employes of this establishment are regularly paid such wages as have been mutually agreed upon as a fair equivalent for their full services within stated hours, the management requires as full and as faithful a rendering of the stated service from each of its employes as it renders to them the stated sums in payment therefor.

2. Every question that may arise between employes and overseers, or relating to work, discipline, order, honesty, and every other question affecting the establishment, will be decided on its merits by the officers, having in view the interests of the business.

These rules are not intended to serve as exact patterns for all shops, as special additional rules may be needed for each particular business, but the above are sufficient to indicate that the necessary regulations for a shop may be made very few and brief, and to emphasize the fact that rules are good only as they are explicitly stated and energetically enforced.

The Expense of Government.

Some very interesting statistics in regard to the government's account with the people are published by Edward Atkinson in the current issue of the *Forum*. The total amount of the normal cost of the government proper of the United States for the fiscal year ending June 30, 1889, was $146,478,144. These expenses included the entire cost of the civil service and of the military establishment, including fortifications and river and harbor improvements, and of the navy including appropriations for the construction of new vessels. This entire amount, however, great though it is, is covered by the duties which were paid on liquors and tobacco. The amount of this revenue was $148,883,788.

It will be seen, therefore, that were it not for the war and its accompanying train of burdens, the entire expenses of our government could be met by the taxes on liquor and tobacco alone.

The tables indicate that since 1871 the revenue from this source has increased more in proportion than the increase of population.

The other items of expense and revenue for the year ending June 30, 1889, will also be of interest. The expenses are:

Indian account	$6,892,207
Interest on public debt	41,001,484
Arrears of pensions settled	21,442,349
Current annual pensions	66,182,429
Total	$135,518,469
The expenses of government before mentioned	146,478,144

The revenues are:

From duties (other than liquors and tobacco)	$204,851,854
Sale of public lands, etc.	22,170,538
Sundries, internal taxes	978,611
Nominal profit on purchase of silver bullion	10,165,264
To this should be added revenue on wines, spirits, beer, and tobacco	148,883,788

The entire expense of government during that year was $281,996,615.60. The entire revenue amounted to $387,050,058.29, and the surplus was $105,053,442.69.

The changes of ratio of the national debt account to the pension account is very interesting.

In 1871, the interest on the public debt was	$125,576,565
The pensions	34,443,894
In 1891, the interest on the public debt was	36,099,284
The pensions for fiscal year ending June 30, 1891	124,415,951

Prevention of Yellow Fever by Inoculation.

At a recent meeting of the Academy of Sciences, Paris, a paper was read on the preventive inoculations of yellow fever by M. Domingos Freire. The author has inoculated 10,881 persons with cultures of *Micrococcus amaril*. The mortality of those so vaccinated was 0·4 per cent, although the patients lived in districts infected with yellow fever, while the death rate of the uninoculated during the same period was from 30 to 40 per cent. These results have led the government of the Brazilian States to found an institute for the culture of the virus of yellow fever and other infectious diseases, and to appoint M. Freire the director.

Utilization of Old Tin Cans.

According to W. L. Brockway's invention, waste tin plate, fruit cans, etc., are heated to 1,000° Fah. in a furnace in which a reducing atmosphere is maintained. It is claimed that in about from three to seven minutes the tin and solder are completely separated from the iron and fall to the bottom of the furnace, while the iron is left in such a condition that after cleaning, cold rolling, and annealing it is suitable for applications in which a tough high-class iron plate or foil is required.

The Government Timber Tests.

Comprehensive timber tests have been inaugurated in the Forestry Division of the Department of Agriculture, concerning which we have received the following information :

To define the objects of the work more in detail, some of the questions which it is expected ultimately to solve may be formulated as follows :

What are the essential working properties of our various woods, and by what circumstances are they influenced ?

What influence does seasoning of different degree have upon quality ?

How does age, rapidity of growth, time of felling, and after treatment change quality in different timbers ?

In what relation does structure stand to quality ?

How far is weight a criterion of strength ?

What macroscopic or microscopic aids can be devised for determining quality from physical examination ?

What difference is there in wood of different parts of the tree ?

How far do climatic and soil conditions influence quality ?

In what respect does tapping for turpentine affect quality of pine timber ?

It is also proposed to test, as opportunity is afforded, the influence of continued service upon the strength of structural material, as, for instance, of members in bridge construction of known length of service. This series of tests will give more definite information for the use of inspectors of structures.

Besides these problems, many others will arise and be solved as the work progresses, and altogether a wealth of new knowledge regarding one of our most useful materials must result. It is proposed to publish results from time to time.

The collection of the test material is done by experts (Dr. Charles Mohr, of Mobile, Ala., for Southern timbers). The trees of each species are taken from a number of localities of different soil and climatic conditions. From each site five trees of each species are cut up into logs and disks, each piece being carefully marked, so as to indicate exactly its position in the tree; four trees are chosen as representative of the average growth, the fifth, or "check tree," the best developed specimen of the site.

Disks of a few young trees, as well as of limbwood, are also collected for biological study. The disk pieces are eight inches in height and contain the heart and sapwood of the tree from the north to the south side of the periphery. From fifty to seventy disk pieces and from ten to fifteen logs are thus collected for each species and site.

A full account of the conditions of soil, climate, aspect, measurements, and determinable history of tree and forest growth in general accompanies the collection from each site.

The disks are sent, wrapped in heavy paper, to the Botanical Laboratory of the University of Michigan, at Ann Arbor (Mr. F. Roth in charge), to be studied as to their physical properties, their macroscopic and microscopic structure, rate of growth, etc. Here are determined (a) the specific weight by a hygrometric method; (b) the amount of water and the rate of its loss by drying in relation to shrinkage; (c) the structural differences of the different pieces, especially as to the distribution of spring and summer wood, strong and weak cells, open vessels, medullary rays, etc.; (d) the rate of growth and other biological facts which may lead to the finding of relation between physical appearance, conditions of growth, and mechanical properties.

The material thus studied is preserved for further examinations and tests as may appear desirable, the history of each piece being fully known and recorded.

The logs are shipped to the St. Louis Test Laboratory, in charge of Prof. J. B. Johnson. They are stenciled off for sawing and each stick marked with dies, corresponding to sketch in the record, so as to be perfectly identified as to number of tree, and thereby its origin, and as to position in tree. After sawing to size, the test pieces are stacked to await the testing. One-half of every log will be tested green, the other half after thorough seasoning. A determination is made at the time of testing of the amount of water present in the test piece, since this appears greatly to influence results.

From each tree there are cut two or three logs, from each log three or four sticks, two of standard size, the other one or two of larger size. Each standard stick is cut in two, and one end reserved for testing two years later after seasoning. The standard size for the sticks is 4 by 4 inches and 60 inches long for cross-breaking tests. There will, however, be made a special series of cross-breaking tests on a specially constructed beam testing machine, gauged to the Watertown testing machine, in which the full log length is utilized with a cross section of 6 by 12 up to 8 by 16 inches, in order to establish the comparative value of beam tests to those on the small test pieces. It is expected that, in the average, 50 tests will be made on each tree, besides 4 or 5 beam tests, or 250 tests for each species and site.

All due caution will be exercised to perfect and insure the accuracy of methods, and besides the records, which are made directly in ink into permanent books, avoiding mistakes in copying, a series of photographs, exhibiting the character of the rupture, will assist in the ultimate study of the material, which is also preserved.

Such work as this, if done as indicated, and well done, will never need to be done over again. The results will become the standard the world over. The strength and value of a given species or even stick will then no longer be a matter of opinion, but a question of established fact, and we will learn not only to apply our timbers to the use to which they are best adapted, but also what conditions produce required qualities, thus directing the consumer of present supplies and the forest grower of the future.

The Direct Conversion of Heat into Electricity.*

That electric currents can be developed by the direct application of heat to the junction of two different metals, which is the fundamental principle of the thermopile, was discovered by Seebeck in the year 1823. As regards the theory of the subject, Clausius suggested in 1880 that "by the molecular motion, which is termed heat, electricity is driven from one material to the other;" and Kohlrausch's theory of 1875 is somewhat similar in assuming that the electric current is in some way connected with the flow of heat, and *vice versa*. The discoveries of later years, culminating in the researches of Hertz, prove, however, that the electric current is merely the result of a certain vibratory motion of the luminiferous ether, and, therefore, in accordance with the principles of the conservation of energy, a certain definite quantity of heat can be converted into a certain definite quantity of electricity without either loss or gain of energy, and it is this meaning that is given to the subject of this paper, conversion by a dynamo machine being termed "indirect."

Proceeding then to calculate the absolute efficiency of the ordinary means of producing the electric current by a steam-driven dynamo, the electrical energy developed is shown to be only 6·4 per cent of the energy existing in the coal burnt in the boiler; but even this low efficiency is eighteen times greater than the direct conversion of heat into electricity as furnished by a Noe and Clamond thermo-battery, where the efficiency works out at only 0·35 per cent of the mechanical equivalent of the gas burnt. If the high efficiency of the dynamo and steam engine in themselves, as manufactured at the present day, be considered, it is clear that not much greater results can be expected in that direction, and the author has for some years been experimenting in other directions, therefore, for the direct conversion of heat into electricity.

The principal idea acted on at first was the heating of a certain metallic salt in a platinum crucible, which should form the positive pole of the element, and a carbon rod immersed in the molten substance the negative pole; this substance would part with its oxygen to the carbon, and then be reoxidized by contact with the air; and with this form of apparatus, a mixture of caustic soda and carbonate gave an electromotive force varying between 0·475 and 0·4 volt, the "sodium blast" generated at the carbon point burning at the surface with its characteristic yellow flame, accompanied with slight explosions. For the similar potash salts the electro-motive force was between 0·4 and 0·31 volt, the flame being violet and the burning more violent, and forming a small display of fireworks. The adoption of lead oxide resulted in a momentary high electro-motive force, and then a sudden collapse of the platinum crucible, owing to the metallic lead reduced falling to the bottom and eating through the platinum. The author was surprised also to find that at the junction of the platinum connection wire the crucible was also severely pitted, as the current had never been short-circuited, and he has no valid explanation to offer therefor.

After these experiments, the results of which did not promise any simple solution of the problem, the author set himself to improve, if possible, the thermo-battery, and for which purpose attention was directed to the following particulars :

1. The adoption of durable materials.
2. That the electro-motive force and specific conductivity should be as high as possible.
3. Improvements in the form of the element.
4. Improvements in the application of the heat, *i. e.*, a higher efficiency in the production of the heat itself.

Subsulphide of copper, in spite of its high electromotive force, gave, on account of high specific resistance, a weaker current than materials which gave only half its electro-motive force, and it was also found that, by a species of dry electrolysis, granules of metallic copper were formed throughout the body of the material, and its use was, therefore, discarded. A form of battery is described, and which was exhibited at the meeting, consisting of tubes of nickel and a special antimonial alloy, which was found to be very durable. This consisted of fifty elements in series united in one casing, and gave an electro-motive force of 3·5 volts, and an internal resistance, when hot, of 0·4 ohm, with a consumption of 7¼ cubic feet of gas per hour, and the absolute efficiency is 1·08 per cent, or three times that of the existing thermo-batteries. Such a battery is almost exactly equivalent to two Bunsen elements, and though it is far below the dynamo in efficiency, still it may be suitable for various small installations and for experimental work, owing to complete absence of polarization, as the electro-motive force does not fall on short circuit. The durability is enhanced by a regulator applied to the gas supply to prevent any accidental overheating.

The author concludes by stating that he hopes to produce cells which are the outcome of still later researches, and in which the efficiency has been raised to over 5 per cent, and thus almost capable of competing with the dynamo. The description of the construction is withheld ; but it is stated that one form is capable of continuously furnishing current for eight 16 candle power lamps at a consumption of 4·5 lb. of coke per hour. This success the author hopes still further to advance, and thereby exceed the efficiency of the dynamo system as a converter of heat into electrical energy.

*R. J. Gulcher. Sitzungsber. der Akad. der Wissensch. Berlin, 18, 1891, 98 ; Proc. Inst. Civil Eng. 105, iii. 82—84.

Results from Scientific Kites.

The *American Meteorological Journal* for July contains an article on Franklin's kite experiment, by A. McAdie. After giving various details respecting Franklin's experiments the author describes similar experiments recently carried on at the Blue Hill Observatory, near Boston, the chief advance being that at every step the electrical potential of the atmosphere was measured by an electrometer. The kite was sent up on several days, and at a height of 1,000 feet sparks over ⅛ inch in length were obtained ; while abnormal movements of the stream of water from the electrometer during electrical disturbance always foretold when a flash of lightning was about to occur.—Cloud heights and velocities at Blue Hill Observatory, by H. H. Clayton. This paper contains the results of cloud observations made at Mr. A. L. Rotch's observatory during the last five years. The average heights of some of the principal clouds were : *nimbus* 412 meters, *cumulus* (base) 1,558 m., false *cirrus* 6,500 m., *cirrostratus* 9,652 m., *cirrus* 10,135 m. The cumulus is highest at Blue Hill during the middle of the day. The Upsala observations show that the base of the cumulus, as well as the cirrus, increases in height until evening, but neither of these conclusions apply to the observations at Blue Hill. The average velocity found for the cirrus (82 miles an hour) is twice as great as that found at Upsala.

The extreme velocity was found to be 133 miles an hour. A comparison between wind and cloud velocity shows that below 500 meters the wind velocity is less than the cloud velocity. Above that, the excess of the cloud velocity increases up to 1,000 meters, and then decreases again till about 1,700 meters, after which it steadily increases. This decrease between 1,000 and 1,700 meters is very probably due to the fact that the clouds between 700 and 1,000 meters were mostly observed during the morning, when the cumulus moves most rapidly, and that the clouds between 1,000 and 1,700 meters were mostly observed during the afternoon, when the cumulus moves slowest.—Meteorological kite-flying, by W. A. Eddy. This is an account of some experiments made at Bergen Point, N. J., to determine the vertical extension of warm air currents by means of self-recording thermometers carried by a kite string. Experiments showed that an altitude of 1,800 feet could be obtained by using one kite, and that many hundred feet could be added to the altitude by lifting the weight of slack string by fastening on larger kites. It is estimated that by this means an altitude of 4,000 feet was obtained. The minimum temperature at an altitude of about 1,500 feet, on February 14 last, was only 2 deg. lower than at the surface.

New Style of Arc Lamp.

M. Xavier Wertz, of New York, has produced a combination arc and incandescent lamp which may develop into a successful article. The carbons are placed in an exhausted glass globe, and burn so slowly that no feeding is required. A short, thick, hollow carbon is connected to a conductor, and inserted in a globe. The second carbon passes inside the first, having a solid core and round head, which rests upon the cylindrical carbon. The space between is filled with an insulating layer of asbestos, which prevents any current passing except at the upper surface of the cylindrical carbon, where the two carbons touch. At this point of contact an arc is formed of sufficient size to produce a light of considerable power. The lamp is intended for high tension series working, and may be fitted with a cut-out and used on ordinary arc lamp circuits.