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SECRECY IN YACHT CONSTRUCTION.

Now that the "Columbia" is launched and the "Shamrock" is practically completed, an accurate description, such as will be found on another page, of the method of construction adopted in the case of the American boat cannot fail to be of interest; moreover, it can be given without any fear of disclosing "wrinkles" whereby those responsible for the construction of "Shamrock" may benefit. And just here it may be well to say that so exact is the science of yacht designing, so much is it a matter of careful theoretical calculation of form, weights and material, that the idea of such men as Herreshoff and Fife "chopping and changing" their plans because of some glimmering of what the "other fellow" is doing, is—well, it is simply unthinkable. Much alike as the two yachts will be to the unpracticed eye, they will represent the latest development of two distinct schools of design as represented by the distinguished architects above named. If the two yachts resemble each other closely, it will be because, by an independent process of elimination and addition, each designer has been drawing closer and closer to the ideal racing machine, profiting each year alike by the failures and successes of his previous boats.

There is no nobler sport than that of yacht racing, none that is by common consent more free from the taint of professionalism. Hence there are many yachtsmen who will hail with delight the day when the present extreme methods of secrecy, such as are characterizing the construction of "Shamrock" and in a lesser degree "Columbia," will be abolished. In the first place, the secrecy is never successfully maintained, and even if it had been, the English challenger upon its arrival in this country has never exhibited any novelties of construction that would justify such elaborate precautions. The novelties (if we except, perhaps, the model of "Valkyrie" II.) have been more conspicuous in the American yacht, as witness the Tobin bronze underbody of "Vigilant," and the aluminum topsides and deck construction of "Defender." The broad and shallow American sloop and the deep and narrow English cutter have merged into the Anglo-American broad and deep cutter-sloop, with little to distinguish challenger from defender in materials and workmanship. Surely, then, we have reached a point in the history of international yacht racing when we can dispense with "petticoat" launchings, private detectives, and all similar incumbrances of a noble sport.

COMPARISON OF ELECTRIC AND STOVE HEATING ON STREET CARS.

A specialist from one of our leading technical institutes informs us that in an early day of electric street traction, and before electrical engineering had resolved itself into a separate profession, he was called in by a street railway company to report on the merits of an electrical heater for warming the cars of the company. Careful tests showed that each heater consumed two electrical horse power, and as it required four heaters, or eight electrical horse power, to warm properly each car, the company was advised that in the state of the art at that day, electrical heating would be uneconomical. The subsequent extensive growth of the railway system in question, the concentration of its power plant in large central stations, improved methods of steam generation and expansion, and more scientific construction of generators and heaters, have so far modified the situation since that first report was made that to-day the same company is not only heating its cars exclusively by electricity, but doing it for less cost than they could be heated by coal stoves. At the same time, notwithstanding the great advances which have been made in the generation and use of electricity, it is evident that the superior economy of electric heating in this particular case must be largely due to local and special causes; and an examination of the books of the company showed that while the cost per electrical horse power had greatly decreased, the economy resulted chiefly from conditions peculiar to street car warming. Thus the mere keeping of the stoves in repair, and cleaning and lighting them, necessitated the employment of a surprisingly large force of men. Then, again, during the period of moderate temperature at the commencement and close of the winter, the stoves would frequently be lighted for brief periods in the morning and evening, or at the request of particular passengers during the day, and this would necessitate the consumption of a whole stoveful of fuel, where, with electric heating, the current could be switched on and off at will, and maintained for the exact period of time during which there was a call for it.

The advantages of electric heating resulting from its cleanliness, absence of odor, and ease of control are familiar to all of us, but that it should have shown a positive economy over coal will come in the nature of a surprise to many of our readers. The result emphasizes the necessity of making all comparative estimates of cost of this kind on the broadest possible lines, a precaution which is too frequently neglected.

AN INVENTION SORELY NEEDED.

As an incidental result of our having become one of the colonizing powers, with four dependencies—Puerto Rico, Hawaii, Guam, and the Philippines—and Cuba likely to become the fifth, our inventors are already called on to cope with a considerable number of entirely new problems, some of them springing from conditions very foreign to anything known to the Father Republic, if we may coin that term—for surely "Uncle Sam" can scarcely be associated with a mother country.

One of the principal and most immediate needs of the hour, especially at this moment in Luzon, is some effective method whereby wood may be rendered absolutely impervious to the attacks of the various species or allies of the genus Termites—the white ants. Writing to our State Department, in 1893, the then United States consul at Amoy, China, Dr. Edward Bedloe, said:

"A fortune lies in store for the man who will discover some process for cheaply making wood proof against white ants. These pests are the curse of existence in Amoy and every other tropical or sub-tropical city. Their voracity is incredible. They ate the framework of a new door in this consulate in three weeks. In the same period they almost consumed a large and handsome cabinet in the court-room, and a heavy pine settee in the ante-room. Their work is invisible. They attack the wood from a mere point, through which they bore to the interior, and there eat everything until only a shell or film remains. Wood which will successfully resist these insect pests must be thoroughly charged with some powerful chemical, both poisonous and non-evaporable. A solution of corrosive sublimate, chloride of zinc, arsenic, or antimony would seem to meet the want. But how to force these into the fibers, until the latter are saturated, and to do so at a merely fractional cost of the wood itself, is the problem that confronts the inventor. The American genius is so prolific in invention and discovery, that I feel assured the problem will be satisfactorily solved."

Six years have passed, and the consul's faith in the genius of American inventors has not yet been vindicated, while the great need of some such process as he suggests has yearly grown greater as clothes-wearing Europeans have attempted to penetrate deeper and deeper into tropic wildernesses. A soldier-correspondent of one of our Western dailies graphically writes from Manila, after having returned from one of the recent Aguinaldo-chasing raids:

"These Tagals are as elusive and annoying as wasps, and not much more dangerous, if you can only catch them. For my part, I consider the white ants much more invincible. A fellow feels pretty bad after a three days' tramp in this fern-house climate to get back to camp and clean clothes, only to find that a colony of white ants have burrowed into his chest and that all his belongings, not made of metal or glass, have been reduced to a rather fine powder."

Now that this white ant scourge is about to make itself felt upon the American colonist, we may look for something more than the stolid acquiescence with which its ravages have been so long received. We have here a field for invention which is decidedly promising. The income to be derived from a successful system of ant-proofing could not fail to be very considerable, and the successful inventor would have the satisfaction of conferring a lasting boon upon this and many another pest-ridden corner of the earth.

PETROLEUM FUEL BETTER THAN COALING STATIONS.

We are in receipt of a letter from a naval attaché in Europe who has been for many years identified with this branch of the service, from which we quote the following: "I note in the United States papers that the Bureau of Equipment of the Navy Department is making large deposits of coal in various quarters of the world, and that experiments are being continued with someone's method of coaling ships at sea. I wish your paper would protest against this and call attention to the fact that the same amount of money devoted to perfecting furnaces for consuming liquid fuel would lead to much more practical results. Ships can never be coaled at sea, except in a dead calm, whereas, with liquid fuel, you can take the tank ship in tow and steam in the teeth of a gale while you pump your fuel on board through a hose. In time of war the tank ships can meet the fleet at any given latitude and longitude in the middle of the ocean. Coaling stations are expensive to keep up, the coal deteriorates, and England has all the good places anyhow."

We are heartily in favor of generous appropriations for liquid fuel experiments, especially as many of the latest battleships building for foreign navies are designed to carry oil in their double bottoms and use it in conjunction with coal in their boilers. At the same time the Navy Department has to deal with the situation as it stands, and for many a long year to come we are certainly committed to coal as the fuel of our warships. The superior advantages of petroleum over coal are so many and obvious that it will unquestionably form a large part of the fuel supply of armored vessels in the near future; but until our own ships are fitted for its use, we think that coal supply stations are a positive necessity, particularly in view of the recent territorial enlargement of our republic.

THE LIQUID AIR FALLACY.

BY HENRY MORTON, PH.D., LL.D., SC.D., PRESIDENT STEVENS INSTITUTE OF TECHNOLOGY.

Having examined a pamphlet entitled, "Liquid Air. Perpetual Motion at Last. Tripler's Surplusage Explained." By H. Gaylord Wilshire, Los Angeles, Cal., 1899, I will try in a brief and popular manner to point out what I conceive to be the essential fallacy of the position taken by the author of this pamphlet.

To the ordinary reader it is not easy either to perceive this fallacy or, in fact, to get any very clear notion of the actual conditions of the problem which the author proposes to solve and explain, there being a remarkable mixture of true and incorrect statements and assumptions which are directly contrary to fact. But, fortunately, at the very end of the article, there is given a note which contains in itself a fairly clear and concise expression of the fundamental position of the author, which thus can be without much difficulty appreciated, and can therefore be answered without too many words and too much elaborate explanation. The note to which I refer reads as follows:

"NOTE.—Theoretically the energy developed by expansion of a given weight of liquid air in *A* will liquefy an equal weight of air in *B* during a definite time. The process toward liquefaction involves overcoming resistance to compression of air in *B*. If this resistance is reduced by cooling with water, then more air in *B* would be liquefied in a given time than is at the same time expanded in *A*. The difference between these weights of air is the surplusage effected by the cooling of the water. (See diagram.)"

To start with, I should explain that, as far as this note is concerned, the only important parts of the diagram are two cylinders, *A* and *B*, having pistons in each, so connected that an upward motion of the piston in *A* involves a downward motion of the piston in *B*, developing equal displacements, so that, for example, if the contents of the cylinder, *A*, doubled in volume, the contents in the cylinder, *B*, would be correspondingly reduced.

This being premised to render unnecessary the reproduction of this diagram, I think there is no difficulty whatever in understanding the position taken by the author of this note. He evidently intends to say that, theoretically, the energy developed by the expansion of a given weight of liquid air in *A* will liquefy an equal weight of air in *B* during a definite time, without the aid of cooling water, which he describes as being subsequently applied and as being a source of an increased effect.

Now, this statement is absolutely incorrect. The expansion of a given weight of liquid air in *A*, so far from developing a power capable of liquefying an equal weight of air in *B*, would be absolutely incapable of liquefying a single drop of air in *B*. What would really happen is this: The energy developed by the expansion of a given weight of liquid air in *A* would develop an equivalent amount of energy in *B*, theoretically, in two forms; in the first place, as heat, or, in other words, the air in *B* would be very highly heated by the act of compression; in the second place, another portion of energy would be developed in *B*, by reason of the increased pressure or tension brought about in the air filling *B* by the afore-mentioned compression. Even if no heat at all were developed in *B*, and it remained at the atmospheric temperature during this compression, this would not convert it into liquid air, for it is, of course, a well-known fact that no amount of pressure will liquefy air until its temperature has been reduced to what is known as the critical temperature, which is 220° Fah. below zero. Still less, therefore, would it be possible to liquefy this air while leaving in it the heat of compression, by reason of which its temperature would be greatly raised; therefore, it would be necessary, as a very first step in any process of liquefying air, to remove this heat of compression, and this is exactly what is done by Mr. Tripler, or anybody else who carries on a process of producing liquid air. By means of appropriate condensers, the air, as it is being compressed, is cooled so that when it reaches the final pressure, which is 2,500 pounds to the square inch, it is at the temperature of the surrounding air, or rather of the water used as a cooling material.

It should be noticed at this point that in so removing the heat from the air, said air has been deprived of a considerable amount of the energy transferred to it from the expansion of the liquid air in the cylinder, *A*. In other words, this first action or step of cooling has thrown away or removed from the apparatus a portion of the energy developed in it. If we could compress the air and retain the heat in it with no loss, then we might expect to recover from said compressed air so heated an amount of energy equal to that which had been used in compressing it; but if we have cooled the air, we have removed heat from it (which may be measured by the amount of water used and the temperature added to said water), we have taken away a portion of its contained energy and its power of doing work.

In several points where this matter is referred to by the author of this pamphlet, he seems to have made the strange mistake of transferring what we might call a debit item to the credit side of an account, and estimated as a gain what is in fact a loss.

Now, then, let us assume that by vaporizing air in the cylinder, *A*, or by any other means, we have developed energy which has been applied to compressing air in the cylinder, *B*, and that we have removed or thrown away a portion of that energy by cooling the compressed air down to an atmospheric or water temperature; what more must we do to obtain any liquid air? This is not hard to answer, because we need only to refer to what is done by Mr. Tripler, Mr. Linde, or anyone else who is carrying on substantially the same process; that is, we allow the highly compressed and cooled air to escape under certain conditions, whereby its expansion in so escaping reduces its temperature and finally brings it to a point at which a portion of the air becomes liquid. It is obvious, however, that in so doing we must throw away or allow to escape a very large proportion of the compressed air, which as far as it went represented what was left of the energy developed by the expansion of the liquid air in the cylinder, *A*.

As a matter of fact, from data which I know to be reliable, in the apparatus used by Mr. Tripler, the amount of air obtained in the form of a liquid represents only about one-twentieth of the compressed air which he allows to escape or expand at this point of the operation. According to certain publications by Linde, in Germany, it would appear that he has done about the same thing, and gets about one-twentieth of the compressed air in the form of liquid air. Either of these figures, however, shows the perfect absurdity of the statement which I have quoted from the note, since it makes it obvious that only a very small fraction of the liquid air used in developing energy by expansion in the cylinder, *A*, is recovered or reproduced or could be recovered or reproduced from the compressed air in the cylinder, *B*, even with the aid of sufficient cooling water to abstract all the heat of compression.

If this state of affairs is clearly understood, as I think it may be by anyone reading the above remarks, the utter fallacy of pretty much all that is stated in this pamphlet will be manifest. Thus, on page 6 of this pamphlet, we find as follows:

> "However, there is an outside force mentioned casually by Tripler in all his statements, but which is not dwelt upon by either him or the 'scientists' as being capable of furnishing the looked-for surplus. It is the water used to cool the air heated by compression in his condenser.'

As I have above shown, however, the water used to cool the air, so far from increasing the amount of energy present in the air which is to be liquefied in consequence of the work expended upon it by the compressing agent, is simply a means of removing and wasting such energy, and therefore obviously is as far as possible from accounting for any such imaginary "surplus"; or, in other words, there would be a great deal more energy or capacity for doing work in compressed air if the cooling water was not applied and such compressed air was used in its heated condition.

It would be tedious and I think quite useless, after what I have said, to quote and further point out the fallacy of succeeding statements in this pamphlet in which this same idea is developed in various forms. The fallacy is obvious at once to anyone realizing what is the actual or true condition existing when air is compressed by the application of force and what conditions must exist before any liquid air can be produced.

In my article on the liquid air fallacy, published in your issue of April 22, 1899, I pointed out what were the true conditions as regards the possible utilization of atmospheric heat in the production of motive power or the doing of work, and I there drew attention to the fact that for such utilization it was necessary, not only to have a certain temperature in the air, but a notably lower temperature in an abundant supply of water, and that the amount of energy derivable was measured simply by the amount of heat transferred from the air to the water. In that case I confined my attention to the calculation of the amount of air at a temperature of say 70°, which must be supplied to the imagined machine if an unlimited supply of water at 50° was also available, and the result so obtained showed the impracticability of such a method so fully that it seemed unnecessary to take any account of the quantity and cost of water. If, however, we choose to consider this, it is easy to calculate, accepting the data given in this pamphlet, what amount of water would be needed, and from such calculation we find that this amount would be very large, so that if the water cost anything, which as a matter of fact it invariably does, it would be a serious element in the expense of a process and would make such process still more impracticable than it is shown to be by the mere consideration of the amount of warm air required.

I refer to this only as showing that in my original article there was no oversight or failure to appreciate the true action of cooling water as an absolutely essential element in any plan or process for the obtaining of power from atmospheric temperature. I also pointed out in that article that if we expected to get power free from nature the cooling effect of the water as well as the heating effect of the atmosphere must be obtained as a free gift, and that if the cold or cooling effect was in any sense manufactured, or if a greater degree of coldness or lowering of temperature beyond that which nature would supply in a stream of cold water was introduced as an element in the problem, then the cost of producing such additional low temperature or cold would be fully equal, and as a matter of experience in the case of liquid air, enormously in excess of any power which could be had by reason of its use. In other words, that if it was too costly to operate the machine between the limits of the temperature supplied, let us say atmospheric air at 70° and cooling water at 50°, this cost would be vastly greater if we attempted to operate a machine by employing the temperature of the atmosphere as a source of heat and liquid air or any other artificially cooled substance as the cooling agent. It would be then, as I said, exactly analogous to an attempt to add to the efficiency of a head of water by digging a well into which we could run the escaping water but out of which we should be obliged to pump such escaping water in order to keep the well empty and thus avail ourselves of the head or extra pressure developed by its depth.

The pamphlet referred to contains in addition a great many less important errors and fallacious arguments, but I think I have gone far enough to show its utter unreliability and to save any of the readers of the SCIENTIFIC AMERICAN from being misled by its extraordinary assertions and unsupported statements.

THE HEAVENS IN JULY.

BY GARRETT P. SERVISS.

There is no time when the stars exercise a greater charm than in midsummer. After a near-by sun has stricken us with his fiercest rays, thousands of distant suns, glimmering through the dark, bring a contrasting sense of coolness and relief. The spirit of romance has always recognized the influence of starlight on a summer night, although psychologists, as such, appear not to have noted it. Yet the spell exists, and millions experience its effects without undertaking to account for them. But there is nothing mysterious in the phenomenon, and the astrologers can derive from it no support for their superstition. It is simply an expression of the innate poetry of humanity. Those lines of Longfellow's,

> "Stars of the summer night,
> Far in yon azure deeps,"

may awaken for the astronomer thoughts different from those that arise in the mind of the unscientific reader, but the impression on both is substantially the same—a half-dreaming consciousness of vastness, sublimity, and superhuman power, set over against a sense of the insignificance of the earth, and mingled with a dim perception of beauty transcending terrestrial standards. Savages and civilized men alike yield to this fascination of the starry heavens, and it is capable of subduing, for a while, the most untamed spirits.

The stars and constellations are most beautiful in the absence of the moon, and this year the opening evenings of July will be free from the presence of that "lesser light" which rules, and sometimes, for the astronomer at least, mars the night.

At 10:30 P. M. on July 1, at 9:30 P. M. on July 15, and at 8:30 P. M. on July 31 the principal attractions of the starlit firmament will be arrayed as here described. Overhead shines the constellation Hercules, recognizable by a quadrilateral figure formed by four of its chief stars, and lying between the beautiful circlet of the Northern Crown on the west and the brilliant Vega, with its two little attendants forming a minute triangle, on the east. Directly north of Hercules is the head of Draco, marked by a conspicuous diamond figure of stars. Below the head of Draco stands the Lesser Bear, Ursa Minor, erect on the end of his long tail which terminates in the Pole Star. West of the Northern Crown is Boötes, the giant huntsman, with his great lone brilliant Arcturus blazing on his garter. North of Boötes appears Ursa Major with the Great Dipper descending, bowl downward, toward the northwestern horizon. The broad constellation of Virgo spreads over the lower part of the western sky, still resplendent with the glory of Jupiter's presence within its borders. Sprawling across the south, and touching the horizon, is Scorpio, the center of the constellation made conspicuous by the fiery red Antares, one of the most remarkable of stars. East of the meridian the sky is spanned from the northern to the southern horizon by the most brilliant portion of the Milky Way. Starting under the Pole Star it passes through the zigzag figure of Cassiopeia's Chair, and higher up, opposite Vega, seems to bear the Northern Cross afloat in its nebulous stream. Next it passes by Aquila and its three notable stars—a bright one between two fainter—and then breaks into alternate deeps and shallows of starry radiance, as it pours downward through Sagittarius and the eastern part of Scorpio to the horizon.

In the constellations named above the owner of a telescope may feast his eyes on innumerable celestial beauties. Take for instance the celebrated Star Cluster in Hercules. The naked eye does not show it, but it can easily be found between the two stars in the quadrilateral before mentioned which lie nearest to the Northern Crown—look about one-third of the way from the northern toward the southern star. A 3-inch telescope will show it; a 5 or 6-inch will reveal it as a wonder.

The northernmost of the two little stars near Vega, called Epsilon Lyræ, is a famous "double-double." An opera glass separates it into two stars; a telescope of 3 inches aperture, or more, divides each of the two again.

A little north of an imaginary line from Arcturus to the brightest star in the Northern Crown is Epsilon Boötis, a beautiful double with contrasted colors. It is a good object for a 3-inch telescope.

The bottom star in the long beam of the Northern Cross, known as Beta Cygni, is a most charming double, the smaller star being bright blue in color. A very small telescope suffices to show it.

Southwest of the last star in the handle of the Great Dipper a lone twinkler of between the second and third magnitudes, Cor Caroli, will be seen. The telescope shows it to be a remarkably fine double, the smaller star having a lilac hue.

Antares is an exceedingly interesting double and can be seen better than last month. A 4-inch telescope will show the little bright green companion of the great red star.

With a low magnifying power sweep the telescope all along the Milky Way from the Northern Cross to the southern horizon; the galactic riches are a perpetual source of astonishment and delight.

THE PLANETS.

Mercury, as an evening star, moves eastward from the sun until July 22, about which time it should be easily seen after sunset. It passes from the constellation Cancer into Leo.

Venus, moving rapidly from Taurus into Gemini and across the latter constellation eastward, is a morning star, fast diminishing in brilliance.

Mars, which passes during the month from Leo into Virgo, is an evening star setting before midnight.

Jupiter, in Virgo, is still conspicuous, although not so favorably placed for observation as in June. On July 2 the shadow of Satellite III. will be on the planet from 9:14 until 10:58 P. M. On July 6 the shadow of Satellite I. will be in transit between 8:42 and 10:54 P. M. On July 7 at 10 h. 1 m. 41 s. P. M. Satellite II. will disappear in eclipse.

Saturn, in Ophiuchus, between Scorpio and Sagittarius, rises before sunset and crosses the meridian, in the middle of the month, about 9 P. M. Accordingly it is well placed for observation. The rings are now opened to about their widest extent, so that the south pole of the planet is hidden behind them while the north pole appears projected against the rings as a background. Titan, the largest satellite, will be west of the planet on July 4; north on July 8; east on July 12; and south on July 16. These dates represent the greatest elongations in each direction.

Uranus remains in Scorpio, and Neptune in Taurus.

THE MOON.

New moon occurs on the afternoon of the 7th; first quarter on the evening of the 15th; full moon on the afternoon of the 22d; and last quarter on the morning of the 29th. The moon is nearest on the 23d, and farthest on the 10th. The lunar conjunctions with the planets occur as follows: Venus July 5, Neptune July 5, Mercury July 9, Mars July 12, Jupiter July 16, Uranus July 18, Saturn July 19. On July 6 about 5 P. M., Venus and Neptune will be in conjunction, less than a degree apart.