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NEW YORK, SATURDAY, JUNE 30, 1900.

THE LATEST LIQUID AIR FALLACY.

Our readers will doubtless remember that about a year ago, when the liquid air craze was at its height, we published (SCIENTIFIC AMERICAN, April 22, 1899) a characteristic article from the pen of President Morton, of the Stevens Institute, exposing the fundamental fallacies underlying the claims which were being made for liquid air. This and other *exposés* that appeared in the contemporary technical press of the country went far to neutralize the pernicious effects of the liquid air promotion that was then rampant. After a period of comparative quiet, the public is again deluged with prospectus literature of the kind that is unfortunately only too successful in emptying the purse of the half-informed and all-too-easily-deluded investor.

The present exploitation, however, is being carried out under a new name, and with promises of profit that are as alluring as the most exacting prospectus-writer could demand. Liquid air no longer parades as a perennial source of motive power whose volume, so far from diminishing, grows larger the more we take from it; and as representing an inexhaustible source of refrigeration it has evidently lost its drawing power. We are now told, indeed, that it is to liquid air that we must look as our most profitable source of heat. Its oxygen is to be extracted, bottled up, and used in our steamships, locomotives and reducing furnaces in such magical fashion as to produce the usual "revolution" in the field of transportation and manufacture. This latest fallacy has been exposed in the very convincing article by President Morton, which, by the courtesy of The Stevens Indicator, we are enabled to reproduce in full in the current issue of the SUPPLEMENT.

The latest claim of the promoters is that, by distilling off its nitrogen, liquid air may be utilized as a means of producing oxygen gas in large quantities and at a relatively low cost. While it is admitted that pure oxygen could be obtained cheaply in this way. President Morton shows that as it costs, according to Mr. Tripler, twenty cents to produce a gallon of liquid air, and as it requires five gallons of liquid air to produce one gallon of oxygen, the cost of production must be one dollar per gallon, or about ten dollars per thousand cubic feet at atmospheric temperature and pressure. It is admitted that this is less costly than the present methods, but it is pertinently asked, "What shall we do with the cheap oxygen when we get it, the present uses for oxygen being very limited and chiefly confined to the lime light and some refined processes in metallurgy?"

The liquid air prospectus tells us that the oxygen is to be used as a substitute for air in the ordinary processes of combustion, as under steam boilers, in iron furnaces, and the like; but used under these conditions it would be in competition with free air, and the cost of the storage or transportation, as the case might be, would be altogether prohibitory. It is argued that the most conclusive way to test the value of this suggestion is to reduce it to a concrete case, with actually calculated proportions of parts, volumes and weights; and because the necessary data is easily obtained, President Morton takes as his text the case of a large transatlantic steamer. He argues that since every ton of coal requires 2½ tons of oxygen for its consumption, and as it takes about 2,000 tons of coal to carry one of these ships across the Atlantic, the transportation in storage cylinders of the 5,000 tons of compressed oxygen thus shown to be necessary for the combustion of the coal, would reduce the carrying capacity of the ship to practically nothing, the coal and the compressed oxygen aggregating a dead load of 7,000 tons, to say nothing of the weight of the storage cylinders.

If the gas were not compressed, each ton of coal would require 66,000 cubic feet of gas, and the whole 2,000 tons would require 132,000,000 cubic feet. Even if forty per cent of the fuel were to be saved, as claimed by the promoters, it would be necessary for the ship to carry twenty-two tanks of the size of the huge gas holders which form such a conspicuous feature in any distant view of New York city.

Your promoter, however, is nothing if he is not ready-witted, and he will, of course, suggest that the idea of storage was never in his mind, and that each vessel would carry the oxygen-manufacturing plant on board, and would make the gas as it was needed. It is sufficient to say that the necessary plant to produce the 1,250 tons of oxygen which would be needed per day for the 500 tons of coal consumed daily in the furnaces of the steamship "Campania" would call for boilers and engines that would rival in bulk and weight the engines and boilers that propel the ship.

Lastly, attention is drawn to the fact that the enormous intensity of the temperature produced by the combustion of fuels in oxygen would lead to the burning and melting down of the furnaces in which it was tried. A pound of coal burnt under these conditions would not yield a greater quantity of heat, but would simply develop the same quantity in less time, with a proportionate increase in the intensity of the heat.

ECONOMIC VALUE OF GOOD ROADS.

There is food for thought in the report of the Maryland Geological Survey for 1899. In the first place we are told that the people of Maryland have expended, during the last ten years, upon the so-called construction and repair of their own roads, the sum of no less than $6,000,000. It seems that the greater part of this money has been frittered away in the attempt to repair roads which have been poorly laid out in the first place, and for the lack of certain necessary engineering qualifications can, in the nature of things, never be made into good roads. As an instance of this it may be mentioned that many of the common roads have no natural drainage. We are told that most of them are in a poor condition for a part of the year, and some of them for the whole twelve months.

As the result of a careful estimate made by the survey, it is shown that the farmers of the State of Maryland expend $3,000,000 a year more on their hauling over the present poorly built highways than would be necessary if the hauling were done on first-class roads. These figures are to be compared with the information collected by the Department of Agriculture in 1895, when, as the result of data received from over twelve hundred counties in various parts of the United States, it was ascertained that the average cost of hauling one ton for one mile over country roads was twenty-five cents; which was just three times as much as the average cost of hauling over the improved macadam roads of six European countries. If this large sum of money represents the loss to the State of Maryland from poor roads, it is easy to say that the total loss throughout the whole United States represents a figure so great that it must have an important bearing upon the prosperity of the country at large, and particularly upon the farming interests as such.

At first sight it seems incredible that in a country so progressive as ours the condition of the common roads should be over a half century behind that of the old world. It is true that the vast extent of the United States, and the great mileage of our roads in some States relative to the density of the population, may be offered as an excuse for our backwardness; but while this plea may hold good as regards the thinly populated Western and Southern States it cannot be applied to the older, more populous and wealthy sections of the country.

COMMERCIAL EXPANSION AS A SCIENCE.

Our last issue contained a letter in which the writer contrasted the business methods of German and American merchants, and proved how, in many ways, Germans showed more business sagacity in dealings with South American firms. According to our correspondent, the secrets of German success are not far to seek. The inability of many American commercial travelers to speak the language of the country to which they are sent; the elaborate American price lists and catalogues, with their complex and useless system of discounts from list prices; the refusal to extend credit; and the inability or unwillingness to humor the customer, go far to offset the superior quality of American goods.

But there are still other reasons why Germany in many parts of the world is slowly but surely outstripping her sister nations in the struggle for commercial supremacy—reasons which are apparent only to him who has made a careful study of German industry on its native heath. Such a study is to be found in the work of a Frenchman, Maurice Schwob, which bears the dramatic title, "*Le Danger Allemand*." The book has forcibly brought home to Frenchmen the necessity of very radically modifying their commercial system, if they desire to regain even a tithe of what they have lost in foreign trade. Fortunately, the American business man is far more energetic than his French *confrère* for which reason Schwob's criticisms of his countrymen can hardly be applied to us. Nevertheless, his analysis of German methods is so instructive, is based upon facts so little known, as to warrant a brief review of his book.

"The German Danger" is discussed by Schwob in five sections—"The Sea Danger," "The Industrial Danger," "The German System," "German Advertising," and "The Conquest of Markets."

"The Sea Danger" for France lies in the decline of the shipping interests of her ports. Besides the successful competition of Hamburg with Liverpool, Schwob notices the development in shipping at Antwerp and Rotterdam, both of which cities owe their unexpected commercial good fortune to the fact that they are outlet ports for the Rhine, by which the products of Frankfort, Mannheim, Mayence, Düsseldorf, and other river towns are transported to the sea. The benefits to be derived by shipping to Antwerp were found to be so advantageous to Frenchmen that the head of the Department of Meurthe-Moselle stated that not only was a part of France thus annexed to Belgium, but that Germany and Belgium together threatened commercially to incorporate the whole of France.

"The Industrial Danger" has also given Schwob much concern. The German government, he finds, understands thoroughly the making of commercial treaties which enable home industries to thrive despite the keenest foreign competition. The revenues obtained from the taxing of imports are not all swallowed by the national treasury; but a certain part of the money received is paid out as premiums for the exportation of German goods. The bureaucratic political system of France, says Schwob, renders a co-operation of the government authorities and merchants impossible. Tariff systems are made and unmade in a day. Laws, ill timed and badly framed, go into effect, which, although designed to check foreign invasion, really cripple French industries. Officials are "politicians" in the very sinister sense which that much-abused word has acquired in the United States. In Germany, on the other hand, the government and the merchants work in harmony. Bills are introduced and passed in the Reichstag exactly when they are most needed, and are so broad in their scope that the hands of the exporting manufacturer cannot be tied by official red tape. Schwob cites a striking example of this intelligent co-operation. For years, German shipbuilders had been purchasing their iron and steel from English foundries. At a convention of German ironmongers and shipbuilders, it was decided that German foundries were thereafter to deliver the steel required by the shipbuilders. It was found necessary to reduce the railway freight-charges on iron; the government immediately provided lower rates, "of its own accord" (*spontanément*), writes Schwob maliciously, for in France the officials rarely act "*spontanément*." And the shipbuilders agreed to pay from three to five per cent more for German than English iron, in order that the home industry might flourish. No protective tariff was established.

Germany's method of "conquering markets" is due primarily to the "floating expositions" sent to all parts of the world. A syndicate of merchants charters a steamer, loads her with goods carefully selected for foreign buyers, sends her from port to port, in accordance with a schedule prepared with characteristic German attention to detail. Representatives of the firms are sent ashore at the various cities. Each man speaks the language of the country fluently; he studies the needs of the population; he distributes samples and intelligently compiled catalogues, and takes orders for goods; in a word, he does everything in his power to further the interests, not only of his firm, but of German commerce as well. When his report has been handed in, a swarm of commercial travelers settles down in the country visited, all of them thoroughly familiar with the business methods of the people, and ready to build on the foundations laid by their predecessor.

Second in importance only to the "floating expositions" are the export associations that, for the last ten years, have maintained trade museums or bazaars for the purpose of exhibiting their wares, and for sending expeditions to all parts of the world, in order to accustom the people to the use of German products, to distribute catalogues of samples, lists of export houses and the goods sold by each. Is it any wonder that one can pick up everywhere so many articles of manufacture that bear the familiar inscription "Made in Germany"? Is it any wonder that not only Africa and South America and the countries of the Orient have been thus commercially conquered by the "indomitable German," but also Norway, Denmark, Holland and Russia—"countries," says Schwob, "that are our friends, and hate and fear Germany."

Although it is primarily intended for his countrymen, Schwob's study contains many a lesson by which American merchants may well profit. Our exports, it is true, have never been so large as in the last ten years; and at the close of each year the records show that there is not a single branch of industrial activity in which we have not made some progress. What we have gained has been gained not so much by concerted action as by the efforts of individual firms. Our progress has been great; but it should be still greater. And only by systematic aggression, by the establishment of more institutions similar to the Philadelphia Commercial Museum, and by arranging more exposi-

tions like the Pan-American Exposition, to be held in 1901, can we hope to compete with the German in markets which he hopes some day to consider exclusively as his own.

ROBERT SIMPSON WOODWARD.

BY MARCUS BENJAMIN, PH.D.

After an absence of thirteen years the American Association for the Advancement of Science returns to New York and will hold its forty-ninth meeting in this city during the week beginning with June 25.

In 1887, Dr. Samuel P. Langley, the secretary of the Smithsonian Institution, presided over the meeting, succeeding on that occasion Edward S. Morse, the director of the Peabody Academy of Science, in Salem, Mass. For this meeting Robert S. Woodward has been chosen to preside, and he will succeed Grove K. Gilbert, of the United States Geological Survey, who was elected last December to fill the unexpired term of the late Edward Orton, a sketch of whom appeared in the SCIENTIFIC AMERICAN for August 18, 1899.

Prof. Woodward was born in Rochester, Mich., on July 21, 1849. Loyal to the State of his birth, he entered the University of Michigan, in Ann Arbor, and was graduated there in 1872 with the degree of Civil Engineer. An appointment as assistant engineer in the United States Lake Survey was offered to him, and for ten years he continued in that service.

In 1882, he resigned from the Lake Survey to become astronomer on the United States Transit of Venus Commission. Two years later he passed to the service of the United States Geological Survey with which he remained for six years, serving in the successive capacities of astronomer, geographer, and chief geographer. He then became an assistant in the United States Coast Survey, with which he continued for three years.

The death of Prof. William P. Trowbridge, in 1892, created a vacancy in the scientific faculty of Columbia University that at first sight seemed almost impossible to fill, and indeed the department over which he had charge was so extended that the difficulty was only met by dividing his chair into several co-ordinate professorships. To that which was designated as Mechanics, Prof. Woodward was called, he having gained his professorial title by filling, during 1886–88, the chair of civil engineering in the Corcoran Scientific School of Columbian University in Washington, D. C., where he acquired much reputation by his success as a teacher.

The choice of the trustees proved a wise one, for with the growth of the college into a university, additional duties have been assigned to Prof. Woodward in the accomplishments of which he has shown exceptional ability. It is not necessary to enumerate the various offices that he holds in connection with Columbia, and they are many, for the most important is that of Dean of the School of Pure Science, which he has filled since 1895, and it is sufficient to show the high esteem in which he is held by his associates.

His scientific work has included numerous contributions in the domains of precise mensuration, geodesy, the physics of the earth, physical astronomy, and pure mathematics, and of the hundred or more titles of papers that he has published the following are the more important: "On the Actual and Probable Errors of Interpolated Values from Numerical Tables by Means of First Differences" (1882); "Results of Experiment to Determine the Variations in Length of Certain Bars at the Temperature of Melting Ice" (1883); "On Errors Incident to Interpolated Values from Numerical Tables" (1886); "On the Free Cooling of a Homogeneous Sphere" (1887); "On the Conditioned Cooling and Cubical Contraction of a Homogeneous Sphere" (1887); "On the Diffusion of Heat in Homogeneous Rectangular Masses, with Special Reference to Bars Used as Standards of Length" (1887); "On the Form and Position of the Sea Level" (1888); "The Effects of the Atmosphere and Oceans on the Secular Cooling of the Earth" (1890); "Recent Experience of the United States Coast and Geodetic Survey in the Use of Long Steel Tapes for Measuring Base Lines" (1893); "The Iced Bar and Long Tape Base Apparatus, and the Results of Measures made with them on the Holton and St. Albans Bases" (1892); "An Historical Survey of the Science of Mechanics" (1894); and "Mechanical Interpretation of the Variations of Latitudes" (1895); and in book form the "Smithsonian Geographical Tables" (1894), a volume of nearly three hundred pages, published by the Smithsonian Institution.

The degree of Ph.D. was conferred on him by his Alma Mater in 1892, and in 1896 he was chosen to membership in the National Academy of Sciences. For more than ten years he has been an associate editor of The Annals of Mathematics; and since 1894 he has been an associate editor of Science; also, he is one of the editorial corps of The Columbia Quarterly.

The American Mathematical Society has honored him by successive elections to the offices of treasurer, vice-president, and president, and he is now president of the New York Academy of Sciences.

He joined the American Association for the Advancement of Science, at its Philadelphia meeting held in 1884, and a few years later was elected to the vice-presidency over the section of Mathematics and Astronomy; delivering an address at the Toronto Meeting in 1889, on "The Mathematic Theories of the Earth," which attracted considerable attention and was largely reprinted in the scientific journals of this country. In 1894, he was chosen treasurer of the association, an office which he still holds. Prof. Woodward has on several occasions been urged for the presidency of the association and would have been elected at the Boston meeting two years ago had he not gracefully withdrawn in favor of Prof. Edward Orton.

Applied Mathematics has no more distinguished representative in this country than Prof. Woodward, and the association has honored itself by choosing its most loyal member in that branch of science to preside over its sessions to be held in this city.

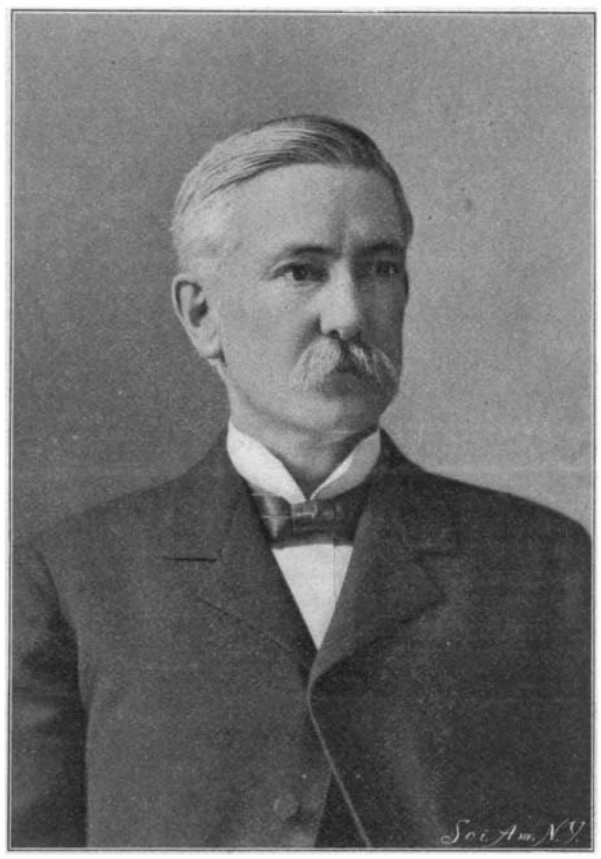
THE HEAVENS IN JULY.

BY HENRY NORRIS RUSSELL, PH D.

Astronomers have never had less occasion to complain of the weather than on the 28th of last May. All along the eclipse tracks, from the Gulf of Mexico to Northern Africa, cloudless skies were the rule, and no one seems to have been unable to see the sun.

But for this very reason, it will be some time before the results of the day's observations are fully known. At the time of writing it is hardly probable that all the eclipse plates have been developed, and their measurement and reduction, especially in the case of those of the spectrum, and those made in the search for a possible intra-mercurial planet, will take a lone time.

The present statement must, therefore, deal simply with some of the results obtained by the Princeton University party stationed at Wadesboro, N. C.



ROBERT SIMPSON WOODWARD.

The eclipse was an unusually bright one, a great deal of light being diffused into the shadow from the illuminated air outside its limits, so that only first magnitude stars were visible, and it would have been perfectly easy to read an ordinary watch face during totality.

The observations of the corona and lower layers of the sun's atmosphere showed that the sun's surroundings were in a decidedly quiescent state. The flash spectrum was faint, and the prominences relatively few—only one being large—while the unknown gas which produce the green line in the spectrum of the corona was conspicuous by its absence, being too faint to be seen or photographed at all, and disappointing those who tried to observe it.

The form of the corona was very close to that predicted by Hansley, showing long equatorial extensions and short curved rays near the poles.

The inner corona showed very little telescopic structure, with no conspicuous evidence of connection with the prominences.

The shadow bands, which appear just before and after totality, were well seen. They moved in different directions at the stations only a short distance apart—a circumstance which strongly supports the theory that they originate in the earth's atmosphere.

About fifteen good negatives of the corona were obtained with instruments up to 12 feet focal length. Those, with exposure of 20 seconds, show extensions of the corona considerably more than the sun's diameter in length.

THE HEAVENS.

At 10 P. M. on July 15, the constellations of summer are visible to great advantage.

The Milky Way forms a great arch across the east, with one foot almost under the pole and the other in the extreme south; and along its line are the constellations described last month.

The present is a good time to note the complex structure of the Galaxy. From Cygnus to the southern horizon it is divided into two streams of unequal brightness and variable width, with several marked condensations and knots, of which the brightest are in Sagittarius, near the southern horizon.

In the northwest appears the Great Bear, standing on his head, and the west is lighted by Arcturus and Spica, the latter being near its setting. The southern constellation Scorpio and Sagittarius are at their highest above our horizon. Scorpio is identified by the presence of Jupiter within its borders, and Sagittarius by the fainter and yellower Saturn and also by the little group of stars called the Milky Dipper, which, though it is in the Milky Way, must always be empty, for it is wrong side up.

In the southeast is a pair of moderately bright stars close together which is worth looking at. They are Alpha and Beta Capricorni and are both double. Alpha—the upper one—has a close companion on the right and a fainter and more remote one on the left. Both are visible to a good eye without a glass. Beta shows in a field glass a still closer companion of the seventh magnitude. With the telescope the stars are much more remarkable. The companions of both Alpha and Beta are double in powerful telescopes, and the companion of Alpha is separated by the most powerful instruments into two stars!

THE PLANETS.

Mercury is in Cancer, and is evening star till the last day of July, setting nearly two hours after the sun on the 1st and easily visible in the evening twilight. On the 31st he is in inferior conjunction with the sun and becomes a morning star again.

Venus is the evening star at the beginning of the month, but sets only ¾ of an hour after sunset, and rapidly approaches the sun, passing inferior conjunction on the 7th. As she passes south of the sun she will be invisible to the unaided eye till late in the month, when she reappears as morning star, and rises about an hour before the sun on August 1. Those who have telescopes may follow with interest the narrowing of her crescent, and may, perhaps, see its extension beyond the half of her circumference, due to twilight in her atmosphere.

Mars is being slowly overtaken by the earth, but is still far from opposition. He moves eastward through Taurus during the month and rises between two and three hours before the sun.

Jupiter is in Scorpio, and is well up in the southeast at sunset. The belts on his surface and his satellites are beautiful objects in the smallest telescope. To aid the identification of the outer two, last months list of their positions is continued.

Satellite III. will be east of Jupiter on the 1st, 8th, 15th, 22d and 29th, and west on the 4th, 11th, 18th and 25th.

Satellite IV. will be east on the 6th and 23d, and west on the 15th and 31st.

Saturn is just past opposition and is visible throughout the night, but as he is as far south as possible and at his greatest distance from the sun the present opposition is very unfavorable.

He figures, however, in the most interesting astronomical event of the month, for American observers—an occultation on the 10th visible throughout the United States.

As in the case of a solar eclipse and for the same reason, the time of the phenomenon is different at different places. At Washington Saturn disappears behind the moon's dark limb at 10:43 P. M., and reappears at 12:05 A.M. from behind the bright limb.

The local time of occultation will be about an hour earlier in the Middle West, and two hours earlier on the Pacific Coast. It will take about a minute and a half for the moon to hide the planet, so that the gradual character of the decrease of its light will be evident to the naked eye, while with the telescope the spectacle of the moon's dark limb slowly and steadily hiding the rings and ball of the planet will be one of uncommon interest.

Uranus is in Scorpio east of Jupiter, and Neptune is too near the sun to be seen.

THE MOON.

First quarter occurs on the night of the 4th, full moon on the afternoon of the 12th, last quarter on the morning of the 19th, and new moon on the afternoon of the 26th. The moon is farthest from the earth on the 3d and again on the 31st, and nearest on the 15th.

In addition to the occultation of Saturn there should be noted conjunctions of the moon with Jupiter on the afternoon of the 8th, Uranus the following morning, Mars on the afternoon of the 22d, Neptune on that of the 23d, Venus on the forenoon of the 24th and Mercury on the night of the 26th.

Princeton University Observatory.