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SCIENTIFIC AMERICAN SUPPLEMENT

No. 999.

For the Week Ending February 23, 1895.

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THE COMMERCIAL SYNTHESIS OF CARBON AND HYDROGEN.

The real and prospective triumphs of chemistry have been in the field of synthesis or the building up of compounds. It is always an easier task for man to destroy than to build. Going back to the days of the alchemists, we recognize in their attempts to discover the philosopher's stone what was really a search for the formation of gold, and in their attempts to discover the elixir vitæ we can picture them as attempting the creation of life, or at least the prolongation of vital energy beyond its natural period, amounting to the synthesis of life itself. It is now but little over a century since modern chemistry had its birth in the discovery of oxygen, something which did away with the old phlogiston theory. Oxygen was produced by heating mercuric oxide, so that the cornerstone of chemistry was a destructive process.

As chemistry advanced, the work of the great chemists early took the form of analysis, Scheele and Berzelius being among those who set the example of patient, laborious analytical work, while the great field of synthesis remained comparatively untouched. It was in 1828 that Woehler made his famous synthesis of urea from ammonium cyanate, producing thus a compound in every sense organic by purely chemical processes. Later the synthesis of cyanogen from carbon and nitrogen was effected. This made it possible to start with solid carbon and gaseous nitrogen and produce urea. A few years after this came Berzelius' discovery that it was possible to synthesize carbon and hydrogen. This experiment was really due to an accident incident to the production of potassium. Again Woehler, in his work on calcium, succeeded in producing a compound of calcium and carbon, which, treated with water, evolved the hydrocarbon acetylene.

But all this represents what may be termed laboratory work; there was nothing practical in it. If we look all through chemistry, we will find that the one great desire of the chemists, a desire whose accomplishment seemed so far off that they did not dare to hope for it, was the synthesis of carbon hydrogen. This synthesis leads to everything. Millions of cubic feet of gas are annually delivered from our gas works for the purpose of producing light. The luminosity of the gas is due to the presence therein of hydrocarbons, and these hydrocarbons have to be formed by destruction. Coal or naphtha, both products originating in the workshops of nature, are destructively distilled to give the necessary illuminating constituents to the gas. One of the most colossal companies the world ever saw is the Standard Oil Company, of America, whose operations consist simply in the exploitation of nature's enormous store of hydrocarbons, represented by petroleum. Among the late achievements in the fields of chemistry none has received more attention, and excited more popular admiration, than the production of coal tar colors, but at the basis of all these comes the inevitable hydrocarbon, and the coal tar of the gas companies with its store of benzone and similar products has been drawn upon for the production of dyes for the textile goods of the world. If we come into the field of hygiene, we find the new medicines made from hydrocarbons originally.

But at last it seems as if the great synthesis had been accomplished, and the electric furnace, the producer of aluminum and silicon alloys, of carborundum, which almost rivals the diamond in hardness, now figures as the agent in effecting the synthesis of carbon and hydrogen. By exposing a mixture of lime and anthracite coal to the electric arc a heavy semi-metallic mass is produced. At first it was produced by an accident and the material was thrown away, some of it into a bucket containing water. A gas of powerful odor was produced which was found to be combustible, which proved to be acetylene, and at last the problem of a century of chemistry was solved, and solved by pure accident. It is interesting to note that in the iron industry the same synthesis is made possible. Cast iron is a combination of iron and carbon. Treated with acid, the iron dissolves, and the carbon unites with the hydrogen of the acid and hydrocarbon gas is evolved. This fact is taken advantage of in the analysis of cast iron in order to distinguish between the combined and uncombined carbon, but like the potassium production of acetylene, there is nothing practical in it. But the new process seems to be practical. The calcium carbide is comparatively cheap. A stick of the solid material represents a producer of illuminating gas, five or six per cent of which gas will convert non-luminous water gas to gas of the finest quality. If the material is immersed in water, the acetylene is given off. Again, the acetylene can be converted into the so-called coal tar colors, and can be made the starting point for the numberless series of organic compounds now produced in the technical factories.

The possibilities of the discovery are perfectly dazzling. Undoubtedly coal tar colors will for many years continue to be coal tar colors; bituminous coal and naphtha will continue to be sources of commercial hydrocarbons for lighting and heating purposes. But the enlightened mind judges of the greatness of discovery by scientific possibilities, not only by economic ones. In the electric synthesis of calcium and carbon leading to the production of acetylene we have a discovery whose economic future may yet prove to be of world-wide importance, and whose scientific interest is of the highest. We have recently published several articles on the subject, and we warmly commend them to our readers; and elsewhere in this issue will be found a discussion on this discovery.

Reflections by an Old Time Woodworker.

An old time carriage builder relates in the Hub how they built carriages fifty years ago and the changes machinery has wrought in the construction. They who are engaged in any part of the woodwork in a carriage factory at the present day know little of the difficulties that surrounded the workmen of the days prior to the sixties, but it will not do to make claim of better mechanics now than then; for while the change has simplified the labor, removed much of that which was extremely tiresome, it has not elevated the skill of the mechanics as a class. There are a few to-day who outrank in skill and technical knowledge those of fifty years ago, but they who do the bulk of the work are not skilled as were the former workmen. The body maker of those days had little more than an outline to work from. If the job was a new one, he made his patterns as he went along, and gave the curves and sweeps without rule, depending entirely upon the eye; and then, as each particular sweep or pattern was completed, and the thickness of wood, form of mortise, tenon, lap or miter was determined, each fact was faithfully recorded on the pattern, and should the latter become broken or mislaid, all were at sea. "I have used that pattern forty years," was a remark made by an old body maker in Newark, N. J., in the year 1857. Said pattern was of cherry, ⅞ inch thick, and so written over in ink that it reminded one of the hieroglyphics on an Egyptian obelisk. The pattern had done its work for a coach corner pillar, a short pillar for a coachee, a family rockaway, brett, and a variety of vehicles of equally dissimilar character, and it was but one of many that had been thus utilized. In those days, when there was no record, the first thing to be done was to mortise the one bottom side for the standing pillars, then mortise the top rail and tenon the pillars, after which these parts were put together and the outside of the bottom side swept off to suit the sweep of the top rail and the turnunder of the door pillars. This done, the corner pillars were fitted on and swept off, and so on until the body was completed; it was "cut and try," and yet when the body was completed it was a model of good workmanship—as good so far as mechanical execution was concerned as the best of to-day.

The manner of working by the body maker was duplicated in every other line. The wheel maker had his hub turned, but he laid off, bored and made the mortises, hewed out, squared and rounded his spokes, sawed and bored his fellies, did all other work by hand, but who makes a better wheel to-day? When bent timber came into use, the steam box and former constituted an important part of the shop fittings, and when the bending was done, all hands turned to and assisted by advice, if not otherwise. Twenty-four per cent perfect was a large average, and fifteen per cent breakage, beyond repair, was a satisfactory result. The chopping block and the broad ax were as much a part of the fittings as was the plane, and one to every two benches was a necessity. All the modern appliances in the line of machinery were absent. In place of a tenoning machine for spokes was a plane with a cutter spur for the shoulders, and guards with a set screw to regulate the depth of the cut. Fortunate, indeed, was the body maker if he had the thick plank sawed up. All their stuff had to be sawed by hand, and the ½ inch panel stuff planed down to ¼ inch by hand. Wages were not so much lower then than now. A good body maker could earn $3 a day; a wheel maker the same or a little more, and a general workman about $9 a week. A top buggy, covered with oil-dressed leather, made up with wood axles and upholstered with moss or rowen covered with curled hair, which, by the way, was picked from the rope by the youngest apprentice in the trimming shop, would sell for from $225 to $250. In view of the fact that every piece of iron was hand forged, all bolts and nuts threaded by hand, paints and colors ground and mixed in the paint shop, we wonder how the carriage builders ever succeeded in business; but they did, and their vehicles were honestly built and did many years' service.

Combined Ship's Buoy.

At the yachting exhibition in London is shown a "combined ship's buoy." It is carried on deck, and when the ship sinks it floats and records at once the hour and minute of the disaster. It then automatically fires rockets, burns blue lights, shows a lamp and rings a bell.

The Brazilian Rubber Tree Tappers.*

The business of rubber gathering, after the forest has been reached, begins with the opening of a "road"—a winding pathway just wide enough to allow a man to pass from tree to tree. Usually 100 rubber trees are connected by one of these roads, the intervals between them varying from twenty feet, or less, to hundreds. While one man's road may not be more than a quarter of a mile long, his nearest neighbor may have to walk five or six times as far to reach the same number of trees.

There is as much difference in the milk from rubber trees as in the milk from different cows. The consistency of the sap varies, some yielding a larger and some a smaller proportion of solid rubber. In the same road one tree may yield a thick, creamy sap, while the next will give a watery one, or even nothing at all, the "flow" being so slight that the sap merely puts in an appearance without reaching the cup underneath. Where several "taps" are made on the same tree, some may run freely, while others give nothing at all. On other trees, again, all the taps may run freely. In view of these differences in quality and quantity of the sap, the yield of a road, instead of single trees, is taken as a standard in any rubber camp.

One man can easily tap 100 trees daily, placing on each five or six cups to catch the sap. These trees, on what is called a good road, will yield, at the commencement of the crop season,† about 22 pounds of sap for each tapping. But all the roads are not equally good, and one with the yield just mentioned may lie next to another with a yield of only 10 pounds of sap. On the lower Amazon, in a field containing several thousand rubber trees, not more than 10 or 12 pounds of sap can safely be counted on for each 100 trees per day. Supposing the trees to be tapped regularly for twelve weeks—the extent of the tapping season—the total yield per tree would be about 7 pounds of sap, or 3½ pounds of cured rubber. But a rubber gatherer can, without great exertion, work two roads during a season, making, at the average yield here mentioned, 700 pounds of rubber. An active, hard-working man can double this product, and can do even better with the help of his wife (seldom with "benefit of clergy") and children. In partially cleared forests a rubber gatherer can care for more trees.

In the state of Amazonas the average size of the rubber trees is larger, and the yield is greater. This is because rubber gathering has not been practiced there so long, and the trees have been allowed to mature fully before being tapped. In the lower districts, where the rubber industry had its origin, the yield per tree is much less now than formerly. A man who worked in the rubber fields forty years ago once told me that he had known roads of 100 trees to yield 40 to 45 pounds of sap per day, while his early employer used to complain because the yield had fallen from 60 and 65 pounds. To-day an occasional rubber tree will sometimes yield two pounds at a single tapping, but there are more on which the scanty exudation dries on the bark without reaching the cup.

The quantity of sap required for making a pound of India rubber varies more than the quantity of milk needed for a pound of butter. While two pounds may be given as the average, very much more is sometimes necessary. The yield of rubber from a given measure of sap is greater at the beginning of the season than at its close, the consistency of the sap steadily diminishing.

The age at which rubber trees become fit for tapping depends upon their surroundings. In the dense forests they will hardly bear tapping before the age of twenty-five or thirty years; in partially cleared forests, they can be tapped at sixteen years, while on lands from which the other growth has been removed, rubber trees begin to yield at ten years, and, if carefully treated, appear not to suffer from the tapping. The trees in cleared spaces grow much more rapidly than those in the dense forests. Without doubt the application of science would increase the yield of sap, and also the proportion of solid rubber contained in it, but this good result is not yet to be looked for. The rubber gatherers will trust to "the prodigality of nature" until all the unexplored fields have been opened and all the existing trees have been exhausted. How long that will be in the future may be imagined when one reflects that trees continue to be tapped that have been yielding rubber ever since it became a marketable commodity.

The season for tapping trees may last for three months, and sometimes six, the operation being performed daily. This is determined by the size of the trees and the richness of the yield. In some cases the trees are tapped only every other day. In others, the trees are tapped daily in the season, but only in alternate years. A rubber gatherer who owns nothing in the locality where he works sometimes taps the trees so heavily as to kill them in a single season, but such a man will find it hard to get a road in the same field again. These roads, by the way, often exist year after year, and have a rental value.

The cups used for catching the rubber milk as it oozes from the tree are now mostly of tin, though in some places cups of burnt clay are still used, being considered superior. The making of the latter requires much time, however, and they are liable to break, so that tin cups are rapidly displacing them. The clay cups are attached to the rough bark of the tree with the aid of a dab of wet clay, while the tin cups are held in place by turning down the top and pressing it into the bark. The tins could be improved by the addition of some sharp points to the back of each, to drive into the bark. The cups are made in three sizes—4, 6, and 8 ounces. The smallest size is used on the lower Amazon, the middle-sized ones in Amazonas, in the developed fields, and the largest size in virgin fields. In the latter case smaller cups are likely to be substituted before the crop is finished.

As in every other industry, there are careless, shiftless workers in rubber gathering. Such persons, when finishing their day's labor, will throw the empty cups on the ground at the foot of the trees, with the "drippings" left within. A more practical man, when he begins the season, will drive into the ground by each tree in his road a stick in which there are as many saw cuts as he has cups for the tree, while underneath is a box in which the last drop of rubber is caught. These drippings at the end of the season represent a not small item.

A rubber gatherer who is fully conversant with his business and is desirous of protecting his trees will work as follows: He will first mentally divide the lower part of the trunk—beginning about one foot from the ground and going as high as he can reach with his hatchet—into six sections, representing the six working days of the week. On Monday, we will say, he will commence work by making taps about eight inches apart around the trunk, forming a circle as high as he can reach. Under each incision he will place a cup to catch the sap: eight will be needed for a tree sixty-four inches in circumference. On Tuesday the same tree will be tapped on a circle about a foot lower, the incisions being directly under those made on the first day. By continuing this process to the end of the week, the circle of taps on Saturday will be about a foot from the ground, and forty-eight incisions will have been made,—i. e., six circles of eight taps each. The next week he will begin by tapping again in the circle of the previous Monday, but tapping between the incisions in the circle. When, after a time, no room for new incisions can be found in the original circles, new circles are started a short distance below, and thus the work of cutting into the bark is continued until the whole surface of the tree is covered with taps. It will then be necessary for the tree to rest for the remainder of the year—possibly for all of the next year. If the tapping has been properly done, by which is meant if the bark has been cut into no more than is necessary, and the wood not cut into at all, the incisions will heal over so as to leave no sign.

Much skill is needed in tapping rubber trees. Deep incisions damage the trees, but if they are too shallow, the sap will not flow. If the tapper, on failing at first to go deep enough, attempts to strike again in the same place, he is likely to miss his aim, thereby making two incisions instead of one, and chipping out a bit of wood between them, which wounds the tree. Some superstitious people try to make the cut in the form of a cross, "for luck."

Having tapped the trees in his road early in the day, and placed the cups in position, the tapper returns home for breakfast. Later he starts out with a bucket or other receptacle to collect the sap from the cups, beginning with the first tree tapped, and going over the same route followed in the morning. The milk does not run more than three hours. At the end of his road he will find himself near his hut again, where he next proceeds to smoke the sap over a fire of palm nuts.

In the case of some large trees two series of circles are described in the tapping, the upper series being reached by means of a staging built around the tree. Such treatment is likely to prove fatal to the tree, however. It is good management to avoid tapping during the flowering season of the rubber tree, which is during September. The best months for tapping are July, August, October, November, and sometimes December.

In answer to several correspondents it may be said that a personal visit to the Amazon states doubtless would prove a more satisfactory source of information than any letters that can be written from here. Life is easy in these latitudes, though somewhat oppressively de rigeur in the cities, where Portuguese customs still prevail. In the country, especially in the rubber fields, it is quite another matter. There a man may go about dressed in a light flannel hunting shirt and cotton trousers, a coat and waistcoat being superfluous. A big straw hat and high hunting boots are needed for going about, besides which one's outfit generally includes a rifle, cigars, and a bottle of quinine—the latter as a precaution against possible fevers.

* This article has been suggested by the receipt during the past year of no fewer than sixty-nine letters of inquiry from India Rubber World readers, to which paper we are indebted, and is written by Mr. M. F. Sesselberg (Para), with the idea that the information which has been asked for may prove of interest to other readers.

† The crop year is measured from the first of July.

Rubber Tires for Ambulances.

An experiment has been made recently in New York of much importance concerning the relative value of rubber-tired wheels on ambulances. Two rubber-tired ambulances have been in constant use for several weeks, one being equipped with solid and the other with pneumatic tires. The weight of each of these wagons alone, not including the weight of the driver, doctors, or patients, is 1850 pounds and it is therefore the heaviest pneumatic-tired vehicle in the world. It has been found that the rubber tires offer a great many advantages over the ordinary iron tires. It has not as yet, however, been determined whether the solid or the pneumatic tires are preferable. There is a great increase of comfort to the sick person who has to be carried over our rough streets by using the rubber tires and it is found also that the noise made by the vehicle is greatly lessened. Another important advantage is the saving in the weight of the ambulances. The ambulances have been made very heavy to give them greater stability to reduce the jolting. With the use of rubber tires the wagons may be made 400 pounds lighter, which of course lightens the load for the horses and reduces the cost of construction.

Several inconveniences have been experienced in the use of both forms of rubber tires. The ambulances are so heavy that the pneumatic tires collapse very often. And the solid tires are likely at any moment to be torn from the wheels, since the strain is unusually great. These difficulties, it is thought, however, can be remedied in time. It is as yet uncertain which form of rubber tires will be adopted, but it is certain the use of rubber in some form will be continued.

Passenger Traffic Between New York and European Ports.

During the past year 879 passenger vessels arrived at New York from European ports, 96 fewer than in the previous year. The number of passengers, however, was very much less. This is especially so in respect of steerage passengers, only one-half the number going westward, as compared with the four preceding years. The total number of cabin passengers was 92,561, and of steerage 188,164, the decrease on the former being 29,268, and on the latter 176,536. The first-class passengers were less by 24 per cent, and the steerage by 48 per cent. It therefore follows that each ship on an average carried less. This, however, applies more forcibly to the emigrant steamers sailing out from Continental ports, for the decrease in their case is very much greater than with the British liners. When the totals are compared with those of preceding years, the decrease is still more marked, and there is no question that the real cause is the restrictive measures adopted by the United States to prevent pauper immigration. By reason of extreme caution the steamship companies have not had to carry back many passengers, but the fact that some of the Continental steerage liners have only carried one-tenth or one-twelfth the number taken in preceding years indicates the effect of the law.

	Cabin.	Steerage.
1894	92,561	188,164
1893	121,829	364,700
1892	120,991	388,486
1891	105,023	445,290

Imitation of Pearl.

When nitrocellulose, dissolved in alcohol and ether, or in soda or potash-soluble glass, is spread over a surface of wood, paper, glass, porcelain, or metal, and the solvent allowed to evaporate, the film remaining is said to have the appearance of mother-of-pearl. The proportions recommended are: 1 part of nitrocellulose; 78 parts of alcohol (90 to 100 per cent); 21 parts of ether.

With soluble glass as solvent, 10 parts of this to 90 parts of water are employed.

The nitrocellulose may be pure or crude, or in different stages of nitrification, as guncotton, etc. Ethyl or methyl alcohol and sulphuric or acetic ether are recommended. The degree of concentration of the nitrocellulose may be varied within certain limits, which variations produce different results. The addition of bisulphide of carbon in the proportion of 25 parts to 100 of the above solution, or the addition of benzine, produces a difference in the brilliancy and arrangement of the colors of the iris developed on the mother-of-pearl-like surface.

Preserve for Binding.

The publishers of the SCIENTIFIC AMERICAN would advise all subscribers to preserve their numbers for binding. One year's issue (52 numbers) contains over 800 pages of illustrations and reading matter. The practical receipts and information contained in the Notes and Queries columns alone make the numbers worth preserving. Persons whose subscriptions have commenced since the beginning of this year can have the back numbers sent them on signifying such wish. Their subscriptions will then expire with the year.