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Contents.

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TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

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THE POTENTIALITIES OF CHEMICAL RESEARCH.

The men of brains—the leaders in the progress of our race—have of late become so wrapped up in one comparatively narrow branch of science, the mechanics and dynamics of electricity, that there has unquestionably been a growing neglect of the greatest and most universal, the most practical and fertile, the most far-reaching and civilizing of all the sciences. A science, moreover, which is scarcely older than that of electricity, that is, one which emerged but little earlier from the swaddling clothes of empiricism. Nevertheless, the young giant, chemistry—of which we speak—has a future before it which involves that of the race of man more intimately and more completely than all the other sciences combined.

Those who pursue electricity, by the inductive method—that of practical experiment and generalization therefrom—have lately entered the complaint that electricity has become nine-tenths mathematics. In a certain sense, this may be all right, but it is not the way in which electricity itself was founded. The men of the laboratory laid its foundation; and it may be asserted that it is still in the experimental laboratory that all the new fundamental facts are and will be born. Mathematics is not a discoverer, though a highly valuable expounder. To many real experimental discoverers, the higher branches of mathematics constitute a trackless maze. Indeed, the peculiar brain powers needed by the expert mathematician resemble those of the musical composer, and the methods of each require the same constant and assiduous cultivation, memorization, practice, mental absorption and abstraction, which together make up that rare combination called "genius."

There is no doubt that in America experimental chemical research has but a slight foothold. The causes are on the surface, and easily understood, but are outside our present scope. It is proposed here to show cause for the conviction, in reasoning minds, that the prospects of our race—some already in sight—depend mainly on the cultivation of experimental, analytical and synthetical chemistry.

First, to present a generalization or induction from the whole field of chemical research. Much of such research has been, is and will yet be, pervaded with what may be called the *random* element. All experimental attempts to penetrate the unknown necessarily partake of this element. It is only when facts have so multiplied as to render *generalization* possible that *systematic* research begins. The great amount of more or less random research yet prevailing proves that chemistry is as yet but an infant, destined to a gigantic growth—a growth in fact illimitable.

We now know with certainty 72 elements of matter. Each one of these is—according to the results of research—the basis of an incalculable number of compounds, no two of which are exactly alike in any one of their relations to other bodies. The changes to be rung on nine bells, or even on nine thousand, are but a drop of water to the ocean, compared with the possible variety of chemical bodies, each possessing certain salient potencies, which are to be found only by experiment, and can rarely be predicted. The number of chemical species or forms of matter, each distinct from all others, is therefore *practically* infinite. The generalization based on this is as follows: A form of matter must be capable of existence, and must, therefore, be within the power of chemical research to discover and prepare, which will possess *any assignable or conceivable potency*, or influence over any given species of matter, dead or living.

If we have here been successful in shaping a form of words so as to make this general induction clear, the results that proceed therefrom will quickly present themselves to any rational mind.

Here, and now, we can only comment on one deduction therefrom. This relates to a new subject which, though of a vital importance to mankind beyond the power of words to convey, is yet in a condition of incipiency—scarcely half born. We might call it chemical pathology—the chemistry of diseases. It relates to the chemical *nature*, *origin* and *cure* of diseases. We are, by dint of numerous random investigations, made mainly in this, our century, beginning to see quite plainly a new induction, which will doubtless form the cornerstone of this new branch of experimental chemical research. The "germ theory" of diseases has gone through long controversies. It has been but quite recently recognized, however, that the germs themselves and their living progeny do not constitute the diseases, and are not even the *immediate* agents, generally speaking, of such diseases. It is now becoming a matter of belief that in some (and of strong suspicion that in almost, if not quite all) of this class of diseases, it is the distribution throughout the circulation of the animal, of specific poisons, similar to snake poisons, products of the conversion or rather *perversion* of vital tissues by the progeny of the disease germs, that constitutes these diseases. The ancients said: "Fas est ab hoste doceri." (It is right to be taught by your enemy.) This applies here. Now that we know that the enemies born from the disease germs kill us by poisoning our blood—if we cannot deal with these enemies directly, we may destroy, or neutralize, or paralyze their weapons. The next step is for the chemist to discover, analyze, and experiment upon these specific poisons—these *tox-albumens*, or *ptomaines*, or whatever they may prove to be—and discover how to destroy them, or combat them with antidotes.

According to the generalization propounded above, such antidotes—and, moreover, we may add, chemical compounds capable of poisoning or dislodging the disease fungoids themselves—must be susceptible of existence, and will sooner or later be discovered. No nobler aim than this could animate a chemist. The prospect is plain that all these hitherto invisible and inscrutable foes of our race will yet be disarmed and defeated by the weapons of the chemical laboratory. Life will then be prolonged, and our vital energies enhanced.

Artificial Coloring of Flowers and Fruit.

The tinting of flowers naturally white has already been spoken of in these pages, and now we have a little more to tell our readers about the same subject. It seems only natural that so purely fanciful an art should originate among our French neighbors, whose ingenuity is so well known. The *Revue Horticole* tells us a few of the secrets of the production of color in flowers and fruit, and we mention them here for the benefit of any who may wish to try such a curious experiment for themselves. It is said that to color flowers through the stalks, it is necessary to put five grammes (1 gramme=15 grains) of any coloring matter into a vessel which will hold about ten grammes, to bruise the tip of the cut stalk with a light tap with a hammer, and then to put the stalk into the vase for a greater or shorter time, according to the depth of coloring required. Two hours after this contact with the dye the tinting of the flower is accomplished. On taking the blossom from the vase, it is advisable to cut off the bruised part of the stalk and soak the flower for an hour or two in a vase of clear water. To tint white bulbous plants, fill a vase with fifty grammes of clear water and fifty grammes of coloring matter, stir the mixture up well, then, after slicing the bulb with a penknife in one or two places and cutting off the tips of the roots, leave it steeping in the tincture until the flowers begin to color. Then replace it in the pot, covering it with a little moist earth, and the flowers will finish coloring there. Fruits as well as flowers can be artifically colored, and sometimes this is done for the purposes of adulteration, as, for instance, when plums are too green they are coated with acetate of copper and sulphate of copper. When too pale, lemons are tinted up with citronine and "naphtol yellow," the green spots being imitated with "diamond green." Strawberries are colored by sprinkling them with "sulfo-fuchsine" or "rhodamine." Peaches receive a beautiful coloring from a mixture of "rhodamine" and "citronine," applied with a brush, using a zinc stencil plate pierced with holes. In melons a tube is introduced through which "atropeoline" and "orange azo" with a little essence of melon is put into the center. Very pretty varieties of apples and pears are contrived by using a little aniline dye. These devices may make bad fruit salable, but are not examples to be copied, unless for the sake of making a curious experiment.—*The Gardeners' Chronicle.*

Honors to the Memory of Tyndall.

At a special general meeting, Friday, December 15, 1893, of the Royal Institution of Great Britain, Sir James Crichton Browne, M.D., LL.D., F.R.S., treasurer and vice-president, in the chair, the following resolution, in reference to the decease of Dr. John Tyndall, honorary professor of natural philosophy of the institution, was read and unanimously adopted:

Resolved, That the members of the Royal Institution of Great Britain, in special general meeting assembled, hereby record their deep regret at the death of Dr. John Tyndall, D.C.L., LL.D., F.R.S., who was for forty years connected with the institution as lecturer, professor, and honorary professor of natural philosophy, and who, by his brilliant abilities and laborious researches, has nobly promoted the objects of the institution, and conspicuously enhanced its reputation, while at the same time he extended scientific truth and rendered many new additions to natural knowledge practically available for the service of mankind; and that the members of the Royal Institution further desire to convey to Mrs. Tyndall an expression of their sincere sympathy and condolence with her in the bereavement she has sustained in the loss of her gifted and distinguished husband.

Fire Losses of 1893.

During the year just ended the loss by fire in the United States in property value was almost $150,000,000, a greater loss than has been recorded in any one year, except that in which Chicago was burned, and that in which the best part of Boston was blotted out. Boston lost more last year than any other city, the estimate being $5,300,000. Nearly the whole of it fell upon the insurance companies.

The Turlock and Modesto Dam.

The completion of the Turlock and Modesto irrigation dam gives California the largest and highest overflow dam in the world.

The contract for the great structure was let in June, 1891, and although two years and a half have elapsed, the preliminaries, and the months lost by reason of high water, reduce the actual working time to fourteen months, during which period 150 men—all white – were employed.

It will be readily appreciated that the preliminary work, including the diverting of the waters of the Tuolumne River by means of flumes, and the excavation to bedrock for the base, was a task of no small magnitude. Added to this was the necessity for lowering the machinery employed, including nine donkey and stationary engines, from the summit of a hill towering above the scene of operations on the hillside and in the river bed. All the supplies, too, were handled in this manner.

The dam, it should be premised, is situated on the Tuolumne River, where that stream foams through a canyon in the foothills of the Sierra Nevada range of mountains, a mile and three-quarters above the old mining town of La Grange and about thirty-three miles east of Modesto. The ragged, mountainous hills that tower on either side are of blue trap formation, covered by a scanty soil, and at the site of the dam the conformation is such that the masonry laid by the builders interlocks with and is supported by the hillsides.

The original plans of the dam were approved by Colonel Mendell, the noted civil engineer, and have been followed without material change. It is constructed on the principle of an arch, on a radius of 300 feet; hence its surface length on the top is 336 feet, while a straight line drawn from bank to bank would be but 317 feet in length. Its base is 70 feet in length and 97 feet through, sloping upward on the lower side at a ratio of 4·67 feet in ten feet, so that at a height eleven feet from the top, from which point it is rounded to carry the overflow water down the slope, its breadth diminishes to 24 feet. The upper wall is perpendicular, and both upper and lower walls are of shaped rock laid in cement mortar.

Embraced in this stupendous structure are approximately 40,000 cubic yards of rubble masonry. Over 31,000 barrels of cement, each weighing 400 pounds, entered into its construction. The center of the dam, between the face walls, is comprised of great masses of blue trap, embedded in concrete, the interstices filled with smaller rock and concrete, and the whole thoroughly rammed. The rock is the blue trap of the country, blasted from quarries opened near the spot, drawn up an inclined railway, and conveyed to the spot required by a system of elevated cable tramways. The concrete used is composed of a mixture of twenty-two cubic feet of broken rock, eight cubic feet of sand and one barrel of cement, washed and mixed in a revolving mixer operated by steam, and conveyed to the dam by the cable tramways.

Two sand-ways are provided for in the dam, but the water not taken out by the canals is to go over the top and down the inclined lower wall to the bed of the stream, impinging first on the "leg" of the structure, which, of rubble masonry, extends out some distance and obviates all possibility of undermining.

A great reservoir is formed by the dam, the water of the river backing up for three miles. This winter and next spring, at times of freshets, a volume of water ranging from five to twenty feet in depth will pour over the structure.

The cost to the districts of this most essential factor in the irrigation enterprise ranges from $525,000 to $550,000, equally divided. The main canals designed to carry the water to the irrigation districts are well advanced, and have a carrying capacity estimated to be sufficient to give an average of one foot of water for every quarter-section embraced in the 257,000 acres comprising the two districts. While the advantages to accrue from the use of the water in this direction overshadow all others, the fact that there exists great possibilities for the generation of power, to be transmitted through the medium of electricity, has not been lost sight of.—*Pacific Lumberman.*

The Earth's Motion Made Visible.

In the December issue of *Popular Astronomy*, Eliza A. Bowen shows how the earth's *revolution* may be made manifest to the eye. Dr. L. Swift, in *Popular Astronomy*, says: Place on the floor of a room free from tremors and air currents a good sized bowl nearly filled with water and sprinkle over the surface of the water an even coat of lycopodium powder, and across this make a narrow black line of pulverized charcoal. Place the bowl so that the black line shall coincide with a crack in the floor, or, if the room be carpeted, lay a stick upon the floor exactly parallel with the mark. After a few hours it will be found that the line is no longer parallel with the stationary object, but has moved from east to west, proving that, during this interval, the earth has moved from west to east.

The reason appears to me to be that the solid floor has with the earth and bowl moved from west to east, and so has the water also, but at a slower rate, as there is a slight inertia, of which the yielding liquid does not instantly partake, to be overcome. It will be seen that the line or charcoal mark always moved from east to west.

Artificial Silk.

A writer in the *Petit Journal*, says the *Mediterranean Naturalist*, gives an interesting account of a new industry which has just been started at Besancon, in France, where wood pulp is converted into soft silken thread.

"I am going to tell you about the most astonishing thing, the most surprising, the most marvelous, the most miraculous, the most triumphant, the most astounding, the most extraordinary, the most incredible, the most unexpected, the most prodigious, the most unique, the most brilliant and the most worthy of imitation and envy of this century—it is the invention of Count de Chardonnet, by means of which wood pulp or cotton is converted into durable, luminous and elastic silk."

For a long time after its discovery the process and system of M. de Chardonnet remained concealed in his laboratory. It made its first appearance at the Exposition of 1889, where it received the highest award that the jury could give. Connoisseurs, savants and manufacturers were greatly interested in it, though it had not reached the degree of perfection to which it has been brought to-day.

The great question, that which leads all others since the new invention tends to produce a revolution in one of the greatest of French industries, is, Can this discovery be utilized for the growing needs of the people?

A complete answer in the affirmative has been given to-day by M. de Chardonnet, who has already, by enlisting the sympathies of several business men, built a mill at Besancon, where the "silk" is being manufactured. Raw material is made from wood pulp, such as is used for the fabrication of certain kinds of paper. This pulp is carefully dried in an oven and plunged into a mixture of sulphuric and nitric acids, then washed in several water baths, and dried by alcohol.

The product thus prepared is dissolved in ether and pure alcohol, and the result is collodion, similar to that used in photography. This collodion, which is sticky and viscous, is inclosed in a solid receptacle, furnished with a filter in the lower end. An air pump sends compressed air into the receptacle, and by its pressure the collodion is passed through it horizontally. This tube is armed with 300 cocks, of which the spouts are made of glass, and pierced by a small hole in the diameter of the thread of a cocoon as it is spun by the silkworm.

The spinner opens the cock, and the collodion issues in a thread of extreme delicacy (it takes six to make a thread of the necessary consistence for weaving). This thread is not, however, fit to be rolled on spools by reason of its viscosity and softness. The matter is yet as collodion, and not silk. To produce the necessary hardness the inventor resorted to a very ingenious but simple method. The little glass tube already mentioned is surrounded by a small reservoir of the same material constantly filled with water; when the thread issues from the aperture in the manner described, it traverses this water, which takes up the ether and alcohol, and the collodion becomes solidified, that is to say, it is transformed into an elastic thread, as resisting and brilliant as ordinary silk.

One more detail. On account of the materials employed in the manufacture of this silk—wood ether and alcohol—it might be rightly supposed, as was mentioned in the former report, that the stuff manufactured would be dangerously inflammable. M. de Chardonnet has apparently obviated such a contingency by plunging the spun thread in a solution of ammonia, thus rendering it as slow of combustion as any other material.

Another practical difficulty to be remedied in the invention is the frequent snapping of the slender threads issuing from the cylinder by reason of unequal pressure. This makes it impossible to maintain a standard quality for the output, and, consequently, there may be produced five pounds of excellent silk followed by five pounds of a comparatively worthless quality. This difficulty is being overcome, but until it is completely removed men of large means will not invest largely in the stock of the company which has been formed to exploit Count Chardonnet's invention.

Up to the present time none of the rich and important silk men of St. Etienne and Lyons have invested heavily in this enterprise. They all profess to believe in it, and declare that in a few years artificial silk produced by this process, when it shall have been somewhat improved in certain details, is destined to figure largely in the commercial world.

The disposition to-day on the part of French capitalists is to await developments. When the process is once perfected, and its results are wholly satisfactory, there will be a lively struggle for the control of this valuable invention, and there seems to be no doubt of the ability of the inventor to remove every obstacle which stands in the way of perfect, practical success.

The Minneapolis Flour Mills.

The annual report of the Pillsbury-Washburn Flour Mills Company, presented to that corporation in London, November 14, shows that the past year has been unfavorable, so far as profits are concerned, owing to the fall in the price of wheat and flour, the decline being about 40 per cent. The following exhibit shows the consumption and production for the past three years:

	Flour produced, barrels.	Wheat ground, bushels.
"A" Mill	1,482,000	6,443,000
"B" Mill	855,300	3,692,000
Anchor Mill	445,200	1,926,000
Palisade Mill	577,400	2,506,720
Lincoln Mill	237,500	1,024,000
Total, 1893	3,597,400	15,591,720
" 1892	3,776,500	16,234,848
" 1891	2,827,800	12,456,000

The yields for the different years, commencing with 1891, have been 4·22, 4·18, and 4·20 respectively, and the best yield for 1893, it will be noticed, was accomplished in the smallest mill, while the "A" mill figures out the largest amount of wheat used for a barrel of flour. The profits, it will be seen, net something under 4½ cents per barrel, but, if wheat has touched bottom, it was declared that the company was in the very best position to make money in the future. Mr. Pillsbury's management of the company's affairs in Minneapolis was warmly indorsed by the directors, his whole-souled devotion and loyalty to the interests of the concern being applauded by a unanimous vote.

The Deepest Metal Mine in the World.

The United States has now, we believe, the deepest metal mine in the world. For some time that claim has been made for the Maria shaft, at the mines of Przibram, in Austria, which was 3,675 ft. below the surface at the time of the great fire in 1892; and nothing, we believe, has been done upon it since that time. It has now been surpassed in depth by the No. 3 shaft of the Tamarack Copper Mining Company, in Michigan, which on December 1st was 3,640 ft. deep, and is now more than 3,700 ft., the average rate of sinking being about 75 ft. a month. This makes it beyond question the deepest metal mine in existence, and only one other shaft has reached a greater depth, that of a coal mine in Belgium, for which 3,900 ft. is claimed.

For the attainment of this distinction we have to congratulate Captain John Daniels, the general manager of the company, for the skill and success with which the work has been carried on. In Germany the completion of the Adalbert shaft to a depth of 1,000 meters (3,281 ft.) was thought worthy to be the occasion of a public festival; and though the Tamarack shaft has been carried down to the present great depth entirely as a matter of business, and no especial formalities have marked its progress, the remarkable achievement certainly deserves recognition, for not only has it been sunk to a greater depth than any before it, but it has been sunk with much greater rapidity and at a less cost than probably any European shaft of anything like its depth or in ground as hard.—*Eng. and Min. Jour.*

A Twelve Mile Gun.

In a paper read before the Western Society of Engineers, Captain W. H. Jaques says:

"The wire-wrapped type had the honor of firing the 'Jubilee Rounds' in the Queen's Jubilee year, and gave wonderful results. On April 16, 1888, was fired at Shoeburyness the first of a series of rounds intended to investigate the conditions attending firing at very long ranges. The gun selected was a 9·2 gun, made under the direction of General Maitland in the Royal Gun Factories. The weight of the gun was 22 tons, that of the projectile 380 pounds, which, fired with a charge of 270 pounds, gave a muzzle velocity of 2,360 foot seconds. The elevation of the first round was 40°. The projectile fell at a range of about 21,000 yards, or nearly 12 miles. On July 12, at 43° elevation, a range of 21,600 yards was attained, and on July 26, with 45° elevation, the range was 21,600 yards, or about 12·4 miles. The projectile remained in the air about 69·6 seconds, and its trajectory reached a height of 17,000 feet, or about 2,000 feet higher than the summit of Mont Blanc."

How to Mend Crockery.

A valued correspondent says: Before being allowed to get dirty or greasy tie all the broken pieces in their places nicely with any kind of string that suits, then put in an iron or tin dish that can be put on the fire, pour in as much milk as will cover the fractures well, put on the fire and boil for say ten minutes, and the whole operation is complete. Don't undo the wrapping until the dish is completely cold, and if yours hold at ours do, you will call it a success.

A SUBSCRIBER.

THE longest reach of railway without a curve is claimed to be that of the new Argentine Pacific Railway from Buenos Ayres to the foot of the Andes. For 211 miles it is without a curve, and has no cutting or embankment deeper than two or three feet.