Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

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The Scientific American Supplement

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NEW YORK, SATURDAY, JUNE 2, 1894.

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 961.

For the Week Ending June 2, 1894.

Price 10 cents. For sale by all newsdealers.

PUPIN'S IMPROVEMENTS IN LONG DISTANCE TELEPHONING.

The efficiency of ocean cables for telegraphic communication and of long land lines for rapid telegraphy and telephoning is greatly impaired by their static capacity and self-induction. On lines possessing the last named factors in high degree only slow telegraphy is possible; any attempt to use the Wheatstone system meets with failure, and telephoning is out of the question. There is no doubt that the telegraphic world is waiting for the invention which shall overcome these troubles, and enable a telephonic conversation to be held over a line of ordinary construction, from New York to San Francisco. The present long distance telephone lines are of very expensive construction.

Professor M. I. Pupin, of Columbia College, has been awarded two patents on apparatus for telegraphic or telephonic communication which are designed to secure the possibilities outlined above. If the inventions answer the expectations which they raise, then it should be possible to telephone across the ocean, and the breadth of the continent should oppose no bar to telephonic conversation.

Professor Pupin proposes to divide a telegraph or telephone line into sections, electrically separated one from the other. At each point of separation a condenser is introduced of large capacity compared with that of a section of the line proper. The capacities are so proportioned as to "time" the line to respond to alternations or changes of very high frequency. By this division of the line into sections its periodicity as a whole will be determined by the periodicity of its single parts. Over such a line rapid signaling and telephoning can be executed, and it is believed that it opens up a greatly extended range for this class of electric transmission of voice and signal.

Its application to land lines is simple enough, but in the case of ocean cables some complications, to say the least, would be involved. Whether it would be practicable to sink a line of operative condensers at intervals along the ocean bed is a matter of conjecture. It would seem rather an innovation to cut an ocean cable into sections only electrically related by the medium of condensers. This thing is provided for in the patents, as Prof. Pupin proposes to use a coil of high inductance in parallel with each condenser to supply a metallic circuit for the determination of faults.

The inventions are most ingenious and promise to perform an important part in the field of long distance telephony.

NEW ZEALAND LABOR LAWS.

John D. Connolly, Esq., United States consul at Auckland, New Zealand, has sent to the State Department a report on the labor laws of New Zealand, a copy of which we have received from the Secretary of State. In a few pages it gives a very striking presentment of paternal legislation in the antipodes, which seems to have proved successful and to be liked by the people. The dreams of Bellamy and of other describers of Utopian states, all of which make the happiness of their fictitious peoples depend upon direct governmental interference, seem to have some degree of realization in New Zealand. It would be hard to find a better place to try these theories. The two islands are not very large, and isolated in the ocean may be taken to represent geographically the New Atlantis. The theories of Sir Thomas More, of Bacon, and of Bellamy may be tried there to great advantage, in the absence of sectional issue and in a country which has every reason for being a unit.

It seems that previous to 1881 New Zealand was afflicted with the borrowing mania, English capital had been largely invested in the country, and for some time there was an abundance of money and "good times." About 1881 the crash came, and for ten years panic reigned. Then the government took up the matter, and by enactments tried to cure or palliate the troubles of the country. A law was passed against unscrupulous promoters and directors of stock companies, making them personally liable for their acts. Another law was for the protection of labor, both in the matter of wages and of personal injuries received while at work. Another act regulated factory labor and established compulsory holidays with full pay. These are but examples of the legislation alluded to, as many more acts were passed.

It is claimed that in the last three or four years the country has wonderfully advanced. The government has charge of almost all large operations. Roads and bridges, occupation for the unemployed, asylums, hospitals, railways, telegraph and telephone systems, life insurance and a savings bank are included among its subjects of work. Profits derived from these enterprises are applied to conducting the affairs of the state.

Most are well managed; some complaints are made against the railroads, however. The public works are conducted on the co-operative system. The government gives the work in small sections to gangs of men, who divide the earnings equally among themselves. There are no contractors. For the unemployed labor bureaus are maintained.

It is an interesting experiment and the results will be of the deepest interest. It is still an open question whether the great improvement of the last few years is due in part to the government's action.

PHYSICAL TRAINING IN COLLEGE.

A large number of boys who went to college in the first half of this century earned a part or the whole of their expenses. It was not uncommon for them to walk from their homes, long distances to college, to save stage fare; they cut their own wood; some of them boarded themselves and took care of their own rooms. The vacations were arranged with reference to their working through them with most profit, and not to their resting.

Their concern was how to find the time for study which they craved. These were the men who were the leaders in the nation in the dark days of the rebellion, as their fathers and grandfathers were in the revolution.

But changes in our social fabric have been nowhere, perhaps, more radical than in college life.

In the last quarter of a century we have become a wealthy people. There are still students in our colleges (and they are often those who take highest rank) who are obliged to work with their hands or brains, or both, to pay their bills, but there are sons and daughters of so many rich people that gymnasiums have become as much a necessity as chapels or recitation rooms. No well equipped preparatory school or college is without one, and exercise in them is part of the day's regular duty. In the best ordered institutions this exercise is taken after a physician's examination and according to his prescription. Calisthenics begin in the kindergarten with the sewing and songs and gifts, and they are continued through every grade of the best secondary schools.

Athletics is the new word which tells the story of our having got beyond the time when college life is for any one strictly a working period—one of work with the hands, so as to be able to work with the brain. The "crack pitcher" or oarsman, the captain of the boat crew or the ball nine, is now the man whom his fellow students point out to strangers as the conspicuous man in his class. He not unfrequently has a good standing for scholarship, but that is of less consequence. The regulations which men who are preparing for these trials of skill are obliged to follow ought to be suggestive and helpful to students who have no part in the games and races except as admiring spectators. These are the rules which are imperative for men in training.* "They must be in bed at ten o'clock every night, they must not smoke, chew nor drink beer or coffee; they must avoid pastry and sweets. They are obliged to run from one to three miles per day, in addition to their regular gymnastic movements. They take a complete bath at the close of each day's exercise."

But the gymnasium, the ball and tennis grounds, and the lakes and rivers, are not the only places where the college students of to-day get physical exercise.

The student who has spent two hours in a laboratory working with blowpipe and reagents, with physical apparatus or a dissecting knife, is perfectly sure while he is washing up his utensils and putting his desk in order that he has had some exercise. Much of the scientific work drives students afield, and the worn geological hammer and battered botanical can may be put in evidence to prove that students handle other tools than books. It is largely because the college work is much more practical than it was a generation ago that the age of graduation has advanced. Memorizing theories did not require so long as testing them does.

It is a requirement of one department of the Massachusetts Institute of Technology (it may be of others) that every student shall, from his own investigation, add at least one fact to the sum of human knowledge.

This institute, the Institutes of Technology at Hoboken, Worcester, and Troy, and the scientific departments in many of the leading colleges all offer fine facilities for men whose tastes and talents are not likely to lead them into the learned professions. In all of these, physical and intellectual effort go hand in hand.

The Flow of Water through New Cast Iron Pipe.

This subject was recently investigated by Mr. S. Bent Russell, of the St. Louis (Mo.) Water Works. The pipe was 12 inches in diameter, 1,631 feet long, and laid on a uniform grade from end to end. In a letter to Mr. J. C. Trautwine, Jr., Mr. Russell states that, as there was an opportunity to make some fairly accurate measurements on the discharge of the pipe, he had the necessary observations carried out, and found that under an average total head of 3·36 feet, the flow was 43,200 cubic feet in seven hours; under an average head of 3·37 feet it was the same; under an average total head of 3·41 feet, the flow was 46,700 cubic feet in eight hours thirty-five minutes. Making allowance for loss of head due to entrance and to curves, it was found that the value of c in the formula $v = c\sqrt{r\,s}$ was from 88 to 93.

* Rules furnished by Dr. Anderson of Yale University.

The Curious Effect of Metals Upon a Fungus.

Some most interesting experiments upon molecular vibrations as indicated by the effect of certain metals upon a species of fungus are reported in *Nature* by Fredrik Elfving.

It seems that a number of years ago, he published his observations upon the effect of iron, zinc and aluminum upon the *hyphae* (the tubes on which the reproductive organs of the plant are borne) of the *Phycomyces* or *Phycomycetes nitens*. This is a fungus so named from its resemblance in the mode of reproduction to *algae* or sea weed.

When the above mentioned metals (aluminum only slightly showing the effect) were brought within from one to two centimeters of the plant, the *hyphae* curved toward the metals. It is a well known fact that sporangiferous *hyphae* curve away from a surface which *discharges* aqueous vapor, and it was therefore inferred that they would be attracted by a body which readily *absorbs* water. As iron is an example of a metal which takes water from the atmosphere and iron affected the *hyphae* more perceptibly than the other metals, Prof. Errera, of Brussels, who has also studied the subject, published the opinion that the phenomenon was accounted for by the influence of the water in the metal.

Mr. Elfving, not satisfied with this explanation, has been experimenting further. He has placed a stick of caustic potash near the *hyphae*; this, as is well known, absorbs water from the atmosphere with extreme readiness, but the *hyphae* were unaffected by being near it. A cylinder of plaster soaked with a solution of calcium chloride and dry plaster, which also absorbs water quickly from the air, both failed to have the slightest influence upon the *hyphae*. These hygroscopic experiments have been repeated by Mr. Elfving several times, and always with the same result, viz., no curve.

He, therefore, has sought another explanation, and believes he has found it in the molecular vibrations of the metal. His belief is chiefly based upon his later experiments. Platinum is one of the metals that, in its normal condition, is inactive toward the *hyphae*. Burnished steel is almost inactive. But let these two metals be exposed to direct sunlight for some time and they attract the *hyphae* powerfully. The attraction is shown by the side of the metal away from the light as well as that toward it, and lasts for a few hours. When the metals were exposed to sunlight in August for seventy minutes they showed this activity, but being in the light for five hours on a cloudy day had no effect upon them.

It would seem that a sort of phosphorescence imperceptible to the eye but perceptible to the plant is emitted by these metals, for when they are heated out of the sun to the same temperature that they showed while in it, they had no attractive power. Plainly, then, it is the light they possess and not their heat which produces the effect. Furthermore, Mr. Elfving finds that the ultra-violet rays have no part in producing the phenomenon, for, when they have been removed from the spectrum, the metals submitted to the remainder of it produce the same curves.

But this is not all. There are some metals which show this same activity when they are heated. Zinc is one of them. A piece heated in a blowpipe flame until it began to melt, and then allowed to cool to the temperature of the hand, produced beautiful curves in the *Phycomycetes*. Mr. Elfving thinks that there is no doubt that molecular vibrations, produced in the case of platinum and steel by light, in the case of zinc by heat, cause the phenomena, alike curious and interesting. Who would dare to say that the physicist may not one day depend upon the *Phycomyces* as much as the chemist does now upon the fungi from which his litmus paper has been prepared?

Lantern Slide Making.

At a recent meeting of the Woolwich Photographic Society Mr. Andrew Pringle said:

"It is essential that there should not be a mass of black in a lantern slide, there should always be a complete scale of gradation. The tone or color is another important point. Some affect a tone which is neither warm nor cold, and consequently you see a very dirty tone. I do not recommend albumen plates, unless the worker can devote his whole time to them and wishes to incur the displeasure of his wife; but it is the best process. Wet collodion plates will give clear high lights, but they are not so good for keeping the shadows clear. The dry collodion process I recommended to you is well adapted for contact work, and keeps the high lights clear. The collodion process is useful for reductions, albumen is not. If you wish for warm tones, you must give long exposure and prolong the development. I don't recommend dry collodion for cold tones. Gelatino-bromide plates do equally well for reduction or contact for warm and cold tones, but for all that, gelatine is not such a good menstruum as collodion. In selecting the negative, it must be remembered that you cannot get a first class lantern slide from a second or third class negative. If you want a medal-taking slide, you must use a plucky negative; don't try with a soft negative, although such a negative may give you a good print. You might be able to get a good slide from such a negative on the Hill-Norris collodion plate, and then give long exposure, and use a restrained developer. The developer for gelatino-bromide plates is ferrous oxalate for cold tones; it cannot be beaten. I keep the stock solution saturated in a couple of sweetmeat bottles. The iron solution is acidified, and I keep both at 60° Fah. Shake up and filter just before use. In mixing the developer, I prefer one to six or one to eight. The development should be deliberate. The Kent water is not a good water for the purpose of washing, and causes a scum of oxalate of lime to appear on the surface of the plate, but it is easily cleared. In another sweetmeat bottle containing a solution of alum I add a drachm or two of hydrochloric acid—I am not particular as to quantity. Plates immersed in the solution are soon cleared. Over-exposure is shown by the greenish appearance of the image, and, of course, under-exposure is known by the hard black tone. An easily restrained developer should be used for warm tones. I do not recommend metol and amidol for lantern slides, and I pass over those. Suppose a beginner wants warm tones, the best thing to do is to keep on exposing on one or two negatives until he obtains two good slides, and then he will be in a position to judge the quality of negative required. Every lantern slide is improved by putting it in the clearing bath; wash the plate well, but don't overwash, and always varnish the plate."

The "Sleeping Sickness of West Africa."

A singular malady prevails in some portions of Africa, known as the sleeping sickness. Dr. C. Forbes, in the May 12th number of the *Lancet*, explains the nature of it.

The victim of this sickness of West Africa (old or young, for this curious and deadly complaint may make its appearance at any epoch of life, though it is more commonly found between the ages of twelve and twenty years, and is more often seen in men than women) gradually gives way to somnolence, which becomes at last a profound and lethargic sleep, the first noticeable signs of which are a visible and persistent drooping of the eyelids of man, woman, or child in the daytime while at work, enlargement of the glandulæ concatenatæ and other cervical glands at the onset. The general health of the negro at first seems to be fair, though he gradually appears to give way to sleep at unusual hours. This tendency to drowsiness and torpor can be combated to a certain extent at the outset by stimulation and purgation; but the patient thus aroused from this lethal slumber relapses almost infallibly again and again into this somnolent condition, the periods of sleep increase in number and the intervals between them lessen, their extent proportionally lengthening. This state of things continues while the malady steadily gains ground; soon the negro appears to be always asleep, bearing semblance in his life—I should perhaps say existence—to insensitive and fungus-like development only. This condition goes on for a varying period, weeks or months, and he little by little refuses all food, spending his time in slumber. When increasing atrophy sets in, with emaciation, after a short space death from exhaustion and starvation almost invariably occurs at the end of three, six, or twelve months. Here it may be stated that just when moribund the tendency or disposition to lethargy is sometimes in abeyance, and the mental faculties become clear at last previous to their total extinction.

Its endemic area is West and West Central Africa, from Senegal to the Congo, in the Sierra Leone district, and the *Hinterland*, but cases are more frequently met with and more virulent in their nature in the valley of the Congo. They are also more numerous inland than on the coast line. It has never been known to affect any but the negro race, but has been seen in the West Indies, etc., among those who have been brought thither as slaves from the Congo or Sierra Leone districts.

The prognosis is bad, as the disease, once established, progresses actively, almost in spite of treatment, to a fatal issue. Guerin reports 148 cases. The result was death in each. Gore's statistics drawn from Sierra Leone, etc., say that there were 80 per cent of fatal cases—rather underestimating the rate of mortality, I fancy. Personally, my experience extends to only thirteen cases, two of which lived for some time; whether they afterward succumbed to renewed attacks I know not, but I do know that eleven died.

The causation of this curious disease may be said to be wrapped in the deepest obscurity. Many attempts have been made to elucidate it. One suggestion put forth was that it arose from a form of blood poisoning arising from ingestion of a fungus growing on certain grains used by the natives as food; but no absolute proof of this assumption is forthcoming. Nor has change of diet and residence, according to my experience and that of others, had any effect on the steady progress of the symptoms. The complaint is, indeed, involved in mystery, and its problem of causation remains unsolved. The three most acceptable theories are: (1) That it may be due to a septic condition of the blood, borne out by swelling of glands, etc.; (2) is it due, as Dr. Manson was the first to point out, to the presence of filaria in the blood? (3) or it may be (though this is an assumption on my part) a neurosis, eventually affecting the neurotrophic system and causing ultimate emaciation and death; this is somewhat substantiated by appearances and lesions sometimes found post mortem in the brain and its membranes.

The Use of Heat in Operative Surgery.

The successful substitution of heat for antiseptics in the preparation of instruments and surgical dressings has naturally led to the use of heat for sterilizing the wound itself. This is an ancient method. Hippocrates, Oribazius, and later writers down to the time of Paré, were unanimous in recommending the use of the hot iron and boiling oils upon wounds. It may even be questioned if Paré did so great a service, after all, when he substituted for the cautery the use of dirty ligatures.

The systematic and scientific use of heat, however, for rendering wounds aseptic, is a thing of recent date. M. G. Phocas, surgeon to the Hospital Saint-Sauveur, of Lille, has made a particular study of this procedure, more especially in connection with operations for resection. He refers to the experience of Felizet (*Bull. de la Chir.*, 1892), who employed the flame of a gas jet for making the wound surface aseptic. He describes also the method of Dreesnau, a pupil of Trendelenburg (*Centralb. f. Chirurg.*, 1893, No. 3). This surgeon poured into the cavities of the wound oil brought to a boiling point by the thermo-cautery. In the same year M. Jeannel, of Toulouse (*Gaz. des Hopit.*, Nos. 59 and 62), proposed to make the surfaces aseptic by touching them with boiling water.

In 1892 M. Phocas began to employ boiling oil according to the method of Trendelenburg. At the same time he undertook, with the help of his assistant, M. Hennecart, some experiments to determine how much heat the living arteries and nerves could bear without disintegration. Three different methods of using heat were tested: first, cold oil was poured into the wound and then raised to a boiling point by a thermo-cautery; second, boiling oil; and third, boiling water applied directly.

It is sufficient to say that the experiments showed boiling water to be much less injurious to the tissues than the oil. M. Phocas finally adopted the following procedure: In osseous cavities he poured in cold oil and heated it with a thermo-cautery for three or four seconds. In other wounds, but more especially in resections and arthrectomies, he touches the wound with plugs of absorbent cotton upon which he has poured water just at the boiling point. In this way every part of the wound is reached by water at a temperature of about 80° C. Each part is touched for three or four seconds, and the procedure is repeated several times.

M. Phocas states that since he has used the boiling water his results have been "incomparably better" than they used to be.—*Med. Record.*

The Pollard Electric Lamp.

The recent suit of the General Electric Company against the Boston Incandescent Lamp Company is based, according to the *Electrical World*, on the method devised by Edward Pollard, now deceased, for passing the current into an incandescent lamp by making the glass stem which supports the filament serve as a conductor of electricity through the application of lines or films of silver to the same. An iron leading wire is then fused into the inner end of the glass stem by simply heating the glass, inserting the iron wire to the extent of about one-fourth part of an inch and squeezing the glass upon it so that the silver-coated surface shall be in permanent contact with it. It is claimed that by the use of the Pollard invention the entire cost of platinum is saved, the cost of the silver used being negligible. The affidavit of Peter H. Walsh, submitted in the suit, gives the following account of the manufacture of the stem:

"I have witnessed in the manufacture of the Pollard lamp the operation of painting a narrow strip of printer's ink upon the inner surface of the glass tube, the introduction of the metallic silver in the state of an impalpable powder or molecular state of division, also the subsequent burning off of the printer's ink, leaving a film-like deposit of metallic silver upon the glass, and the remaining operations involved in forming the stem, and was not only interested, but much surprised at the rapidity with which these operations were performed. As observed by me during my visit to the works, the deposition of silver upon the glass tube was accomplished at the rate of about a thousand per day by one girl. The process is highly ingenious and original, and from a scientific point of view very interesting and beautiful. I made several determinations of the weights of silver deposited upon each tube by accurately weighing the tube before and after deposition upon a delicate balance, and found the maximum weight of metal to amount to 12 milligrammes, or about 0·19 of a grain, and having a value of 0·026 of a cent."