Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

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

TERMS FOR THE SCIENTIFIC AMERICAN.

One copy, one year, for the U. S. or Canada.....$3 00
One copy, six months, for the U. S. or Canada..... 1 50
One copy, one year, to any foreign country belonging to Postal Union, 4 00
Remit by postal or express money order.

Australia and New Zealand.—Those who desire to receive the SCIENTIFIC AMERICAN, for a little over one year, may remit £1 in current Colonial bank notes. Address

MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

The Scientific American Supplement

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, $5.00 a year, for U. S. and Canada. $6.00 a year to foreign countries belonging to the Postal Union. Single copies, 10 cents. Sold by all newsdealers throughout the country.

Combined Rates.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for one year, to any address in U. S. or Canada, on receipt of *seven dollars*.

The safest way to remit is by draft, postal order, express money order, or registered letter.

Australia and New Zealand.—The SCIENTIFIC AMERICAN and SUPPLEMENT will be sent for a little over one year on receipt of £2 current Colonial bank notes.
Address MUNN & CO., 361 Broadway, corner of Franklin Street, New York.

NEW YORK, SATURDAY, OCTOBER 13, 1888.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 667.

For the Week Ending October 13, 1888.

Price 10 cents. For sale by all newsdealers.

A LETTER ENVELOPE GUM GREATLY NEEDED.

In consequence of the decline in the supply of gum arabic, the Post Office department has been obliged to abandon its use of this excellent material as a sealer for letter envelopes. In lieu of gum arabic a filthy and foul-tasting compound has been substituted, which is a disgrace to the department and a nuisance to all who have occasion to seal a government envelope. Any one who closes a letter in the ordinary manner finds the lips soiled and a villainous taste left in the mouth.

It is to be hoped the ingenuity of chemists will be able to purify the substances now used, or produce a new gum that shall be free from the objections mentioned. Such an invention or discovery ought to prove highly profitable to its author, for it is greatly needed by the public.

A PROPOSED ELECTRO-MOTOR TRIAL.

The project of a large sleeping car company to have built for them a four-mile electrical railroad, for illustrating the advantages of each type of motor, will be the first really practical attempt to compare the various systems on the same line and under similar conditions. If the avowed purpose of the company may be accepted in good faith, and the projectors of the various systems will really assent to such comparative trials, we are likely to get at more cold facts concerning electro-motors than we have had for many a day. The advantages and defects of the overhead trolley system and the underground conduit plan will be exposed before critics eager to make them known. There is the curve on the plane and on grade, the straight line on grade, starting and stopping, unexpected weights and hauls, and the like. Which system can most quickly accede to the requirements, most readily overcome the various difficulties, and bear the handicapping? What are the relative advantages of taking the current from a wire overhead, and from a third rail, and from a sunken main?

The projectors of the third-rail system say that the trolley system is uncertain; the trolleys snap from their propelling wires or fly off at slight impediments, relying on the climbing capacity of the passengers in the car below to keep them in their places. On the other hand, the overhead people—we do not refer to celestial folk, who would not, of course, prevaricate about such small things as electro-motors—we say these overhead people declare the trolley system to be the only reliable one; the transmission of the electrical energy being wholly removed from contact with the ground, which, as is well known, is the worst of insulation, and carried through the air, which is the best. In the use of high tension currents, they aver, and it would seem with reason, that it is difficult to protect the public, and with low tension currents slight leakages often suffice to reduce the available energy below the amount required to operate the road. Those who may have watched unprejudiced the progress of the various systems of electrical locomotion will doubtless agree that each seems to have some special virtue in the way of economy or certainty of operation. And so it is to be hoped this wealthy manufacturing company is sincere in its promise to give each a fair trial. A four-mile line would seem to be adequate for the purpose, and the neighborhood of large stationary engines a most convenient starting point.

THE NEW PHILADELPHIA SUBWAYS.

The plan adopted for burying all the telegraph and telephone wires of Philadelphia has about it that air of cool consideration and substantiality that mark the Quaker mind. After long investigation of the hundred and one good, bad, indifferent, but always cheap plans for burying the wires, the managers of these companies have thrust all aside and hit upon an expensive system of their own in the belief—a reasonable one, be it said—that it will prove cheapest and most satisfactory in the long run. They will build a brick conduit eight feet high and four feet wide through the main streets and avenues. There will be fifty 3 inch iron pipes, each containing 100 wires, and so 5,000 wires in all. One connection only will be made with each block, a main running from the conduit and underneath the house line to the middle of the block, where, from the top of a tall pole, the wires will be run in mid air to the rear of each house. The estimated cost of construction, it is said, will be $250,000. Powerful pumps will keep the conduit filled with dry air, and every foot of main may be subjected to daily inspection because of its generous dimensions.

As will be seen, it is not necessary, in such a system to tunnel every main street and avenue, but, at most, only every second or alternate one, for from one line the wires may be run to the blocks on either side. Indeed, the number of main lines could, it is obvious, be still further reduced by branching, and, doubtless, it was only the fear of possible trouble from complication that induced the Philadelphia managers to forego the temptation to so lessen their construction account. The work is now fairly started, indeed, a part on the south side of Market Street, from the Delaware River to Fourth Street, is nearly complete.

Curiously enough, the tunnel system has been looked upon, from the very first, as impracticable, because of its cost. Nor is this surprising when we remember that most of the estimates for construction were for lengths of lines greatly in excess of what is now found to be required, while some seemed to be based upon such elaborate construction as that of the Paris sewage system. This Philadelphia system, even though it should fail of success as first projected, may, through experiment and modification, yet prove the most worthy of all, and furnish criteria for a practical system of subway construction.

THE DIRECT PRODUCTION OF LIGHT.

In his paper entitled The History of a Doctrine, read before the American Association at their last meeting, in Cleveland, Prof. Langley gave a graphic account of the development of the undulatory theory of light. He held that much yet remained to be done in that field of research, and he formulated a definite object for investigation—the relations between radiation and heat. For at the present time it is far from clear how much heat the purely light-giving radiations from a luminiferous body can produce. The mechanical equivalent of light is as yet unknown.

We have every reason to believe that it is very low. There is little doubt that could we estimate the equivalent in energy of the light-giving radiations of a source of light, it would be surprisingly small. Acting on this idea, and assuming and probably believing that the hypothetical luminiferous ether is an actual entity, Prof. Lodge, in England, and Prof. Hertz, in Germany, have been making very interesting experiments in the direction of the production of light. Accepting the identity of luminiferous and electrostatic disturbance ethers in accordance with Clerk Maxwell's hypothesis, they have endeavored by rapidly alternating pulsations or electrostatic discharges to produce light waves without the intermediation of ignited or incandescent matter. Hertz produced such rapid alternations that, treating them as waves, their length would have been two meters. Lodge's oscillations were slightly longer.

Nothing is truer than that the contrast between the small amount of energy absolutely needed to produce light and the large amount that practically has to be expended gives a disparaging view of man's progress. In the flame of a candle, a lamp, or a gas burner the light is probably derived from ignited carbon. Yet in the case of gas, for raising this carbon to the light-giving temperature, not over one or two per cent of the heat of the flame is theoretically required. Of the total radiations of a gas flame, according to Sir. C. W. Siemens, but five per cent are luminous, and for an incandescent electric lamp he gives about the same ratio. These estimates can be accepted as provisional only, but they are at least indications of the amount of waste. In the maintenance of the incandescent electric lamp a full horse power is required to keep a few feet of minute carbon filament at the incandescent temperature. Taking the useful radiations at five per cent of the total, it follows that we should be able to run twenty times as many lamps could we produce radiations restricted to the range of light.

Prof. Lodge's way of putting the case is so very striking that we refer our readers to it, as given in the last issue of the SCIENTIFIC AMERICAN. He states his case as a whole with great clearness. Where he refers to "atom" he probably employs the word in the physicist's sense, and as a concession to accuracy might have done better in using the word "molecule." It is evident that to his mind the ether is a real entity. In this he corresponds with the general tendency of English physicists. In comparison with some of the positive views concerning the ether which were enunciated at the last British Association meeting, Prof. Langley's address on the subject of radiation reads almost like a proclamation of uncertainty. From such an authority as Prof Langley, one who by his classic experiments on radiant energy has won the highest reknown, the *quasi* disclaimer comes with added grace.

The ether is still hypothetical; an *a priori* attempt to produce light by throwing it into oscillation by direct electric action seems based on an insecure foundation. A few years ago the world was startled by the announcement that the astronomer Lockyer had discovered the identity of all the elements and the unity of matter. When this came to be sifted down, it proved only a hypothesis, although a highly probable one, based on spectroscopic observations. It was so well founded that it holds ground to the present day as a probable proof. Yet in the practical sense it was nothing. When first reported many doubtless saw the transmutation of metals near at hand.

So it will be with the experiments we speak of. Should they lead to the production of light unaccompanied by obscure heat radiations, the world will be incalculably benefited. The energy corresponding to the maintenance of a single horse power will give the light of five thousand candles. Oil will be burned no longer, save in isolated places. An ordinary house will be lighted by a motor of $\frac{1}{50}$ horse power. "Wasting the midnight oil" will have a mechanical as well as an intellectual significance. All the world, therefore,