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Contents:

(Illustrated articles are marked with an asterisk.)

SIX MONTHS OF PROGRESS IN ENGINEERING.

One of the most notable engineering works of modern times, the East River Bridge at New York, has made considerable progress during the six months that are past. No accidents of importance have occurred. All difficulties seem to be foreseen and provision made to meet them as they arise. It is extremely interesting to see a work of this magnitude progressing with such ease and certainty, and the fact demonstrates the great advances which modern engineering can boast. The particulars of construction and the present stage of the work have been so recently placed before our readers that we need not dwell at any length on its details.

The caisson on the Brooklyn side has, since our former notices of the work, been sunk to its final resting place, and the work of filling up the cavity will soon be commenced. The caisson was commenced in November of last year, and the work of sinking it began in March last. The foundation now rests forty-five feet below low-water mark, thus placing all the timber completely beyond the reach of the water. The entire structure weighs about 30,000 tuns, to support which fourteen stone piers have been erected throughout the different chambers into which it is divided. The stone tower to be erected, for which the caisson will constitute the foundation, is to be 270 feet high, while the floor of the bridge will be 118 feet above the water. The caisson for this side of the river is being now constructed, and will be launched some time early in January. In its erection several improvements suggested by experience with the one just completed, have been made.

The great bridge at St. Louis is also familiar to our readers, and through Capt. Ead's report, extracts of which have appeared in this journal, they have been put in possession of facts relative to its present status. These bridges each presents peculiar difficulties, which it has been the triumph of modern engineering to overcome. When completed they will stand among the most notable structures of their kind ever erected.

The Hoosac tunnel, we are happy to say, under able direction is now making steady and, considering the nature of the work and the extraordinary difficulties attending it, even rapid progress. The facts connected with this great work are too familiar to our readers to be referred to in detail here, as the progress made, with interesting and minute details, are laid before them as fast as new facts are developed.

The Mont Cenis tunnel was announced to be completed in December, 1870, and as we have received no advices that indicate possible disappointment, that work is, at the time we go to press, probably completed.

The Darien Canal Survey, under the direction of Com. Selfredge, has resulted in a favorable report as regards the San Blas route from Mandinga Bay, on the Atlantic, to Chepo, at the southern end of Panama Bay on the Pacific. Further investigations are in progress.

The treatment of sewage has been studied with great earnestness during the entire year. It has now become a mixed mechanical and chemical problem, the importance of which is second to no other in modern engineering. It is attracting the attention of the ablest minds and must soon reach a satisfactory solution.

Street paving is another problem which is receiving much attention. Inventions multiply, and innumerable experiments are tried, most of which fail to give satisfactory results. The difficulties to be overcome are numerous, but the reward to him, who shall finally so far succeed as to place himself beyond the reach of competition, will be very great.

The loss of the British iron-clad, *Captain*, has elicited much discussion calculated to throw some doubt upon the sea-going qualities of very heavily-clad vessels, and is likely to modify in an important manner the construction of future vessels of the same class.

Many minor civil engineering works of greater or less importance have been begun or completed during the publication of the present volume, which we cannot enumerate at this time.

The system of propelling boats by cables laid in the beds of rivers and canals, is making great headway in Germany. Such cables are now successfully working in the Danube, the Rhine, and several other smaller rivers as well as canals. It is claimed for the system that it saves one third the expense for power attending the use of paddle wheels.

In steam engineering there has been no marked progress. Numerous minor devices, many of which have been described and illustrated in our columns, have been originated, but these inventions pertain mostly to safety appliances, rather than to the more economical generation and application of steam to the performance of work. The sectional tube system in boilers has received a great impulse from the many disastrous explosions which occur of late with shocking frequency, and is daily growing in popularity with a certain class of steam users.

The use of steam on common roads is also growing in favor, and daily extending. Steam plowing also is gaining ground, and has undoubtedly a brilliant future in store.

The direct application of solar heat to the generation of steam has been again prominently brought before the public, through the published experiments of Capt. Ericsson.

In mechanical engineering there is little of note to record, although the past six months have been prolific of new and useful minor inventions. Those who complain of the rate of progress made, must remember that great discoveries do not generally follow each other in quick succession, and possess their souls in patience. Man is slowly but surely subduing the brute forces of nature and bringing them under subjection to his never-satisfied will and desire.

PROGRESS OF CHEMICAL SCIENCE.

Professor Roscoe has sent us a copy of his address to the Chemical Section of the British Association at Liverpool, September 15, 1870, from which we gather some interesting information on the recent progress of chemistry.

With regard to the position of chemical science at the present time, the learned Professor says that it will not take a careful observer long to see that in spite of numerous important and brilliant discoveries, of which every year has to boast, we are really but very imperfectly acquainted with the fundamental laws which regulate chemical actions, and that our knowledge of the ultimate constitution of matter upon which these laws are based is but of the most elementary nature. Take for example the Atomic Theory. This has been freely used by chemists to enable them to explain chemical phenomena, and some authors regard the existence of atoms as the very life of chemistry. Dr. Frankland, on the other hand, cannot understand action at a distance, nor the discontinuity of matter, an idea lying at the base of the notion of atoms. Professor Brodie thinks that the science of chemistry neither requires nor proves the atomic theory, while Sir William Thomson attempts to form an idea of the size of atoms and molecules, and states that in any ordinary liquid, the mean distance between the centers of contiguous molecules is less than the hundred-millionth and greater than the two thousand-millionth of a centimeter.

In this connection the labors of the late Professor Graham are gratefully remembered. This philosopher paid special attention to the molecular properties of gases. "What do you think," he writes to Hofmann, "of metallic hydrogen, a white magnetic metal?" The condensation of hydrogen in palladium, and the discovery of the occlusion of hydrogen in meteoric iron, confirmed the conclusion to which spectrum analysis had previously conducted us, that the meteorites came from an atmosphere of incandescent hydrogen existing under very considerable pressure. Graham's fame as one of England's greatest chemists justly rests upon this important discovery. In addition to the blow given to our preconceived notions of atoms, Professor Roscoe refers to the researches of Dr. Andrews on the continuity of the liquid and gaseous states of matter, thus overthrowing our cherished opinions on the existence of three separate states or conditions of matter, viz., the solid, liquid, and gaseous. Dr. Andrews believes that a large number of easily condensable gases or vapors possess a critical point of temperature, at and above which no increase of pressure can be made to effect a change into what we call the liquid state, the body remaining as a homogeneous fluid, whilst below this critical temperature certain increase of pressure always effects a separation into two layers of liquid and gaseous matter. The boldness of modern research is exemplified in the observations of Lockyer and Zollner on the pressure acting in the different layers of the solar atmosphere. The red flames, chiefly composed of hydrogen, which shoot forth from the sun, must have burst out from under great pressure, and Zollner arrives at the conclusion that the difference of pressure needed to produce an explosion capable of projecting a prominence to the hight of 80,000 English miles above the sun's surface (a hight not unfrequently noticed) is 4,070,000 atmospheres. In order to produce a tension capable of overcoming this gigantic pressure, the difference in temperature between the inclosed hydrogen and that existing in the solar atmosphere must be 74,910° C.! and in a similar way Zollner calculates the approximate absolute temperature of the sun's atmosphere to be 27,700° C. or eight times as high as that given by Bunsen for the oxyhydrogen flame, a temperature at which iron must exist in a permanently gaseous form. Professor Roscoe also alludes to a new galvanic battery invented by Bunsen. In this second battery only one liquid, a mixture of sulphuric and chromic acids, is employed. The plates of zinc and carbon can be lowered at once into the liquid and raised again at will. The electromotive force of this battery is to that of Grove's (the most powerful of known forms) as 25 to 18; it evolves no fumes in working and can be used for a very considerable length of time without serious diminution of the strength of the current.

A very important bleaching agent discovered by Schutzenberger, is called hydrosulphurous acid and has the formula of $H_2 SO_2$. The sodium salt of this new acid is obtained by the action of zinc on the bisulphite. The hydrosulphurous acid possesses powerful reducing properties and bleaches indigo rapidly. At a time when so much attention is bestowed upon disinfectants and antiseptics there ought to be experiments conducted with this new agent.

The interesting researches of Matthiessen and Wright on morphine and codeine have thrown a new light on the constitution of these opium alkaloids. Treated with hydrochloric acid morphine loses one molecule of water and gives rise to a new base, apomorphine, which differs in a remarkable manner from morphine, both in its chemical and physiological actions, being soluble in alcohol, ether, and chloroform, whereas morphine is nearly insoluble, and acting as the most powerful emetic known, $\frac{1}{10}$ of a grain producing vomiting in less than ten minutes.

The discovery of the sedative properties of chloral-hydrate by Liebreich marks an era in medical chemistry second only to the discovery of the anæsthetic properties of chloroform.

The discovery of the artificial production of alizarine, the coloring matter of madder, which was announced a year ago, now appears likely to be worked out on a practical scale; it is the artificial production of a natural vegetable coloring substance which has been used as a dye from time immemorial. One of the most important discoveries of recent times is a method proposed by Dr. Mond for the utilization of what has long been known as soda waste. The insoluble monosulphide of calcium is oxidized to the soluble hyposulphite, and by decomposing this salt by hydrochloric acid, all of the sulphur is deposited as a white powder. In this way the greater part of the sulphur used in the production of salt cake by Le Blanc's process is reclaimed and a great saving is thus effected to the alkali manufacturer.

Another discovery of almost equal magnitude relates to the recovery or regeneration of the black oxide of manganese used for the evolution of chlorine in the manufacture of bleaching-powder. This subject has long attracted the attention of chemists, and during last year a very simple and economical process, proposed by Mr. Weldon, has obtained recognition and is now worked by more than thirty-seven firms in Great Britain. The process depends upon the fact that although when alone the lower oxides of manganese cannot be oxidized by air at the ordinary temperature and under the ordinary pressure to the state of binoxide, yet this is possible when one molecule of lime is present to each molecule of the oxide of manganese. The oxide of manganese is precipitated from the still-liquors with the above excess of lime, and by the action of the air on this a black powder, consisting of a compound of the binoxide of manganese and lime, is formed, which is capable of again generating chlorine on addition of hydrochloric acid, and thus the chlorine process is made continuous, with a working loss of only $2\frac{3}{4}$ per cent of manganese.

The last important discovery alluded to by Professor Roscoe is a process for the direct production of chlorine from hydrochloric acid without the use of manganese at all. In the presence of oxygen and of certain metallic oxides, such as oxide of copper, hydrochloric acid gas parts at a red heat with all its hydrogen, water and chlorine being formed.

The mixture of air and hydrochloric acid gas is passed over red hot bricks impregnated with copper salt. The oxide of copper acts as by contact and remains unaltered, while the chlorine, watery vapor, and excess of air pass at once into the lime chamber. Some practical difficulties have been encountered in the working of this process, but there is every prospect of its ultimate success.

We have thus given an analysis of Professor Roscoe's admirable discourse, and have passed in review the prominent chemical discoveries of the year. It will be seen that some of the recent discoveries are of great practical value.

THE SOLAR ECLIPSE OF 22D DECEMBER, 1870.

The line of totality stretches from the North Atlantic across the south of Spain, passing over Cadiz, then over Algeria, thence over Syracuse, in Sicily, into Turkey, Greece, etc. The duration of the eclipse will not vary much from two minutes at any place, too short to make the eclipse a very important one, and still less so from the low altitude of the sun. Congress has appropriated nearly $30,000 to equip observers, and we believe, after a good deal of pressure, the British Government has provided a ship and $10,000 for a similar purpose.

The astronomical data derivable from a solar eclipse are of two kinds: one respecting the moon's motions, the other the physical constitution of the sun. The first is not important just now, but we may observe that the moon, coming against or in front of the sun, allows an observation of our satellite's place in the heavens to be made at a very central point in her orbit. This is of importance to mathematical astronomy, but can only be properly made at a fixed observatory, which need not be on the line of totality.

The expeditions above referred to must devote themselves to the acquirement of physical and cosmical knowledge, from appearances which are only shown when the disk of the moon