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(Illustrated articles are marked with an asterisk.)



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THE SCIENTIFIC AMERICAN SUPPLEMENT
**No. 182,**
**For the Week ending June 28, 1879.**

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## SIX MONTHS OF SCIENTIFIC PROGRESS.

The scientific and industrial record of another half year is completed with this issue of the SCIENTIFIC AMERICAN. It is believed that no scientific enterprise of popular interest, no notable occurrence, no great industrial undertaking, no important discovery or invention—in short, nothing pertaining to the world's best thought and action during the past six months has failed of timely notice in these pages, while in character and number the illustrations which have given instruction as well as pleasure to our readers are such as to compare favorably not only with those of the preceding volumes of the SCIENTIFIC AMERICAN, but those of any other popular journal ever published.

When Volume XL. was begun there still prevailed in many quarters no little doubt and misgiving with regard to the immediate industrial future. The confidence expressed by the SCIENTIFIC AMERICAN in the continued improvement in American industrial affairs has been happily justified; and there is every reason to believe that the prediction that the country was entering upon an era of unexampled prosperity will but feebly express the ultimate fact. The threatened derangement of our manufacturing industries, through the alteration of the patent laws in a way to affect injuriously the rights of inventors and patentees, was fortunately averted, we trust permanently, by the failure of the obnoxious Senate bill 300; and we hope that the public sense of justice and sound policy which frustrated that scheme will prevent a renewal of the attempt next winter.

The steady improvement in the American export trade has been almost as marked a feature of our recent history as the marked improvement in domestic trade. Particularly noticeable has been the outspoken acknowledgment of the superiority of many American products by English and European statesmen and manufacturers, and the frank admission by them that the industrial supremacy of the world lies in the near future with America.

Among the notable improvements in the arts brought forward recently, mention may be made of Barff's process of obtaining a protective coating to iron, Holloway's utilization of the sulphides in ores as fuel, and the new composition for the lining of Bessemer converters, making possible the use therein of phosphorus bearing ores.

The completion of the Sutro Tunnel, the progress on the tunnel of St. Gothard, and the completion of the Joseph II. Mining Adit, are perhaps the most notable achievements in engineering that will occur to our readers. The meeting of the International Interoceanic Canal Congress at Paris promises to mark an important date in the history of man's victories over nature, but its significance can be determined better a dozen years hence.

In pure science there is nothing more important than the investigations of Prof. Crookes with regard to the behavior of electrified molecules in vacuo. His observations are certainly curious, his methods are extremely delicate and skillful, and the results obtained are wonderfully suggestive. What more may come of them the future only can determine.

Among the more important inventions our readers will recall Cowper's writing telegraph and Edison's loud speaking electro-chemical telephone.

Six months ago popular attention was very strongly drawn to the development of the electric light, and something of a panic prevailed among the holders of gas stocks. That flurry has blown over. The electric light has not fulfilled its promises, and Mr. Edison's assertion that his latest lamp is a complete success falls on indifferent ears. The world is not so eager for the change as it appeared, and on all sides the disposition is to await developments patiently. Possibly after all the "light of the future," suggested by the SCIENTIFIC AMERICAN several years ago, and recently worked out practically by Molera and Cebrian, may prove the final solution of the problem.

Among the false lights of the immediate past mention may be made of the extremely confident but suddenly extinguished pretensions of the Hosmer and Gary motors. Instead of revolutionizing the industries of the world by force self-generated, they have dropped out of sight with the thousand other motors of the impossible sort. To which class we may properly add also Mr. Keeley's machine for the utilization of "inter-molecular etheric substance."

In this hasty glance at the salient features of the work of the past six months notice may be taken of two or three which we are confident have added not a little to the interest and value of the SCIENTIFIC AMERICAN. These are the series of illustrated articles on our leading industries; the papers on amateur mechanics, with their practical suggestions and numerous illustrations; and the specially admirable illustrations of natural history. Nothing finer than the last have ever been given in a popular periodical. It is perhaps needless to add that the constant aim of the publishers of the SCIENTIFIC AMERICAN is and will be to make this paper, so far as practicable, a perfect and impartial record of scientific and industrial progress the world over.

## CITRIC ACID—FROM THE LIME AND LEMON.

The source of profit in the cultivation of the lime and lemon, which we have recently had occasion to point out (p. 339), has evidently attracted the attention of many of our southern fruit growers, judging from the number of communications and inquiries we have since received respecting the industry.

For the benefit of those interested in the matter we give the following outlines of the process for obtaining the citric acid from these fruits:

After removing the seeds and peel, the fruit is subjected to strong pressure—a good cider press answers very well on a small scale. The expressed juice is then evaporated in copper or leaden pans (porcelain enameled iron vessels would be less objectionable) at a temperature not exceeding 150° Fah. until it has a density of about 1·23, when it is a dark, thin sirupy liquid containing from 27 to 32 per cent of citric acid.

An instrument termed a *citrometer* is sometimes used to measure the amount of citric acid in the fluid, but the method cannot be relied on, owing to the variable amount of saccharine and other matters present and to the fact that a small portion of the acid is almost invariably decomposed during the concentration. The concentrated juice usually comes into market in casks containing about one hundred gallons.

To obtain the citric acid from the juice it is first clarified by filtration, heated to about 200° Fah. in a lead lined vat, by means of steam circulating in a coil of leaden pipe arranged around the inner side of the vessel. Powdered whiting (lime carbonate, chalk) is then gradually added until the acid is fully saturated, a point readily determined by its ceasing to effervesce. The whiting must be added in small quantities, suitable to the amount of liquor under treatment, and the mixture kept constantly agitated by machinery until the whole of the acid present is converted into insoluble calcium citrate. The mixture is then allowed to settle, after which the supernatant liquid is drawn off and the residue repeatedly washed with warm water, by decantation, the agitating apparatus being set in motion after each addition of fresh water.

The washed citrate is then transferred to a similar vessel, where it is agitated with hot dilute sulphuric acid in the proportion of about 9½ parts of strong acid diluted with six times its weight of water, to every 10 parts of whiting previously used. By this treatment the calcium citrate is decomposed, sulphate of lime and free citric acid being formed. The mixture is drawn off into a settling tank in which the heavy sulphate subsides, while the clear solution of citric acid is drawn off into lead lined vacuum pans, where it is concentrated by steam heat. The concentrated solution of citric acid is then passed through canvas bag filters usually containing a small quantity of boneblack, previously freed from phosphate of lime by dilute hydrochloric acid. The filtrate runs into crystallizing pans placed beneath, in which it stands until the crystals cease to form.

The mother liquors are run back into the crystallizing pan, and the crystals are dried in a centrifugal machine, or by other suitable means.

The article thus obtained is sufficiently pure for ordinary purposes, and represents the citric acid of commerce.

It is largely used by the dye calico printer as a "resistant" for iron and alumina mordants. When required for other purposes it is necessary to purify it by recrystallization.

Citric acid to be used for medicinal purposes or for effervescing drinks, etc., should be prepared in vessels of earthenware, porcelain, or porcelain-enameled iron, as it is apt to contain traces of lead if prepared in leaden vessels.

## THE TIDE WATER OIL PIPE LINE COMPLETED.

The first flow of oil from the Bradford oil district reached Williamsport, Pa., June 4. Only a few trifling leaks have been discovered in the entire length of the pipe, or over a hundred miles. The line starts at Williamsport and runs slightly north of west over the mountains into Potter county and on to Coryville, or Frisbie, the initial point, in McKean. It passes over a high range of mountains near the village of Waterville, at the forks of Pine creek, where great difficulties were overcome in laying the pipe.

There are tanks at Coryville and a pumping station. The next pumping station is at a point about four miles from Coudersport, where tanks have been put up and buildings erected for the engine, etc. The distance from Coryville to pump station No. 2 is 22½ miles; from there to Williamsport is 77½, and the oil when raised 1,200 feet at the summit, runs down to Williamsport of its own gravity, as the fall is 2,100 feet. The pumping engines are forty horse power each, and each has an equal share of the lifting to do in the way of the application of power. The pipe is six inches in diameter, and required 28,000 barrels of oil to fill it. At Williamsport receiving tanks holding nearly 60,000 barrels had been provided, and seventy oil cars were in readiness to transport the first flow of oil over the Reading railroad. The capacity of the pipe line is about 6,000 barrels per day, and if everything works according to the anticipations of the company, it may become necessary before the close of the season to build another line.

## IMPROVEMENT IN SUGAR MANUFACTURE.

A sugar planter and manufacturer sends to the Martinique *Bienpublic* an account of an experimental application to sugar cane of the diffusion process employed in the beet sugar factories of France and Germany. The experiments were made at the plantation Moncepos, Guadaloupe, with an apparatus of six macerators. It was badly adapted to meet the difficulties incident to the peculiar nature of cane, yet it showed (1) that by a methodical washing of the slices of cane an artificial juice nearly equal in density to natural cane juice could be obtained; and (2) that one hour of systematical maceration is sufficient to completely exhaust the cane fiber of the sugar with it contains.