300,000 tuns of beet sugar, which at £25 per tun would be worth £7,500,000, the molasses (100,000 tuns at £5) bringing up the value to £8,000,000. Beet root may yet redress the injury inflicted on Ireland by the potato.

Perhaps no English chemist possesses superior qualifications for the preparation of such a work than Dr. Crookes. His ability as a chemical writer and experience as an editor have placed his journal, the *Chemical News*, at the head of all similar publications printed in the English language, while it is equal in reliability, comprehensiveness, and in all other respects to any journal of its kind published in the world.

The book is not, however, valuable on account of the extent of original matter contributed to its pages by the author, but as a specimen of able and discriminating compilation; and in its freedom from superfluities or omissions, it is excelled by few technical treatises.

An introduction gives an account of the discovery of sugar in beet roots by Marggraf, in 1747, and a recital of the difficulties he met with in his attempts to establish its manufacture. This is followed by a brief history of the rise and progress of the industry, and a survey of its present extent. The introduction is followed by a chapter upon the beet, its nature, composition, average yield, and percentage of sugar it contains in various localities.

Chapter II. gives full direction for the cultivation of the beet in all its stages of growth, and also methods for harvesting and preservation of the crop. In this chapter will be found much additional matter to that originally furnished by Professor Deby for our columns; the views of Dr. Voelcker, an extensive contributor to the "Journal of the Royal Agricultural Society," on the "Chemistry of the Silesian Sugar Beet," and "Beet-Root Pulp," and also those of Mr. Arnold Baruchson, who has published a valuable work upon Beet-Root Sugar*, being given.

The chapters referred to in our extract from the author's preface, contain the principal part of the technical information contained in the work, so far as it pertains to the manufacture of sugar from beet roots, substantially the same as published originally in Vol. XX. of the Scientific American. But the ten other chapters contain very full information upon very important matters. The chemistry of beet-root sugar is much more fully treated in the fourth chapter than was done by Mr. Deby. From the ninth to the fifteenth chapter inclusive, the work treats of what is known as the new "concreting process;" the utilization of the spent-root beet pulp; the manufacture of spirit from beet juice; the new sucrate of lime process, which seems likely to prove of great importance; the manufacture of potash salts from the beet residues; excise regulations; percentage of sugar in different kinds of beets; yield per acre; and a full description of Dr. Schiebler's calcimeter, or apparatus for the quantitative estimation of the carbonate of lime in bone-black, by volumetrical assay.

An appendix contains useful tables of comparison of the degrees of Baume's areometer or hydrometer, with the specific gravities of liquids.

The work is a handsome octavo, printed on tinted paper, and tastefully bound. It should be in every technical library, and should meet with a large sale in this country, as much of the matter it contains has hitherto been inaccessible to the majority of American readers.

* Beet-Root Sugar: Remarks upon the Advantages derived from its Growth and Manufacture in the United Kingdom, together with a Description of its Rise, Progress, and Present position on the Continent of Europe, and some Practical Directions to Agriculturists and Manufacturers, with an Appendix on the "International Covention." By Arnold Baruchson. London: Effingham Wilson, Royal Exchange. 1868.

PAPER AND PAPER STOCK.

The Industrial Society of Mulhausen, France, recently offered a reward for the best treatise on the manufacture of paper and the choice of stock. The award was made to M. Oriolli, from whose admirable dissertation we propose to prepare a few abstracts.

The author first gives a scientific exposition of the properties of cellulose, then discusses the best methods for its treatment, and, finally, gives an account of all the raw material from which paper can be made.

It is gratifying to see that in the manufacture of paper, as well as in all other arts, there has been great progress during the last hundred years. Chemistry and mechanics have each contributed their part. The former has afforded us improved methods for washing, bleaching, bluing, and coloring the stock, which must yield a different product from what was made by the ancients. The mechanical improvements have been many, and tend to facilitate and cheapen the manufacture of paper. The use of ultramarine, which at one time was almost as valuable as gold dust, is a contribution from chemistry that the most sanguine believer in the progress of science could not have foretold. To see the beautiful blue color that Raphael so highly prized now made so cheaply as to be available in every laundry and in extensive manufactures, is one of the triumphs of modern science.

The same science that has given us our color has also taught us that the cellulose of all plants is the same as that contained in rags; and, in fact, the fiber of some plants will give us a paper that cannot be made from rags.

Not all plants, however, are adapted to the making of paper. Much depends upon the bark, membrane, and fiber, and there is a difference in the purity of the cellulose in various plants. The chemical tests also show a modification in the fiber of plants. The cellulose of cotton yields a blue color immediately with tincture of iodine; that of flax does not turn blue until an acid has been added, and hemp requires both acid and considerable time before the blue color makes its appearance. These reactions point to the presence and absence of starch and glucose in different species of plants. Chemically pure cellulose is perfectly white, more or less translucent, elastic, with a mean specific gravity of 1·5. It is insoluble in water, alcohol, ether, and volatile and fixed oils. It is unchangeable in dry air, but when moist, it becomes yellow in consequence of the formation of ulmic acid. In the sunlight moist cellulose suffers changes that have not been fully explained, and these alterations are modified and retarded by coloring or any organic matter. The action of acids upon cellulose is full of interest. Sulphuric acid changes it into a species of parchment, and if the action of the acid be permitted to go on for some time, the cellulose is transformed into starch, dextrine, and glucose. Very concentrated sulphuric acid chars paper and converts it into ulmic acid. Nitric acid has violent action upon cellulose and changes it into explosive compounds, and longer contact converts it into oxalic acid. Hydrochloric acid dissolves cellulose in small quantities.

A mixture composed of 80 per cent hydrochloric acid and 20 per cent nitric acid has been shown, after a great number of experiments, to be the best adapted for the disintegration of woody fiber. In 24 hours it converts the cellulose of wood into a spongy, soft mass, that can be easily separated by the fingers. The color is not changed, and all of the incrusting and foreign matter of the wood is destroyed.

In consequence of these experiments, Oriolli came to the conclusion that woody fiber treated as above, afterwards carefully washed, pressed in a mortar, again washed, neutralized with a 10 per cent soda lye, bleached with a 10 per cent chloride of lime bath, would yield long, soft, strong, silky fiber for the manufacture of paper. But notwithstanding the success of the experiment in a small way, all attempts to apply it on a large scale have proved unsuccessful. The wood was mixed with the *aqua regia* in large stone reservoirs, and it was found to be impossible to prevent leakage; then arose the difficulty with the red fumes of nitrous acid that produced a most deleterious effect upon the workmen. After the wood is disintegrated it must be hastily washed or the acid would wholly destroy it, and there was difficulty in performing this operation, as the acid would attack iron rapidly, and thus introduce chloride of iron into the stock, which would certainly ruin it for the manufacture of paper. There was also a great loss of soda growing out of the neutralization of the pulp after it had been disintegrated.

The inventors found so many difficulties that they were obliged to abandon the process, but it nevertheless possesses many points of interest, and may suggest a way of treatment for other fibers that have thus far not been found available for the manufacture of paper.

It is somewhat remarkable that Oriolli insists upon the necessity of some kind of treatment, by acids or alkalies, of the woody fiber before it can be adapted to the manufacture of paper, and yet in the face of his theory we have in the United States vast quantities of wood paper made without bleaching and by simply washing the pulp which is rasped from the sticks by rapidly revolving wheels.

In this country the whole process is a purely mechanical one, excepting in the establishment near Philadelphia, where chemical agents are employed.

Oriolli prefers boilers with double bottoms to any other invention for preparing the stock, and he lays much stress upon the gradual increase and decrease of the temperature. He also gives an account of the successful employment of ammonia water in the treatment of certain kinds of fiber. In reference to the various ways of bleaching the pulp preference is given to the employment of chlorine gas and of hypochlorites. If the hypochlorite of alumina were a salt that could be made in sufficient quantity and at a reasonable cost, it would be better than any other as a bleaching agent, but under the circumstances its use must now be confined to a superior quality of paper where the cost is of less importance. Bleaching by chloride of lime appears to have been universally adopted, although of late years much has been said about the use of permanganic acid as in every way preferable.

As for the vegetable fiber best adapted to the manufacture of paper, nearly everything has been tried—roots, leaves, stems, bark, cabbage, potatoes, beets, vines—but in practice none of them has been found of any value. On the other hand straw, wood, corn stalks, rice straw, esparto grass have been successfully used in various countries.

Interesting and valuable articles could be written upon each of the last enumerated raw material now used in the manufacture of paper. In Austria the husks of corn are not only made into paper but into clothing, and a good article of food is also produced from them. Paper clothing is also made in China and Japan, where a good coat can be had for ten cents, and a suit of clothing for a quarter of a dollar. In Germany paper napkins are now introduced, the cost of them is a trifle, and they can, after having been once used, be thrown into the common stock to be worked over again.

The fact that cotton and linen are really the same thing, chemically speaking, as paper, may take away from the prejudice that some persons entertain in reference to the use of paper collars, cuffs, and clothing. The cheap production of paper suggests its application for many ornamental and useful purposes. For doors, windows, cornices, papier-mache statues, moldings, bookbinding, pails, tubs, boats, and houses, there is a great future open to paper, and hence the importance of increasing our stock of raw material and our knowledge of the best methods for its manufacture.

ARTIFICIAL ULTRAMARINE.

Ultramarine, as known to the ancients, was called *lapis lazuli*, and was a precious stone. Very fine specimens of the mineral were ground up and used by the old masters, Raphael, Guido, and Domenichino, for the choice paintings, but the color was as dear as it was highly prized.

A few years ago a German chemist, while experimenting with anhydrous sulphuric acid and sulphur, made the accidental discovery that an exquisite blue color was produced. He came to the conclusion that the blue color of the ultramarine was probably due to sulphur and sulphuric acid, and at once instituted some experiments with alumina, soda, sulphur, and sulphuric acid, and succeeded, after repeated failures, in actually imitating the precious stone. It is not necessary to follow out the history, but is more agreeable to refer to the great success attending this industry at the present time.

Ultramarine is now so cheaply made that it enters into more industries than the public are aware of. We find it in the laundry as a bluing to correct the yellow color of linen. In the manufacture of white paper the consumption is becoming enormous. It finds ready application for fancy paper, paper hangings, and window shades, and is largely used in painting, not only decorations, but the common wood work of our houses. In the refinery of sugar it is also employed to give a fine white color to the loaf.

Its cheapness and the abundance of the supply have suggested its application in all cases where a clarifying substance is desired, and its manufacture has now reached proportions of many tuns per annum. We can buy a box of bluing for twenty-five cents that would have cost Raphael some thousands of dollars. Such is the success of the application of chemistry to the arts; and it is a color of so much importance in many manufactures that its cheap preparation has become a matter of prime necessity, and numerous establishments now vie with each other in producing a choice and cheap article. The principal seat of the industry is in the neighborhood of Nuremberg, where the original discovery of its artificial production was made.

PROJECTED SHIP CANALS.

The great Suez Canal, and the proposed Darien Canal, have so occupied the attention of the public that few have had their attention called to the numerous projects of a similar character now on foot in various parts of the world. It would seem that nations are everywhere looking for new and shorter routes of commerce, and that an era of ship canals has commenced.

In a recent issue we announced that the Suez Canal had been deepened so as now to admit the passage of vessels of the largest class. This was doubted by a cotemporary journal which is supposed to know more about spiritual than engineering matters. The fact remains, however, and sufficiently substantiates our statement, that large cotton steamers, one of them carrying over eleven thousand bales, have recently made the passage, one of them passing through the canal in only fourteen hours, and this passage has justly been accepted as establishing the practicability of the canal for larger vessels.

The prospects of the Darien Canal are not definitely settled, but it is hoped a practicable route will be established ere long.

The canal that was proposed to be established between the Baltic Sea and the German Ocean is now much favored by various commercial associations, and is so strongly urged that probably a survey to establish the most practicable route will soon be made.

It is thought that a canal will also soon be cut through the Isthmus of Corinth in Greece, thus connecting the Gulf of Ægina and Lepanto. This canal cannot, however, compare in extent or in commercial importance with the one intended to connect the Baltic with the German Ocean. It is, however, favored by the Greek Government, and will probably be cut through sooner or later.

A much more important project, and one which in magnitude eclipses all the others is a canal connecting the Bay of Biscay with the Gulf of Lyons, a distance of two hundred and twenty-five miles. An estimate of the cost of the work has been placed at $125,000,000. The termini of this work as now projected are Bordeaux on the Bay of Biscay, and Cette on the Gulf of Lyons. The section of the cutting is proposed to be of the same dimensions as the Suez Canal.

Other minor works of the kind are under consideration, and it is quite evident that the isthmuses of the world are destined to become the scenes of remarkable engineering works in the time to come.

The commercial changes the works already projected will effect, if they should ever be completed, are altogether beyond present comprehension. A work like that proposed between the Bay of Biscay and the Gulf of Lyons, could scarcely have been looked upon, in any other age, except with doubt and derision. If any now deride, it is because they see reason to doubt financial, rather than engineering success.

FRICTION MATCHES.

Matches without phosphorus or other poisonous ingredient are made by J. J. Karlen & Sons, of Erlenbach, Switzerland, in the following manner:

To a solution of bichromate of potash dissolved in cold water is added hyposulphite of lead, then chlorate of potash, then sulphur, then peroxide of manganese, and finally peroxide of lead, in the order stated.

These six materials are well mixed and kneaded together with water to form a thick paste, which is then rubbed upon a slab or passed through a mill, such as is used for grinding paints, so that all the ingredients are intimately and thoroughly blended. The paste is then warmed in a bath of luke-warm water, but not hot water.

Gelatin or glue having been dissolved in somewhat warmer water, this solution and powdered glass are added to the former mixture, and the whole mingled together in the form of a paste, which is then well stirred for a quarter of an hour, when the composition is ready for dipping the match sticks.

It is important that the chlorate of potassa be ground to