who brought it in pails, pots, cans, and barrels; thus the whole army of wagons arrived safely at Eger, where on the 20th of June more than 140 Saxon locomotives and thousands of wagons were stationed.

The Prussian expedition, which left Zwickau a day later, soon found that the trains had successfully escaped. The men who imperiled their lives by taking care of the railroad property deserve our admiration as much as the bravest soldiers on the field of battle.

The fleeing masses have since returned and have brought the much-desired peace with them. All the dams thrown across the track have again been levelled. May the dams thrown across the road of civilization be also. removed and levelled, and, if possible, by the agency of the locomotive which unites all nations more completely and better than all the cannon, orations, and banquets of the world.—*Gartenlaube, Leipsic.*

A METHOD OF CONTROLLING THE PRODUCTS OF THE BESSEMER PROCESS.

PREPARED FOR THE SCIENTIFIC AMERICAN BY DR. ADOLPH SCHMIDT.

(Concluded from Page 136.)

The regular practice of the three trials above described, after each Bessemer charge, will enable the manager of the process to compare the phenomena observed during its course with the results obtained, and thereby to acquire very soon a far more exact practical and theoretical knowledge of the process, and much greater certainty in conducting it than would be possible without the testing. But to extend this certainty to the subsequent working or selling of the raw metal, and to give to this experience a high practical worth for the Bessemer trade, well-determined exterior signs are necessary, which may prevent the ingots from being sold or used for other purposes than they are adapted for. To this end all the metal resulting from the process must be divided into a certain number of classes, the metal of each charge must be adjudged according to the results of the three testing operations described, to one of these classes, and the ingots of the charge must be marked with numbers or other exterior signs, indicating the class to which they belong. As the testing operations are made after the casting of the small ingot, without delay, and can be done in little more than half an hour, the large ingots of the same charge will still be hot and soft after the trial has been made, and the number decided upon, can easily be stamped upon each of them. The numbers should also be marked in a charge journal, kept regularly, and giving an account of the raw material, the more important phenomena, and the results of the charge.

According to experience in the Austrian Bessemer works I believe that the most convenient division of the Bessemer products will be in five classes or numbers whose characteristics I will endeavor to give in the following statement:

Number I. is the hardest kind of Bessemer metal, and resembles the harder kinds of cast steel in common with which it requires to be forged at a certain and carefully chosen temperature. This temperature is indicated by a not too bright yellow color in the heating furnace and metal. If the temperature is raised to a bright yellow or lowered to a light red, this hard kind of Bessemer steel will break in being forged or bent. Having, from its chemical composition and molecular structure, a natural tendency to hardness, it is capable of being hardened to a very high degree, so as to be useful for the manufacture of turning chisels, small files and surgical instruments. It can, when hardened, be bent but a little without breaking, and exhibits a very perfect elasticity returning energetically to its shape after being bent. Its fracture is slightly conchoidal and smooth, the grains being too small to be distinguished by the eye; color, a very light gray. It contains chemically about 1 per cent of carbon. On being tested as to its tensile strength, it extends not more than 5 per cent of its original length, and breaks under a strain of 125,000 to 150,000 lbs. to the square inch of sectional area.

Number II. has similar qualities with No. I., though less sharply pronounced. It is equally a true steel, and can be used for making chisels, larger files, axes and even scythes if the general quality of the metal is very good. It will also do good service as head plates for rails. Entire rails made of this number, though resisting very well, would be too liable to break. It allows greater differences of temperature in being forged, not cracking or breaking in a moderate or in a bright yellow heat. It is generally softer than No. I., but hardens perfectly well, and cannot then be bent durably to any considerable extent. Though its elasticity is nearly as perfect as that of No. I. its elastic force is remarkably less. Its fracture is less smooth, showing the granular structure more distinctly, and presents no conchoidal but an even surface. It contains about ¾ per cent of carbon, and has a tensile strength of 100,000 to 150,000 pounds per square inch, with a corresponding extension of 15 to 5 per cent; the extension being the smaller, the greater the strength.

Number III. has still steel-like qualities in a remarkable degree, but cannot be considered as a true steel. It resembles in its properties the ordinary kinds of puddled steel. It is the best material for tires, being hard enough to resist impressions from the rails, soft enough not to injure them, and tough enough not to break. It can also be used and do good service as head plates of rail piles and for rolling entire rails. It is much less sensitive in regard to temperatures than the former, and can, if it is of a good quality in general, be forged and bent without cracking at all temperatures between bright red and welding heat. It can be hardened, though not as easily or perfectly as the former numbers. Its elasticity is much less perfect, and it does not quite resume its original form after bending when hardened. It can however be bent considerably in this condition. Its fracture is even but of a darker color and larger grain; the single grains can be seen in the structure with the eye. It contains about ½ per cent of carbon, and has a tensile strength of 80,000 to 100,000 lbs. per square inch, extending at the same time between 20 and 15 per cent of its original length before breaking.

Number IV. has scarcely any qualities of steel, and had better be considered as a hard kind of wrought iron, having a somewhat steel-like, grainy structure and appearance. It can be forged and bent at all temperatures down to a pretty dark red. It does not get much harder by being heated and cooled in water, and can be bent, after cooling, to an angle of about 150°. When broken slowly the surface of its fracture is grainy, uneven and often partially fibrous. It resembles in its appearance and qualities what is called in Germany "Fein korn," i. e., fine grain iron, which is manufactured in puddling furnaces by a process similar to steel puddling and is chiefly used for head plates of rail piles.

The Bessemer metal No. IV. will also suit that purpose, but it will also prove an excellent material for rolling entire rails, and its softer varieties make good boiler-plates. Harder kinds of the metal have been tried for making boiler plates, but did not stand the change of temperature well enough. Number IV., contains about ¼ per cent of carbon. It breaks at a charge of 70,000 to 80,000 lbs. per square inch, extending before the rupture between 25 and 20 per cent.

Number V. stands very near real wrought iron, being however generally less fibrous in structure and less soft than the purest kinds of the latter. It is more difficult to work or bend, and has a higher degree of tenacity than ordinary wrought iron. When manufactured with care and from very pure pig iron, it will replace wrought iron in a great many instances. Compared with the preceding numbers it is a very soft and tough material. It can be hammered and bent without breaking at all temperatures from 40° up to 3,600°. It cannot be hardened, but will bend to an angle of 90° and more, after having been heated and cooled in water. Its fracture is partly fibrous and partly grainy, with large dark-colored grains. It welds very perfectly, though not always quite as easily as wrought iron, and greater care has therefore to be taken in the operations with this material than is required in welding common wrought iron.

It contains only about 0·05 per cent of carbon. The tensile strength or tenacity is between 60,000 and 70,000 lbs. per square inch, and it extends before breaking from 30 to 25 per cent of its original length. It is an excellent material for the manufacture of boiler plates, car and locomotive axles, and large forgings of all descriptions.

It has been observed at the Bessemer works of Neuberg, in the Austrian province of Steria, where most of these observations have been made, that if the process is interrupted exactly at the moment which is the easiest to recognize, when the flame begins at last to diminish in brightness and to flicker, before it shortens remarkably, No. V. will be obtained without any addition of Spiegel or pig iron. But if molten pig iron is added, the resulting metal will, by the addition of every 3 per cent, become one number harder, so that 12 per cent is necessary for producing No. I., after a good and regular charge. This may however be different with different materials, and must be determined by special experience with each kind of pig iron.

If we compare the condition of the Bessemer trade in Austria—where Bessemer metal is already used in the place of cast-steel, as well as of wrought iron, and where, for instance, locomotives are made in nearly all their parts of the different kinds of the metal—with the condition of the same trade in England, where the manufacturers are not yet able to furnish rails and tires of a quite reliable quality, and where the metal has till now but a very low credit for all other purposes, the great practical value of the method above described will become apparent. For the difference in the purity of the pig iron used in these two countries is not considerable enough to account for this great difference of public confidence in the products of the process, and the superiority of the German Bessemer industry, in this respect, must chiefly be ascribed to the more careful and scientific manner in which the process is there conducted.

THE LATE ALEXANDER DALLAS BACHE.

Dr. Franklin, justly reverenced as one of the fathers of modern science, has been fortunate likewise in his other posterity. His only daughter, Mrs. Richard Bache, was worthy of her parentage, in intelligence, force of character, and devoted patriotism, and transmitted to posterity the intellectual rank, the personal virtues and even the scientific bent of her illustrious progenitor. Her son, Benj. Franklin Bache, was an able journalist, and her grandson, Alexander Dallas Bache, has just died, ripe in years and honors, leaving a name already long claimed by the scientific world as its own. The names of FRANKLIN and BACHE will thus be associated in the records of science and in the regard of mankind. The first Bache from England (Richard) the son-in-law of Franklin, also bore an honorable part in the history of his adopted country, having been president of the republican society of Philadelphia at the beginning of the Revolution, and Postmaster General of the United States during the war. Philadelphia, rich in historic honors, shares in the same happy association, having been the residence of all and the birthplace of the latter two, of this noble line.

Prof. Bache was born in Philadelphia, on the 19th of July, 1806. He graduated at West Point, in 1825, at the age of 19, at the head of his class—never having received a mark of demerit—was commissioned a lieutenant of topographical engineers, and remained for one year at West Point as assistant professor. From twenty-one years of age to thirty-five, he was professor of mathematics in the University of Pennsylvania; next, the first principal of the Central High School of Philadelphia, being transferred to the chair of Natural Philosophy and Chemistry in the University; traveled in Europe in behalf of Girard College, and presided over that institution from 1843 to 1853, when he was appointed to the great work of his life, as Superintendent of the Coast Survey. Of this work nothing could be more fitly spoken than the official tribute from the Secretary of the Treasury, Hon. Hugh McCullough:

Under his direction that great national work has been eminent, no less for its abundant results than for its high scientific character, which has won the approbation of the leading learned bodies of the world, among whom his name has long been held in honor.

That the deceased Superintendent had become illustrious in America and in Europe is due to the steady devotion of his great talents to the service of the people. His genial disposition attracted the love of associates and of subordinates; his wisdom commanded their respect. He leaves us a name of unsullied purity, and a memory that adds lustre to the many public records upon which it is borne.

All remember the many testimonies to the vital importance of the results of the Coast Survey, which are bound up with the exploits of our navy in the late civil war, at Port Royal, New Orleans, Charleston, Savannah, Mobile, Fort Fisher, etc. Every topographical datum required for successful approach and attack in those waters, had been placed by that means in the hands of our naval and military commanders, and it is not too much to say that the Coast Survey was one of those leading providential preparations without any one of which the failure of the war would have been morally inevitable.

Prof. Bache's long and final illness was softening of the brain, and he died at Newport, R. I., on the 17th of February, in his 61st year.

Prof. Agassiz, in his lecture on Thursday evening, remarked that the Coast Survey of the United States is the most perfect coast survey ever made in the world, and that it is the work of Bache in its perfection. He had the talent to apply to practical purposes the most advanced results of science, and to make his practical work contribute to the progress of science, in a manner which has advanced geography in America far beyond what it is anywhere else.

GLEANINGS FROM THE POLYTECHNIC ASSOCIATION.

The regular meeting of this branch of the American Institute, was held on Thursday evening, February 14th, Prof. Tillman presiding.

The President read, as his usual summary of scientific items a condensed statement of the seventeen principal points proved in a course of lectures on chemical and dynamical geology, delivered by Dr. T. Sterwy Hunt, F. R. S., before the Lowell Institute of Boston.

A VOICELESS DUCK.

Dr. Rowell exhibited to the society the throat of an unfortunate duck, which when living was incapable of uttering any sound owing to the enlargement of the bronchial tubes. The case was brought forward as an illustration of his theory, that in the larynx there reside organs of speech, which if once destroyed are never renewed.

BEET SUGAR.

The discussion on this subject was resumed. Mr. Grant believed it clearly proven that beet sugar can be made here cheaper than cane sugar imported from Cuba. Minnesota, he considered to be the state most favorable for its production and manufacture. The soil of New Jersey is also admirably suited but the high value of land is a serious objection to its being profitably grown. More sugar is produced from beets than from equal quantities of cane. The usual product of cane sugar in Cuba is 1700 lbs. to the acre, but in Illinois there is no difficulty in raising beets that will yield 2000 lbs. to the acre.

The climate required for raising beets is the very opposite of that necessary for the successful cultivation of the cane, the colder latitudes being more favorable than hot or tropical ones. After some further discussion the meeting adjourned having selected "Bridge Building" as the subject for the next meeting.

The able article on beet sugar cultivation, read by Dr. Hirsh before this body a few evenings since, we have been permitted to use, and a portion of it appeared in our last issue. The crowded state of our columns necessitates deferring the remainder until next week, when the second and concluding article w ll be published.

Production of Natural Colors by Photography.

M. Niepce de St. Victor has recently communicated to the French Académie des Sciences the results of his latest researches, having for object to obtain and fix the colors of nature by means of photography. His paper is full of very important, new and interesting facts, proving that the fixation of natural colors on the ptotographic tablet as a practicable and available result, which for a long time has been considered as a dream, is not perhaps so far from being fully realized—not as a mere scientific experiment, but as the completion of the splendid discovery of photography.

The process of M. Niepce de St. Victor may be shortly described as follows:—The silver plate must first be chlorurised, and then dipped into a bath containing fifty centigrammes of an alcoholic solution of soda for every 100 grammes of water, to which a small quantity of chloride of sodium is then added. The temperature of the bath is raised to about sixty degrees centigrade, and the plate is only left in for a few seconds, the liquid being stirred all the time. The plate being taken out, it is rinsed in water and then warmed until it acquires a bluish-violet hue, which is probably produced by the reduction of a small quantity of chloride of silver. The plate is now coated with a varnish composed of dextrine and chlor