Such a conclusion could not long be entertained without attempts to put it in practice, and schools have been established both in America and Europe, subordinating classical training to scientific instruction. The Cornell University is such an institution, and although it gives special prominence to agriculture and the mechanic arts, making other scientific and classical instruction secondary, it yet deserves, in our opinion, to rank as the first school in the United States, when it is considered with reference to its scope and its immense endowment.

In saying this we do not disparage those scientific schools which, with a narrower scope, and on a smaller scale are doing most excellent work. Of these the Polytechnic Institute at Troy, N. Y., and several others, cannot be too highly praised, for their judicious management and the thoroughness of their course of instruction. The organization of the Cornell University is, however, so radically different from these schools, that it must be looked upon as an experiment in American education. As yet it has not got fully under way, and its ultimate success or failure is problematical. We believe it will prove a triumphant success, and we have had this faith from the outset.

Its annual register has come to hand, and from it we gather that it has a large corps of able professors, and a very large class of students—four hundred and twelve being the number instructed during the past year.

The scheme of military instruction, in compliance with the act of Congress, has been partially developed, and is made accessory to the preservation of quiet, order, and health. The shops which are ultimately designed to form a marked feature of the institution are not yet ready, but it is hoped that another year will witness their completion.

The following extract from the register, will show what is designed to be accomplished by the labor department:

When the shops are in operation good practical machinists, who have already a sound ordinary English education, and who wish to make themselves thoroughly scientific master mechanics, can probably do much toward their own support, and at the same time perfect themselves in their special department, in making models of instruments, machines, and apparatus for the University and other illustrative collections. But this will require skilled labor—the labor of young men already more or less accustomed to the use of tools.

The largest part, however, of the existing corps is composed of young men who can give only unskilled labor. For these almost the only work at present is upon the University farm, or in the grading of roads and paths on the University grounds. The time usually given is three hours a day, from two o'clock to five P. M., except on Saturday, when more time may be taken. Much excellent work has been done, and many students, while doing much toward their support, have thus physically strengthened themselves. The price paid is just what would have to be paid to other parties doing the same work, and as a student has usually less muscular development then an ordinary laborer, his earnings must be less. An energetic and capable student, coming at the beginning of the long summer vacation—extending from the first of July to the middle of September—could earn enough on the farm to give him an excellent pecuniary start, which, with what he could earn during the Trimesters, would do much toward carrying him through the year. But during the year now begun, with very few exceptions, students commenced work at the beginning of the fall Trimester, and as their studies have taken much time they have had comparatively little opportunity to labor toward self-support. It is hoped, too, that some simple remunerative manufacture may be introduced which will aid in supporting students, but, at this time, the University authorities cannot recommend any young man to come relying entirely on unskilled manual labor for support. Some few have that peculiar combination of mental and physical strength required thus to entirely support themselves—the great majority have not.

Why would not a beet-sugar establishment be just the branch of manufacture needed? If the beet will grow well upon the lands of the institution it might afford employment for many, and at the same time aid much in the permanent establishment of an important branch of industry. It will aid, also, in sustaining the agricultural science department, in which there seems to be a deficiency of interest at present.

The library now numbers nearly twenty-five thousand volumes. An important feature of this library is the publications of the Patent Office of Great Britain, comprising about twenty-five hundred volumes. The Museums of Geology, Mineralogy, Botany, Agriculture, Zoology, and Technology, embrace many large and fine collections. In addition to these there are large collections of apparatus, etc., in chemistry and physics, as also collections in the fine arts. These collections are receiving valuable additions from time to time, and form a very useful and attractive feature of the institution.

Although agricultural science was intended to occupy a conspicuous place in the University course of study, the register shows that only thirty have studied agriculture out of the large number matriculated during the past year, while of those pursuing mechanic arts, engineering science, and the arts in general we find 106. This number will doubtless be augmented when the workshops are opened. We do not argue from these figures that agricultural science is less needed in this country than mechanical science, but that there is perhaps a greater avidity for the acquisition of knowledge on the part of young mechanics, or those who desire to become mechanics and engineers than among those who desire to cultivate the soil. It is the nature of the arts to stimulate a thirst for knowledge which agricultural pursuits, as they are conducted, do not. This is not the fault of the latter occupation *per se*. It is the fault of the present morbid state of society, which draws away the more ambitious youths to glittering centers of trade, depleting the farming classes of a kind of intellect which, if retained in it, would give a much higher intellectual tone to the occupation.

But we have extended our remarks to a much greater length than we intended. The Cornell University has our best wishes, and we hope the experiment will result in an improved system of education throughout the United States.

AMERICAN SILK.

The present state of this industry in the United States, is very satisfactory. Not only are important advances making in the manufacture of silk goods, but the growth of raw silk in various localities is on the increase.

We have been informed that the Dale Manufacturing Company, of Paterson, N. J., has been importing workmen from France, and making extensive preparations to commence the manufacture of dress silks, and we have seen dress silks produced in this country, which, in our opinion, are in no way inferior to French dress goods of the same class.

The Positive Motion Loom, described in No. 2, current volume of the Scientific American, weaves dress silks of a quality equal to those woven by hand, and at a very much more rapid rate, and is doubtless destined to become largely identified with the manufacture of silk dress goods, not only in this country, but abroad.

A great stimulus to silk culture has been given by the demand for American eggs in foreign markets. It has been found that by the purchase of these eggs the old stock, which in many European localities had become effete, may be replaced by a new, vigorous, and healthy stock, so that for some time the export of eggs from this country has become an important and growing business.

In this trade, California has as yet had the largest share, but Louisiana is destined to become a formidable competitor.

We have before us a specimen of cocoons, grown by MM. Rocci & Maillé, in Covington Parish, La., crop of 1868, which will compare favorably with any grown in any part of the world. These cocoons average about 450 to the pound. The entire crop, amounting in round numbers to 1,000,000 cocoons, was grown during March and April.

The original stock of this firm was introduced into Louisiana in 1845, and its offspring has ever since been remarkably free from disease.

Italy paid, in 1868, 50,000,000 francs to Japan for silkworms' eggs, and the Italian government offers, for 1869, a prize of 50,000 francs for the best sample of eggs to be sent to that government for examination. MM. Rocci & Maillé feel confident that their chances for securing the premium are as good, to say the least, as any others.

Some of these eggs, with specimens of cocoons, having been sent to Italy, the government deemed the matter of so much importance that it has sent a special agent to examine and report upon its merits. We are informed this agent is now here, and that his report will probably be very favorable, as the facts in the case are such as to warrant this belief.

This statement shows to what an extent the silk industry may be developed if properly fostered by our government, and also justifies the statements we have hitherto made in regard to the adaptability of certain sections of the United States for the culture of silk. They are also another proof of the large and varied resources of our country; resources so great that the enormous importations we are making of foreign products is a blot upon the statesmanship of our legislators as well as a serious drain upon the vitality of our institutions.

THE ELASTICITY, EXTENSIBILITY, AND TENSILE STRENGTH OF IRON AND STEEL.*

Although Sweden possesses in its numerous lakes and canals extensive means of water communication, yet owing to the severity of the climate this mode of traffic is necessarily suspended during at least five months in the year. In spite, however, of the manifest advantages of a rapid and uninterrupted means of intercourse, it was not until about twenty years ago that railway communication was first introduced into Sweden. The construction and management of these railways, or at least of the main lines, were undertaken by the government; for it was believed that the amount of traffic in a country so thinly populated would be insufficient to render any private speculation of this kind remunerative.

It might be supposed that a country possessing such vast iron-making resources as Sweden would naturally manufacture its own railway plant. It was soon found, however, that English materials could be obtained for considerably less than the cost of similar articles manufactured at home, and hence Sweden was for many years dependent chiefly upon England for its supply of railway materials. Indeed, the Swedish charcoal iron always commanded so high a price in the English market, that it was advantageously exported for the use of the steel manufacturers of Sheffield, while English iron of a lower quality, but suitable for rails, tires, axles, etc., was imported into Sweden; this interchange being facilitated by the free trade enjoyed by that country.

After the importation of foreign materials for the construction of railways had continued for about five years, the Swedish Diet called attention to the expediency of using products of home manufacture. As the question was one of great national interest the government was induced to appoint a scientific commission for the purpose of determining whether Swedish raw material was equally suitable for the manufacture of railway plant, and whether its superior quality would adequately compensate for its increased cost. The members of this committee were selected from among the most experienced men of the country, and consisted of Messrs. Ekmann, Styffe, and Grill.

The execution of the experiments was confided to Mr. Styffe, who secured the assistance not only of certain practical engineers but also of several men of science connected with the University of Upsala. It is an account of these investigations that forms the subject of the work before us.

Experience has taught us the necessity of thoroughly examining the elasticity, extensibility, and tensile strength of iron and steel intended for the construction of railway plant.

In England important investigations on the strength of these metals have been undertaken by Messrs. Fairbairn, Hodgkinson, Kirkaldy, and other engineers. On the continent of Europe experiments on this subject have been ably conducted by several eminent physicists, among whom may be especially mentioned Lagerhjelm, Wertheim, and Kupffer.

The Swedish committee in prosecuting their inquiries of course availed themselves of the results of these previous investigations, but extended the methods of experiment to the question immediately under their discussion. Their researches extended over a period of five years, and were prosecuted on account of the Swedish government without any regard to expense; the sole aim being to attain accurate results. In the present work the minute details of this important investigation are recorded with admirable fidelity and clearness; but while these details are of the greatest value to the man of science, it should be distinctly understood that it is by no means necessary to study them in order to arrive at the main results of the inquiry. Indeed these results are stated so plainly and succintly as to be understood by any iron-master or practical engineer, while the refinements of the experiments and the investigation of the formulæ may, if necessary, be omitted without much prejudice to the reader.

The materials examined by the committee were obtained from the most renowned iron works of Sweden, and from the chief iron producing districts of England.

As noticed in the title of the work, the researches were directed principally to an examination of the elasticity, extensibility, and tensile strength of iron and steel; these properties being regarded as of prime importance in determining the value of railway materials. It is, however, to be regretted that no experiments were made on the relative capacities of different kinds of iron and steel to resist concussion; for railway materials are, by their nature, constantly exposed to shocks of this kind, and there seems to be a very uncertain relation between the strength of a material to resist tensile strains and to withstand the force of impact; the extensibility or power of extension under a tensile strain is, however, a character more worthy of reliance as a comparative measure between these two properties of the metal.

Formerly but little attention was directed to the connection between the chemical composition of iron or steel and its mechanical properties. During the last ten years, however, the subject has recived considerable attention, especially with reference to Bessemer steel; and it is now usual to determine the carbon at most of the European steel works—thanks to the simple coloration test introduced by Prof. Eggertz.

In most of the tables appended to this work the author has given the amount of carbon in the bars examined. Considerable attention has also been paid to the influence of phosphorus on iron and steel; and the author remarks that he knows no instance of a good steel containing more than 0·04 per cent of this element.

The effect which slag exerts on iron is also noted, and under certain conditions its preference is said to be beneficial.

Not only does the author trace the connection between the chemical composition and the strength of the material, but he also examines the influence exerted by the manipulation to which the material has been subjected. In a valuable series of curves he shows graphically the manner in which the properties of iron and steel are affected by their chemical constitution and mode of manufacture.

In examining the results of some of these investigations, the manufacturer will be struck by the results obtained from "Cleveland iron" as compared with Staffordshire iron. These results are certainly not confirmed by general experience, and their explanation is possibly to be found in the author's note (p. 25) in which he tells us that the bars representing the Cleveland iron were procured through an agent, and were therefore probably selected. On the other hand, the so-called Staffordshire specimens were purchased in Stockholm, and nothing known as to their manufacture.

The author's experiments on hardening tend to corroborate a fact previously known; namely, that iron admits of being hardened, although to a far less extent than steel. When steel is hardened by being plunged into cold water, the scale of oxide formed upon its surface is thrown off, and it may be said that this behavior of the metal constitutes the only practical point of difference by which steel may be distinguished from iron.

But perhaps the most important part of Mr. Styffe's work is that which relates to the effect exerted by differences of temperature on the strength of iron and steel, as detailed in Chapter III. The subject had indeed been previously examined by Dr. Fairbairn, but in the Swedish experiments a lower limit of temperature was attained, the thermometer falling to the freezing point of mercury, or 40° Fah.

In Sweden the difference between the extremes of temperature in summer and winter is twice as great as the corresponding difference in England; and hence materials well suited for use in that climate may be dangerous for a Swedish railway.

As the same remark of course applies to other countries that suffer from severity of climate, the subject cannot be too attentively studied by engineers in Canada and certain parts of the United States.

The great point brought out by Mr. Styffe's researches is, that the bars of iron and steel tested by him for tensile strength, so far from being weaker, as generally supposed,

* The above is the title of a work, by Knut Styffe, Director of the Royal Technological Institute at Stockholm. It has been translated from the Swedish, and supplied with an original appendix, by Christer P. Sandberg, Inspector of Railway Plant to the Swedish Government and Associate of the Institute of Civil Engineers, and is published by John Murray, London, 1869.