tional system include technical schools? How shall their distribution among the various vocations and professions be symmetrically effected? To what extent and in what manner should the State sustain them? and What are the deficiencies in number, curriculum, and method of the schools already established?—these questions are those of the hour. These constitute the great problems of the citizen, the educator, the legislator, and the statesman of our time. Such questions as these demand discussion and action, imperatively and continuously. They are more pressing and vital than those of tariff or currency, annexation of adjacent provinces or choice of gold or silver, iron or copper, for our coinage. Economical errors of the latter sort may isolate us from the rest of the world; but errors in the moral and intellectual, or the technical, training of the people, may make home life less satisfying.

The magnitude of the demand for technical instruction in the United States is greater than is usually supposed, and the real need—which vastly exceeds the demand—is far beyond the ordinary estimates of even the educator engaged in this special work. The writer has estimated that, were the United States, as a whole, to provide as liberally for the technical education of its people as do some of the provinces of France, and of Germany especially, there would be established:

Twenty technical universities, having in their schools of engineering and higher technique, 50 instructors and 500 pupils each.

Fifty trade schools and colleges, of 20 instructors and 300 students each.

Two thousand technical high schools, or manual training schools, of 10 instructors and 200 pupils each.

That is to say: There should be in the United States to-day, 1,000 university professors and instructors, and 10,000 students under their tuition, studying the highest branches of technical work; there should be 1,000 college professors and 15,000 pupils in trade schools, studying for superior positions in the arts; 20,000 teachers engaged in trade and manual training schools, instructing pupils, 400,000 in number, proposing to become skilled workmen. We have in this country 10,000,000 families, among which are at least 1,000,000 boys who should be in the latter class of schools. The cost of such education would be, per annum, about 50 cents per inhabitant additional to the present school tax, and in the shops of these schools less than \$100 per student, and under \$300 per annum per student, for total costs of higher education.

The actual number of schools of the highest class in this country—schools which are neither technical universities nor colleges, but, usually, either schools of restricted curricula, as engineering schools, or single and narrowly limited departments of colleges of general and mainly liberal learning—is about fifty. The number of real trade schools prepared to give proper training, scientific and practical, in any one trade, is unknown to statisticians, but they are exceedingly rare, and a thoroughly representative trade school, like hundreds of those scattered all over Europe, is unknown. We have, perhaps, a dozen good manual training schools in the larger cities; but we have no system of carefully organized, complete and well-sustained schools of either class, supported by nation, by State, by city, or by any form of public or private permanent systematic effort.

"Such is the intimidating comparison, also, of the condition of our country and the more enterprising and wisely governed countries of Europe. The latter have had two generations the start of us, and only the extraordinary natural advantages of our country and the more extraordinary general intelligence and enterprise of its citizens can possibly prevent this disadvantage under which we labor telling fatally against us in the course of time when the inevitable competition of the world shall affect us."

On the other hand, every State is doing more and seeing more each year of the duty before it, and its importance, and the State universities and the independent colleges and schools are feeling their way constantly, though slowly, toward the solution of this tremendous problem. Our people are peculiarly well fitted to benefit by the opportunities which may be thus offered and to secure, in the interim, those kinds of training and those forms of knowledge which are the essential basis of the as yet incomplete technical system, and to compete with other nations at this disadvantage. The freedom of our institutions has engendered freedom of will and of intellectual action; and the free action of a thousand minds, untrammelled, though untrained, preserves us against dangerous rivalry from the better schooled but intellectually enslaved masses of the world outside. What will be the final outcome of the changes which are now slowly evolving an educational system in this country, and at the same time giving freedom and stimulus to European peoples, no one can predict. It can only be hoped that we may, in good time, have our own and an ample and efficient, "complete and perfect," system of education of our people for the life and the work of our people.

At the moment we have no system of suitable education of the nation, but we are making some progress toward the production of what is needed.

The character of our technical schools remains as yet as unsettled and various as the independent and far-separated points of origin permit. The State universities usually offer a few fairly well-defined courses in engineering and architecture and in the science and art of agriculture, and a few of the independent colleges stand beside them. The higher and lower literary colleges usually do but little in this field, and do that only under pressure and rarely well. The independent schools have as many standards of work as they have foundations. Some demand a good high school preparation; others only a few selected preparatory studies, and they, often, very elementary. Of the endowed schools some, as the Massachusetts Institute of Technology, are able to offer numerous courses in science and in the constructive work of applied science; others, as the Rensselaer Polytechnic and the Stevens Institute of Technology, elect to offer a single but strong course. Some approximate the technical university in their magnitude, extent and variety of work; the others, often denominating themselves engineering colleges, give a nondescript trade-school

course. A few, like the Pratt Institute of Brooklyn, the Cooper Institute of New York, aid thousands of artisans; others give costly instruction to the wealthy few.

We need, in every State, a technical university, or a technical school side to a university, in which the highest possible grade of professional school shall be maintained, and for all the professions based upon learning. Law and engineering, medicine and architecture, theology and agriculture, all have their scientific basis, and their highest provinces and grandest fields lie where only the highest scientific training and widest knowledge can make them satisfactorily productive of good. Their courses should be precisely adapted to the presentation of all modern science, and the best of contemporary practice, to educated and well-prepared disciples, by the great leaders of each. That only can be rightly called a learned profession which demands of all its practitioners a thorough familiarity with the science, as well as with the art of that vocation. The planning of courses taught in professional schools should be capable of being very exactly defined and adjusted to the needs of the profession. The courses of the now more common mixed schools are less easily prescribed.

We need a trade school, or a technical college, embracing trade schools, in every large city in the country. We should have at least one in each of the smaller States, and from two to four in each of the larger and more densely populated States. The East needs weaving schools and schools of industrial art to serve as a foundation for her manufacturing system and her decorative work. The West is in especial need of similar schools to stimulate the introduction of manufactures among her agricultural districts. The South is in want of technical and trade schools to give her material to introduce into her cotton mills and metallurgical works. All parts of the United States need many such schools where at the moment one exists. Manual training schools are required wherever boys and girls are growing up to lives in which industry and skill are their only ways to competence or even to security from an old age of poverty and suffering. There should be not less than ten of these schools to every Congressional district in the country; and they should be open to the poorest, offering instruction in all the trades to the boys, in all the domestic arts to the girls.

(To be continued.)

TEXTILE FIBERS.

SOME of the finest transverse sections of textile fibers we have ever seen have been recently shown to us by Mr. Abraham Flatters, Openshaw, near Man-

SCALE: THOUSANDTHS OF AN INCH.

1. Tahiti. 2. Brown Egyptian. 3. Orleans. 4. Rough Peruvian. 5. Maceio. 6. Scinde. 7. Lagos. 8. China. 9. Red Peruvian. 10. Extremes in 1-8.

chester, who is now devoting his time to their preparation. The difficulties lying in the way of the preparer of such subjects as these may be appreciated when it is remembered that the diameter of a cotton fiber may vary from $\frac{1}{1000}$ of an inch at the tip to $\frac{1}{100}$ at the base, and that the slices of many of the sections noticed herein are only the $\frac{1}{2000}$ of an inch in thickness.

Of cotton fibers there is a goodly selection in transverse section, accompanied also by several stained slides of the entire fiber, showing the endochrome and the full length of the staple. We have examined them all under the 8mm. Zeiss apochromatic objective of 0.65 N. A., and also by the 4 mm. objective (0.95 N. A.) of the same series, using the 12 and 18 oculars, and we can say with confidence that we have never examined specimens of such perfect preparation. The wood cut will give an idea of Mr. Flatter's work.

The slides of Peruvian are exceedingly instructive to all those interested in textile matters; the "rough" is cut in slices of $\frac{1}{1000}$ to $\frac{1}{2000}$ of an inch in thickness, and the "smooth" is somewhat similar, the sections showing all positions from apex to base, and containing specimens of "dead" or "unripe" cotton; the *bete noire* of many a dyer. The "red" Peruvian is cut somewhat thicker, and shows the deposit of endochrome in the inner tube. The Egyptian brown is another slide of this character, not only showing endochrome within the inner tube, but in many sections the cellulose substance is also colored. "Gallini" also exhibits a light yellow endochrome; while the best slides to show the accretion of cellulose within the investing membrane are those of Orleans and Texas cotton, which are splendid sights under the Zeiss 2 mm. apochromatic of 1.30 N. A., and the 12 compensating ocular. To those who have only studied the structure of the cotton fiber

under common objectives we advise a careful perusal of these remarks.

The slide of China cotton is a good specimen of well matured fiber, while the "Nankin" shows a yellow endochrome more intensely than even Egyptian brown. Among the East India cottons we have "Rangoon," "Comrawuttee" and "Hingunghat;" in African, "Lagos," while Brazilian is represented by "Ceara" and "Maceio," all these sections being cut to thicknesses varying from $\frac{1}{1000}$ to $\frac{1}{2000}$ of an inch.

There is a slide of "extra fine" Sea Island cotton, and also of "Tahiti," the latter being better than the former in point of excellence, from a microscopical point of view, showing as it does every point from "unripe" to fully matured, and a slight deposit of endochrome likewise. A section of 60's yarn and a section of bleached cotton stained with catechu concludes this series. In the latter the whole cellulose contents are stained brown, and the investing membrane made more apparent.

Among other textile fibers the transverse section of the stem of *Linum usitatissimum* shows the flax fibers *in situ*, while another slide exhibits the fibers when isolated. The stem of *Cannabis sativa* also shows the fibers *in situ*, the transverse section of the hemp fibers themselves making another slide in the series. The fibers of the *Corchorus capularis* (jute) have been very neatly sectioned, and exhibit great dissimilarity to the two former fibers. The *Bahmeria nivea* or china grass, known also as "Tchou-ma," or "Ramie," is shown by three very carefully prepared slides, the entire fiber, a section of the same showing it to be quite distinct from the flax, hemp or jute, and a longitudinal and transverse section of the stem of the plant from which the fibers are procured. "Silk cotton," raw silk, raw wool, mohair, and others will give the reader an idea of the contents of this useful series. Mr. Flatters prepares lantern slides showing the details of the foregoing textile fibers, extremely valuable to all those engaged in technical instruction; the slides are prepared on a micrometric background, and every detail has been so thoroughly considered in their preparation that we have felt it our duty to bring them before the notice of our readers.—*Chemical Trade Journal*.

THE FIRST PHOTO MECHANICAL REPRODUCTION.

By JULIUS F. SACHSE.

PROFESSOR S. R. KOEHLER, curator of the Section of Graphic Arts in the Smithsonian Institution, and director of the Museum of Fine Arts in Boston, Mass., questions our claim made in the *American Journal of Photography*, October, 1892, that to Joseph Saxton, of Philadelphia, is due the honor of making the first practical photo-mechanical reproduction used on a printing press. He even goes so far as to deny that the Saxton specimen was a photo-mechanical reproduction in the accepted meaning of the term.

Professor Koehler in his exhaustive paper states that "a photo-mechanical reproduction" is one for which the printing form has been made principally by the action of light, aided by etching, washing out, etc., without the intervention of the human hand except for corrections, elimination of defects, etc.

The second requisite is that the printing should be done by mechanical means—i. e., on a press. This second requisite the Saxton vignette as a matter of course meets, as it is printed from an intaglio plate on a roller press.

Then Professor Koehler goes on to state that the first requisite is not met. For even, he continues, "if the view of the mint should have been daguerretyped on the metal block used by Gobrecht for the die, which is impossible, as the character of the view shows, it still would have had to be engraved or sunk by the human hand."

Now, notwithstanding above opinion by the eminent authority as above quoted, the writer still adheres to the original claim as made in the *American Journal of Photography*, October, 1892, and subsequently repeated before the Franklin Institute. The facts of the case simply stated are: In 1841, Joseph Saxton, a well-known Philadelphia scientist, made a daguerreotype of the Philadelphia mint for the purpose of obtaining a printing plate for the title page of a book about to be issued. The daguerreotype was then placed in the battery, and an electrotype made of the original. This was then backed with soft metal, and separated from the daguerreotype. Gobrecht, the engraver, then took this intaglio and strengthened certain parts with the graver, so as to give the necessary relief. When completed, an electrotype was then taken from this corrected intaglio and backed, from which the plate was ruled, giving, as Eckfeldt says in the text quoted, "a faithful and beautiful transcript of the original." As a matter of fact, there was perhaps much less handwork done on the first electrotype than there is on many a Goupil photogravure of the present day.

Further, this result was a practical plate, from which a large edition was printed. It may be of interest to state in connection with this subject that an electrotype portrait made from a daguerreotype may still be seen in the Gutekunst rooms, 712 Arch Street, Philadelphia. It is dated 1853, and was made by Mr. F. Gutekunst personally.

In view of above facts, the writer certainly thinks that in all fairness the objections to the first requisite are disposed of.

Professor Koehler further states: "Leaving aside, however, the question as to the nature of the Saxton vignette, it is not true under any circumstances that it is 'the first photo-mechanical production' made in the year 1841. Nicéphore Niepce began his experiments looking to the making of printing plates, i. e., plates printable in a press, in the year 1813. There is still in existence a plate made by him from an engraving in the year 1824. This plate is preserved in the Museum at Chalon-sur-Marne, and an impression from it is on exhibition in the Section of Graphic Arts at the United States National Museum, Washington, D. C. It is but fair to state that there is a slight doubt as to the absolute correctness of this date, as Niepce Victor says that his uncle obtained plates made after the fashion of the one in question, 'since 1827.' The difference, however, is only three years."

This claim in favor of Niepce is not a new one. The

* Sibley College Reports.

facts of the case are as follows: The impression alluded to is a portrait of Cardinal Georges d'Amboise, minister of Louis XII. The plate from which the print was made is of block tin, and it is alleged was obtained as follows: The metal is said to have been coated with a solution of asphalt and Dippel's oil (obtained by the dry distillation of bones). Upon the coated plate was laid Briet's engraving of the cardinal, and after being printed in the sun it was fixed with a solvent, and then lightly etched with acetic acid. Afterward it was sent to Lemaitre, a celebrated Parisian engraver, to have the lines engraved and deepened, so as to give it a printing character.

The strangest feature about this story is that no one knew anything about either plate or print until its disclosure after a lapse of forty years, by Isidore Niepce, a son of Nicephore Niepce, in a letter to Fouque, dated March 10, 1867, who was then compiling his "La Verite sur l'Invention de la Photographie" (Paris, 1867). *Vide* also, Dr. J. M. Eder, Handbuch, Halle a. S., 1891, pp. 109-114.

There is certainly no comparison to be drawn between this alleged crude attempt of Nicephore Niepce, which, even if true, was of no commercial value, and the practical result obtained by Joseph Saxton, the Philadelphia scientist, in the earliest days of the dawn of photography.—*American Journal of Photography*.

VARNISHES AND VARNISHING.

DR. VALENTA has dealt rather exhaustively with this subject, and he points out that the heating of the plate—so much objected to by amateurs—is by no means essential, as cold varnishes are quite satisfactory, if made and used to the best advantage. He speaks first of those cold alcoholic varnishes which are mostly solutions of gum sandarac in alcohol; but as such a solution of sandarac in alcohol will give only a matt surface, these varnishes contain certain other additions. Such additions are oil of lavender, oil of citron, etc., and he gives in the following a formula for the production of such a varnish, which he has thoroughly tested:

Gum sandarac.....	18 grammes.
Alcohol.....	100 c.c.
Oil of lavender.....	1 c.c.

This varnish dries rather slowly, but gives a solid and only slightly sticky film, excellently suited for retouching. In this regard it is to be preferred to others, which, even after hours of drying, will leave impressions if touched by the hand.

He then speaks of cold varnishes containing ammonia. Such a varnish is, for instance, the "crystal varnish" of Durkes. These varnishes are easily recognized, even if no great excess of ammonia should be present; or if they are perfumed, as when heated, they will always emit fumes of the ammonia, easily discernible by its odor and the alkaline reaction of the gas. These varnishes are an imitation of ammonia shellac varnishes used in collotype, and contain mostly shellac as the resin. This gum, dissolved in alcohol, does not give a clear film if the plate has not been heated before, while an addition of ammonia will result in the formation of clear films even upon cold plates. The ammonia is added mostly after the solution of the shellac in alcohol has taken place.

For the production of such varnishes a solution of ammonia gas in alcohol is, according to his experiments, the most suitable; in this the shellac will only swell in the cold, but will dissolve easily to a clear, yellow liquid when slightly heated.

In the following he gives a formula for the production of such a varnish:

Alcohol saturated with ammonia.	100 c.c.
Shellac.....	8 grammes.

If the varnish is desired thicker, the quantity of the shellac can be increased up to fourteen per cent. The product on the market is made, as mentioned, by dissolving shellac in alcohol, and subsequent mixing with ammonia in aqueous solution.

Cold varnishes containing ether and acetone contain either sandarac or some other hard gum, and copal or amber, in which latter case they excel in quickness of drying and great hardness, while the cold varnishes of this kind containing sandarac are generally somewhat sticky for three to five minutes after flowing. In the following he gives a formula for the production of a very good rapidly drying and very hard cold varnish; 30 grammes angola copal and 5 grammes amber are powdered and mixed with

Ether.....	300 c.c.
Acetone.....	200 c.c.
Chloroform.....	10 c.c.

These gums are brought to a partial solution by prolonged standing in the solution, and shaking from time to time; or, what is simpler and quicker, the mixture is digested from one to two hours with the dissolving medium. A part of the gum will dissolve quickly, and a clear yellow liquid will form, which, poured upon glass, forms a quickly hardening, clear, and solid film, which is very good for pencil retouching.

Benzole cold varnishes generally contain sandarac or gum dammar. Varnishes prepared with the latter gum are always softer than the former. As these gums dissolve only with difficulty in benzole, artificial means must be employed, by treating first with alcohol, and then adding the necessary quantity of benzole. If proceeded with in this manner, clear varnishes are obtained, which furnish a solid; but, by employing gum dammar, a slowly hardening clear film.

A good formula of this kind is the following:

Benzole.....	90 c.c.
Alcohol.....	10 c.c.
Gum dammar.....	8 grammes.

This gum can also be applied to papers, and for this purpose a corresponding dilution is necessary. In such a varnish I have been able to trace a small addition of gutta-percha.

Collodion Cold Varnish.—Varnishes of this kind sold as crystalline, brassoline, or Zapon varnish mostly contain amyl acetate. They consist of pyroxyline which has been dissolved in amyl acetate and acetone with or without the addition of benzole, and sometimes camphor.

The quantity of amyl acetate in these varnishes makes the use of the same under certain circumstances very disagreeable; but they form very solid and well-adhering films.

Such a varnish can easily be produced by pouring 1,000 c.c. acetone upon 150 grammes pyroxyline, and then adding a mixture of 2,000 c.c. amyl acetate and 2,000 c.c. benzole.—*Photographic Work*.

A FEW CURIOSITIES.

JUST now, when the Columbian Exposition has attracted universal attention to so many strange people from out-of-the-way places, we feel sure that our readers will be much interested in the accompanying cuts

CAFFRE DOCTOR'S AMULET.

from Meyer's *Konversationslexikon*, for which we are indebted to our honored contemporary, the *Illustrirte Zeitung*.

The first of these engravings represents an amulet of the kind used by the charm doctors of the Caffres, a native race of Southern Africa. These people have no conception of a Supreme Being, but believe implicitly in witchcraft and the shades of their ancestors, swearing by the latter. Their charm doctors, rain makers and prophets exercise great power over them.

Other South African nations are represented by the

BATTA DANCING STAFF.

cuts of the Marutse dagger—which is more elaborately decorated than the amulet—and of the Herero woman's head-dress.

Another picture shows a dancing staff used by the Batta, that strange race of cannibals living in Sumatra. Cannibals are usually supposed to be men of no

intellectual development, but these have not only a very logical language, but also a written character. They write from left to right and their books are formed of the inner bark of a kind of palm cut into long strips and folded in squares, part of the wood being left at the ends to form the covers. But apparently this mental progress has not carried refinement or delicacy of feeling with it.

The cut of the Cingalese mask brings us to another

CINGALESE MASK.

people possessed of a rich language with a regular grammar. They have a literature that includes works on religion, botany, history and lexicography. These inhabitants of Ceylon, like their neighbors in India and the native races in China and Japan, are worshippers of Buddha. A bronze image of this god is shown in one of our engravings. As every one knows, all of these nations have attained a high degree of civilization, their industrial products being noted all over the world for their fine and artistic workmanship. This is exemplified by the picture of a glove, part of an East

MEXICAN STONE FIGURE.

Indian suit of armor. But some of the less civilized nations also possess artistic skill, as we may see by the cut of the Bashkir decoration, that constitutes a portion of the costume worn by the people of this semi-barbarous race that inhabits the territory lying between the Caspian Sea and the boundary of Siberia.

The other cuts lead us back to our own continent, giving us a realizing sense of the fact that it, too, has

MARUTSE DAGGER.

its antiquities, although generally called the "New World." One is a stone figure found in Mexico, and the other the ancient pyramid of Xochicalco. The construction as well as the carving of this pyramid differ considerably from those of other Mexican pyramids. No one knows who built it, or for what