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ABSTRACT

John Runkle, president of the Massachusetts Institute of Technology (MIT), viewed the Moscow Imperial Technical School exhibit at the Philadelphia Centennial Exposition of 1876 and saw the Russian method of manual training as the answer to the dilemma of combining theory and practice in engineering instruction. On August 17, 1876, shops in which all the mechanic arts needed by prospective engineers would be taught were established at MIT. As a result of the publicity provided by Runkle, manual training schools took root across the United States. The two most influential were in St. Louis (Missouri) and Chicago (Illinois). At Washington University, Calvin Woodward established the Manual Training School. His method of organizing instruction was so attractive that the St. Louis public schools took up manual training. At the time of its inception, the Chicago Manual Training School was the only independent educational institution of its kind in the world. Due to opposition from traditional educators who subscribed to faculty psychology (the theory that the brain consisted of faculties that could be strengthened through mental training) and who controlled the content of public education, manual training took hold first in private schools and at the elementary education level. Forces contributing to the demise of manual training were its association with the discredited theory of mental training, the novelty effect, and the increased demand for skilled workers and vocational education. (Contains 15 references.) (YLB)

MANUAL TRAINING SCHOOLS IN AMERICA

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If there is one thing Americans do really well, it's to throw a patriotic bash. And the Philadelphia Centennial Exposition of 1876 was no exception. It was a grand affair, this first centenary of American independence, intended to show the rest of the world how far America had come under capitalism and democracy. It was unprecedented also in that it connected a national celebration with an international exposition, thus identifying the independence and history of America with the industrial art and progress of the world.

It very nearly didn't happen because of scandals in the Grant administration, but in 1871 Representative H. D. Morrell of Pennsylvania introduced a bill creating the United States Centennial Commission, whose duty it was to prepare and superintend the execution of a plan for holding an exposition of American and foreign arts, products, and manufactures under the auspices of the government of the United States. This legislation gave the proposed exposition the prestige of a national enterprise.

The Centennial Commission chose Fairmount Park in Philadelphia (over the protests of other cities) as the location of the exposition. Philadelphia, they felt, was most associated with American independence. That being done, the Commission decided that $10 million would be necessary for the purposes of the exposition. A dollar amount was fixed to be subscribed by every state and territory; 16 foreign nations planning to attend also subscribed an appropriate amount ranging from $600,000 from Japan to $10,000 from Ecuador.

The exposition opened on a bright and sunny Wednesday, May 10, 1876. Representatives of the various nations were conducted to the speakers' platform during the

playing of their national anthems. Generals Sheridan and Sherman were greeted with cheers. Then the orchestra performed the Centennial Grand March composed by Richard Wagner.

After the opening ceremonies, the procession of dignitaries marched to Machinery Hall and surrounded the great Corliss engine (two cylinders, 2500 horsepower, 39 feet tall, 680 tons, and cost $200,000). The President of the United States and Dom Pedro, the Emperor of Brazil, simultaneously opened the steam valves of the great engine. It was now in motion and eight miles of shafting and hundreds of machines of every description were in operation, and the exposition was at that moment thrown open to the public and to the world.

Even though Tsarist Russia did not subscribe to the exposition, it did attend and, according to one observer, was only second to England in the size and variety of its exhibits. This same observer claimed that the most instructive exhibits in the Russian display were of machine tools made by the pupils of the Moscow Imperial Technical School. This school was for the education of contractors and engineers and was maintained by funds from a tax on capital, fees of foreign students, and profits received from articles constructed by the pupils.

The exhibits were full-size tools, implements, and parts of machinery constructed by the pupils at the school. They consisted of samples for imitation in learning wood turning, joining, and blacksmithing. The Russian exhibit would probably have gone unsung if it were not for one man: Dr. John Daniel Runkle, who was president of the Massachusetts Institute of Technology in 1876. Dr. Runkle is sometimes credited with being the founder of manual training, and M.I.T. with being the first manual training school, in the United States.

Dr. Runkle and his associates were struggling with the problem of rounding out the theoretical studies of the prospective engineer with the mastery of the practical details of tools,

machines, and processes, without unduly prolonging the period of training. Many large employers of M.I.T.'s engineering graduates did not consider them ready for engineering assignments until they had spent one or two or more years of apprenticeship in the firms' shops. Dr. Runkle saw the Russian method of manual training as the answer to the engineering instruction dilemma.

The distinctive characteristics of the Russian method, as viewed by Dr. Runkle were first, to separate entirely the construction shops from the instruction shops; second, to do each kind of work in its own shop; third, to equip each shop with enough places and sets of tools to accommodate as many pupils as the teacher could instruct at one time, and; fourth, to graduate the samples to be made in each shop in order of difficulty.

President Runkle was not the only M.I.T. representative at the exposition. On June 8, a 370 member party left for an encampment, called Camp W. B. Rogers, in Philadelphia. The party consisted of members of the M.I.T. Corporation, faculty, graduates, former students, and friends and members of the Institute. The University of Pennsylvania granted use of its campus for the encampment and the State of Massachusetts loaned the necessary camping equipment. The party returned to Boston June 23.

Upon his return to Cambridge from the exposition, Dr. Runkle set to work on plans for introducing the new methods of teaching at M.I.T. He recommended the establishment of a series of shops in which would be taught all the mechanic arts needed by prospective engineers. By vote of the Corporation of M.I.T. on August 17, 1876, the shops were established. In his report of 1877, Dr. Runkle said, "The plan announced in my last report, of building a series of shops in which to teach the students in the department of Mechanical Engineering and

others the use of tools, and the fundamental steps in the art of construction, in accordance with the Russian system, as exhibited at Philadelphia in 1876, has been carried steadily forward, and I have now the pleasure of announcing its near completion."

The Russian Government authorized the duplication of its Philadelphia exhibit for the Institute. A communication from George H. Boker, U.S. Minister at St. Petersburg, announced the gift to the institute of eight cases of models. The material was received the next year and the following resolution was passed by the Corporation:

That the Corporation of the Massachusetts Institute of Technology takes this opportunity to cordially congratulate His Imperial Highness, Prince Pierre d'Oldenbourg, that,at the Imperial Technical School of Moscow, education in the Mechanic arts has been for the first time based upon philosophical and purely educational grounds, fully justifying for it the title of the "Russian system." What, then, was this Russian system that so moved Dr. Runkle and the Corporation, where did it come from, who was behind it?

In 1826, Empress Marie of Russia decreed the opening of various workshops in Moscow. These workshops were for learning various trades and were to accommodate up to 300 orphans. On July 1, 1830, a statute was passed that changed the workshops to formal vocational schools, the first opening in 1832. The program of studies for this school took six years to complete: three years of preparatory classes and three years of vocational classes. Fifty of the 300 students were given a stipend of 70 rubles per year; they were the children of merchants, bureaucrats, and artisans. Pupils who completed the program of studies earned the "skilled master's" degree; those who did not complete the preparatory courses were granted a "master's" degree or "junior master's" degree. By a decree of 1868, the vocational

school was rededicated as the Moscow Imperial Technical School (now the Moscow Highest Technical Academy of N.A. Bauman).

The school was organized like most other postsecondary schools, with nine years of classes. The first three years were divided into three areas: machine construction, mechanical engineering, and manufacturing processes. The other six years consisted of general and specialized courses. In 1887, the school was transferred from Empress Marie's jurisdiction to that of the Ministry of National Education. In 1895, the ministry approved a new plan for the school which called for two technical areas: mechanical and chemical. The whole program lasted for five years. The school had such courses as God's Laws, Advanced Math, Physics, Chemistry, Anatomy, Physiology, Mineralology, Architecture, Geography, Machine Construction, Manufacturing Processes, Metallurgy, Political Economy, Geodesy, Statistics, Bookkeeping, Foreign Languages, Drafting and Art. The courses included experiments in physics, chemistry, mechanics, and natural sciences. Students were accepted into the academy if they had a diploma from a secondary school. Tuition was 75 rubles per year. Those who finished the program with top grades graduated as mechanical engineers; those who did not, as mechanics or technicians.

The faculty consisted of eleven professors and six assistant professors. The Inspector of Educational Workshops was in charge of workshops, while the state engineer was in charge of the physical plant. The director of the school was chosen by the Education and Artisan Committee.

The director chosen by the Education and Artisan Committee was one Victor Karlovich Della-Vos, who was responsible more than anyone else for the success of the school and for

devising the method of providing instruction shop activities to large numbers of students. Della-Vos was born in the Black Sea port of Odessa and was the oldest of seven brothers and sisters. As a child he liked to study and learned to read with almost no instruction. Until the age of seven, he spoke only Italian. On finishing Richelieu Gymnasium, he went to Moscow University, where he was accepted without examination because he came with such a high recommendation from his gymnasium. Victor Karlovich finished his education at the university in 1853, at which time he received his degree in physical and mathematical sciences. In that same year he carried out an agricultural experiment which earned for him recognition for outstanding work.

In 1854, Della-Vos began his career, which included teaching Russian at the Academy of Domestic Agriculture, and math and physics at Richelieu Gymnasium. In 1859, he was made principal of a school belonging to the Armenian Church in Odessa. Shortly thereafter, he was ordered by the Ministry of State Domains to go to Paris to study both the theoretical and practical aspects of machine tool building. During his stay in Paris, he attended lectures by the best professors of mechanics at a conservatory of arts and trades.

At the same time, be began working as a simple artisan in a factory and continued there for two years. He was "discovered" there by the Minister of State Domains who offered him a post at the newly reopened Petrovsky Agrarian and Forestry Academy as soon as Victor Karlovich was finished in France. After returning from Paris, Della-Vos was made a professor of mechanics in the Petrovsky Academy. In 1867, he was sent for five months to the Paris World Exhibition by the Ministry of State Domains; while there, he studied technical publications and bought various educational materials for the ministry.

On finishing his work in Paris in August, 1867, Della-Vos was made director of a Moscow vocational school. Then on July 1, 1868, he was made Director of the Moscow Imperial Technical School. He believed from the beginning that the workshop method of instruction was inefficient and too expensive, so he organized instruction shops separate from construction shops. In working out a system for these instruction shops, Della-Vos came upon his teaching innovations.

"Everyone is well aware," he believed, "that the mastery of any art--drawing, music, painting--is readily attained only when the first attempts are subject to the laws of gradation, the pupil following a definite method or school, and surmounting, little by little and by certain degrees, the difficulties encountered." Della-Vos and his colleagues set out to develop a similar method for the mechanic arts. They organized instruction shops for each art or trade, analyzed each into its component skills and arranged these in order. They combined drawings, models, and tools into a series of graded exercises by which each student could reach a required skill level. It was this system of graded exercises in instruction shops that caught the attention and fired the imagination of John Runkle and many other educators in the United States.

As a result of the publicity provided by Dr. Runkle's writing and speaking, manual training schools and manual training took root across the United States in cities like St. Paul, Indianapolis, Providence, Cincinnati (where it was called The Technical School of Cincinnati), Baltimore (the first manual training school to be supported at public expense), Toledo (coed), Philadelphia (the second public manual training school), and New Orleans (the Manual Training School of Tulane University.) But without doubt, the two most famous (and

influential) manual training schools were in St. Louis and Chicago.

Hail to the skillful, cunning hand!
Hail to the cultured mind!
Contending for the world's command,
Here let them be combined.

These words celebrating a combination of cunning hand and cultured mind have been attributed to William Greenleaf Eliot, Unitarian minister, civic leader, and founder of Washington University at St. Louis. When the state of Missouri granted a charter for an educational institution in 1853, practical education claimed a higher priority than traditional disciplines among the school's supporters. Eliot expressed this attitude in an address to the trustees in 1854: "I hope to see the time when that which we call the Practical...Department, will stand in the foreground, to give character to all the rest.... Its effect would be to elevate mechanical, agricultural, and mercantile pursuits, into learned professions. It would annihilate that absurd distinction, by which the three pursuits of Law, Medicine, and Theology, are called professions, and everything else, labor or trade.... It is the ignorance and not the labor, upon which society looks with contempt; but the ignorance, for the great part, is involuntary, and herein consists the hardship." To educate the laborer, or "mechanic" as he was called, was for Eliot an especially important mission for a school which would serve the great American West. The goal was not to give the mechanic a veneer of classical education, but rather, to develop practical education into a respectable discipline.

In 1854, evening classes for mechanics were begun in the O'Fallon Polytechnic Institute associated with Washington University but in 1868 the institute was transferred to the St.

Louis public schools. By 1870, Washington University was less involved with the manual training than it had been ten years earlier. And evening lectures and other traditional mechanics-school methods at O'Fallon were inadequate. Shop training catered to commercial interests; schools set up by industry reflected merely the processes of the industry. Clearly, something new was needed if the University were to make a contribution to practical education. That something was the St. Louis Manual Training School at Washington University.

Early in the 1870's, a new method of manual training was developed at Washington University. The force behind this new method was Dr. Calvin Milton Woodward. Woodward graduated from Harvard University with the Bachelor of Arts degree in 1860. After graduation, he was awarded membership in Phi Beta Kappa. In 1883, Washington University conferred on him the degree of Doctor of Philosophy. As a professor of mathematics in the university, he had occasion to teach a class in applied mechanics. Thinking to make the work more objective and more easily understood, he enlisted the aid of the university carpenter in arranging the necessary workbenches, tools, machines and materials for the construction of working models to illustrate the various mechanical principals. Students, however, were unable to construct the simplest models with carpentry tools.

With this background, it is easy to understand why Dr. Woodward was so impressed by the Russian exhibit at the Philadelphia Centennial Exposition. From the exposition and his own experience, he concluded that (1) all mechanical processes are capable of analysis into a few simple elements, "just as all the words of the dictionary are but combinations of the letters of the alphabet," and that the most efficient way for the learner to master these elements was

a carefully organized sequence before he attempts to combine them in the construction of useful objects, and; (2) the mechanic arts were capable of being organized for instruction purposes and taught in accordance with the same principles of teaching or learning that apply to science, mathematics, and other school subjects.

Almost from the beginning, Professor Woodward conceived of manual training as something that should be a part of the education of all boys, and not reserved simply for those fortunate enough to enroll in the engineering college. The Manual Training School of Washington University was established by action of the trustees on June 6, 1879 and opened its new building at the southwest corner of 18th St. and Washington Ave. on September 6, 1880 with an enrollment of about 50 pupils. By 1883, 195 pupils were enrolled.

Candidates for admission during the first year had to be at least fourteen years old and had to present a certificate of good moral character signed by a former teacher. They also had to pass an examination in arithmetic, common school geography, spelling and penmanship, and writing. The course of instruction covered three years and was about equally divided between mental and manual exercises. Daily sessions began at 9 a.m. and closed at 3:20 p.m. with time out for lunch. Each pupil had three recitations per day, one hour of drawing, and two hours of shop practice. The curriculum included courses in pure mathematics, science and applied mathematics, language and literature, penmanship, freehand, and mechanical drawing, and in tool instruction. Students completing the course of study received the diploma of the school.

It was not assumed that every boy entering the school would be a mechanic. Some would find that they had no interest in the useful arts and would pursue other careers. Some

would continue their education to become engineers and scientists. The grand result would be an increasing interest in manufacturing careers, more intelligent mechanics, more successful manufacturers, better lawyers, more skillful physicians, and more useful citizens.

By the school year 1914-1915, the school had grown to three buildings and had instituted an athletic program. Latin had been added to the curriculum for the benefit of students planning on going into traditional professions. Assembly rooms could accommodate 300 boys for recitation, exams, and study. A physics laboratory had been equipped by alumni and was named The George Warren Krall Laboratory to honor an instructor by that name. Drafting rooms, a forging shop, machine shop, molding shop, turning and pattern-making shop, and joinery and cabinet shop were equipped with the latest machines and equipment.

Dr. Woodward resigned from his academic position in February 8, 1910 in order to devote more time to writing and lecturing. He was 72 years old and had spent nearly 45 years at the university. He died at his home on January 12, 1914. The Manual Training School catalog of 1914-1915 contains this memorial:

> His clear vision saw the pressing needs of young men; his inspiring personality drew together the group of friends who made this school a success; his broad sympathies and wise counsel gave encouragement and intelligent direction to the thousands of young men who came within the sphere of his influence, and bound them to him for life.

His method of organizing instruction was so attractive that the St. Louis public schools took up manual training, and by 1915 were competing with the original school. In 1915, The St. Louis Manual Training School was combined with Smith Academy, a boys' preparatory

school, and in 1917 both were closed. Manual training, Washington University's greatest contribution to education in the 19th century, had passed into the public domain.

Manual's graduates proved to be very successful in their life's work, but they were a select group to begin with. Because the school had the reputation of being "tough," the faint of heart seldom applied for admission.

The Chicago Manual Training School at the time of its inception was the only independent educational institution of its kind in the world. Other such schools were departments of colleges or institutes of technology. The Chicago school was unique in another respect: it owed its origin entirely to laymen.

At its monthly meeting on March 25, 1882, the Chicago Commercial Club discussed the subject of reform in methods of education. The establishment of a manual training school was agreed upon and $100,000 pledged for its support. The club consisted of 60 Chicago merchants who realized that the destruction of the apprentice system would lead to a decline in American industrial power.

The Chicago Manual Training School Association was incorporated in April 11, 1883 and the cornerstone of the school building was laid September 24, 1883. Classes began February 4, 1884 with a class of 72 students selected by examination from 130 applicants. The object of the school as stated in the articles of incorporation was to provide instruction in the use of tools, with such instruction as necessary in mathematics, drawing, and English. Tool instruction included carpentry, woodturning, pattern making, iron chipping and filing, forge work, brazing and soldering, and machine shop. Time was to be divided equally between "manual and mental exercises."

The school building was located at the corner of Twelfth Street and Michigan Avenue and had accommodations for several hundred pupils. The mechanical department had 24 cabinet makers' benches, 24 lathes, a 52 horsepower Corliss engine, and two tubular boilers. The lathes, boilers, and engine were made especially for the school. The American Electrical Society donated nearly 500 volumes to the school. Pupils were able to obtain books from the Chicago Public Library "on unusually favorable conditions."

The trustees appointed Dr. Henry H. Belfield as director of the school. Dr. Belfield had long advocated the introduction of manual training into the Chicago public schools, in which he was a teacher and principal. He believed that the objective of the manual training school was to educate the mind, and the hand as agent of the mind. He was convinced that three years at a manual training school would give at least as much purely intellectual growth as three years of the ordinary high school.

Candidates for admission to the first year had to be at least fourteen years old, and present evidence of good moral character. They had to pass an examination in reading, spelling, writing, geography, English composition, and the fundamentals of arithmetic. The ability to use the English language correctly was especially desired.

Upon admission, students' laboratory work was evenly distributed through the three years of study. First year: carpentry, wood carving, wood turning, pattern making, and proper care and use of tools. Second year: molding, casting, forging, welding, tempering, soldering, and brazing. Third year: chipping, filing, fitting, turning, drilling, planing, and the study of machinery. Latin could be taken in place of English, literature, and history.

Throughout the course of study, one hour per day was given to drawing, and not less

than two hours per day to laboratory work. The remainder of the day was devoted to study and recitation. Before graduating, each pupil was required to construct a machine from drawings and patterns made by himself. A diploma was given on graduation.

The Chicago Manual Training School was given by its trustees to the University of Chicago High School in 1898, where it experienced the same evolution as many other manual training programs: from exercise work to the project method to the study of industry. It was phased out in 1988 when the shops were found to contain asbestos and the cost to remove it prohibitive.

Perhaps the finest testimonial to the Chicago Manual Training School came from Charles Bennett in his monumental study of the history of industrial education:

> It was the tenacious adherence to high standards of scholarship in the Chicago Manual Training School that, at a critical time, turned enemies of manual training into enthusiastic friends.

Manual training found its way into American schools at a crucial period in their history. Educators and writers were aware of schools' inadequacies to serve a rapidly developing industrial civilization, and to serve an achievement and democracy oriented populace having little in common with traditional standards of social and economic success. Study of European reformers supplied new methodology and our industrial activities supplied the content.

Manual training fought an uphill battle from the beginning, primarily with traditional educators who subscribed to the educational psychology of the day, faculty psychology.

Faculty psychology held that the brain was made up of a series of faculties that could be strengthened, like a muscle, with proper exercises called "mental training." Exercise was provided by certain subjects and the form (thus formal education) by which these subjects were presented. Thus, it was believed, the reasoning faculty could be strengthened by the study of Latin through memorization. Not surprisingly, then, educators like Runkle and Woodward stressed the mental training value of manual training. But many influential traditional educators of the day were not convinced.

In an 1882 debate before the National Education Association, Albert Marble, Superintendent of the Worcester, MA school system, stated emphatically that, "... the schools are to train boys and girls in those directions that are common to everybody, and one of the things that boys and girls ought to learn in those schools is how to get information from books. There is no information stored up in the plow, hoe handle [or] steam engine, but there is information stored up in books...."

William T. Harris, another influential traditional educator, in a debate with Calvin Woodward before the National Education Association in 1889, opined that "putting the whole boy in school" was a dangerous reincarnation of Rousseauism, one that failed to distinguish between the higher and lower faculties in individuals. To teach a child carpentry, Harris warned, was to give him a limited knowledge of self and nature; to teach him to read was to offer him the key to all human wisdom.

With this kind of opposition to manual training by traditional educators who controlled the content of public education, it is not surprising that manual training took hold first in private schools and at the elementary education level. The success of manual training in these

school made it possible for public school advocates of manual training to point out that it was no longer experimental, had educational value, and that public funds could be legitimately used to support it in the public secondary schools.

While traditional educators opposed the introduction of manual training, they had little to do with its demise. Several other forces finally laid to rest manual training as a discipline and as a program title. Manual training tried to associate itself with mental training, which was based on faculty psychology. When faculty psychology was discredited and replaced with other theories of how we learn, mental training was likewise discredited, and with it manual training.

As manual training matured, questions arose about its organization, methodology, and content: should it produce narrow skills to produce factory employees or wider skills to produce journeyman mechanics? Should it dictate the steps of an exercise for students to follow or provide problems to be analyzed and solved by students? Should it be staffed by artisans trained to teach or teachers trained to be artisans. Should there be manual training schools or manual training in schools? Should it be mandatory or optional?

Another force contributing to the demise of manual training was the novelty effect. When the novelty of manual training wore off, students' interest waned and they began looking for something new. Industry interest diminished as it saw that manual training was not a source of cheap labor to break the unions, while unions saw manual training as an attempt to produce scabs. But the thing that contributed more than anything else to the demise of manual training was the need for skilled workers.

By the opening of the new century, the shortage of skilled labor was as acute as ever

after 20 years of manual training. There was a renewed agitation for "real" vocational education for the trades. Leaders in manual training began once again to promote the vocational values of their field. The promotion took the form of insistence on "factory methods" in shopwork, organizing classes into groups with a foreman over each group, the proper routing of materials through the shop, and to use more group projects and fewer individual projects. Teachers were urged to make closer contact with industry, use field trips to factories as a primary part of their courses, and to use factory methods of record keeping.

Manual training educators had been forced to deny the vocational value of manual training in order to make it palatable to traditional educators. But Calvin Woodward, who in 1890 denied that manual training had any connection with vocations boasted in 1903 that "... by multiplying manual training schools we solve the problem of training all the mechanics our country needs." And so it was that manual training bifurcated into what became vocational training, and manual arts, which became industrial arts which has become technology education. All of which are remembered fondly but erroneously by many as "shop."

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