

of the problem to be solved, and what quality is more valuable to any construction engineer than the ability to visualize a contemplated piece of work? Topographical surveying was found in cases to be not thoroughly understood, yet in what branch of the profession is ability to interpret topographical maps not necessary? It has seemed at times as if the whole scheme of the education had been at fault, that the scholars had never been compelled to tackle the tasks set and do the allotted work as a duty, whether congenial or not, and further, that the foundation of all, the general knowledge that every man who wants to attain success must have, was lacking. I wish you would think of these things. Is it not better to have the mind so trained that it can grapple unafraid with any problem, than to start life with only a smattering knowledge of certain applications of partially understood laws? The courses of study at the schools are for two distinct purposes, one to train the mind and the will for work, and the other to furnish the useful tools for doing the work. The memorizing of certain facts is of little value. The ability to do certain things in a certain way without knowing clearly why that way is best, or even if it be the best, is poor preparation for an engineer. The study of accomplished engineering work has the same value as the study of history; it is experience acquired at second hand, but to be most valuable, failures should be studied along with successes. The development of mankind as portrayed in general history is a picture of a struggle upward with many slips and falls, but nevertheless with a continued advance.

Same Strategy, Different Tactics

It is a saying well known to students of military affairs that strategy is always the same but tactics vary. In other words, the fundamental principles of the science of war always remain the same, but the methods of applying these principles vary through the ages in measure as the advancing knowledge of nature's laws forges new tools for the soldier's use. The better knowledge of chemistry and of metallurgy are the main causes which make the fighting methods of this war different from those of earlier wars. Have you ever thought of a ship as a truss, which must have a certain limitation of depth on account of the natural limitations of our harbor entrances but whose length (and consequently the cross section of the ship) is limited by the qualities of the materials which are available? So with our guns. Increased chemical knowledge gives new and more powerful explosives. Advances in metallurgy make it possible for these explosives to be utilized to the greatest advantage. Improvements in the vehicles of transportation, in the paths in which they travel and in the means for the transmission of orders, make possible the handling of men in larger bodies and on larger battle fronts. In all lines of endeavor required by war, the influence of the advancement of human knowledge makes itself felt, and those charged with the responsibility of defending the nation's life must be constantly alert to take advantage to the fullest extent of the advancements in human knowledge. In military engineering, the officer entrusted with certain work must obtain beforehand all the information he can. He must study the surroundings, take into full account the character of the tools and supplies available, and must know the number of men whom he has to carry out the work, as well as their individual abilities. He must then lay out the plan he hopes to follow, estimate probable difficulties to be met, and be ready to change this plan at short notice and adapt it to unexpected happenings. All this means that he must be thoroughly trained in the art and craft of his profession, so that when trouble occurs his mind will work in part intuitively and he can see quickly the best course to take and will be prepared to follow it and carry it through. All this involves a long and special training and a quickness of view and decision which are vital to the success of his work, especially in war.

The same principle holds good in civil engineering, in which the general principles of mechanics and construction remain unchanged, but the processes must vary with the character of work to be done, with the condition of the labor

market, with advances in machinery and methods of doing work, etc. This is exemplified particularly in those works in which the great forces of nature must be opposed, or made obedient servants for the accomplishment of a desired result, as in river and harbor improvements. The chief enemies are the weather, storms and floods, and often an uncertain supply of labor and a long distance from a base of supplies. While the civil engineer does not often have to make the instant decisions of the military engineer engaged in actual war, he must, nevertheless, follow the same path in carefully planning his work ahead, must see that one part in the programme will not delay or overlap another, and must have behind him a general knowledge of construction and an experience in the special work he has in view which will enable him to meet and decide the unexpected and drive the work ahead. In both cases—the civil and the military—the chief requisite to success is the careful study and choice of a suitable plan of work and the ability to meet the changes in conditions which always come.

Many Problems the Same

Again, the problems connected with the organization, care, training and use of large bodies of men are similar in both military and civil engineering work. The greater the hazard, the greater the need for discipline. The larger the force, the more elaborate must be its organization. The more active the opposing forces, the greater the need for the training which makes the doing of the necessary thing intuitive. Discipline is probably the most essential factor for efficiency where large bodies of men must act in co-ordination in a hazardous work. The will of each man must be subordinate to that of his commander. What may be the right thing to do from the viewpoint of the subordinate might be disastrous from the broader vision possible to the commander. This subordination of will must be sharply distinguished from the blind doing of what is directed. Intelligent initiative must always be cultivated, for each man is allotted a definite field of responsibility, and within that field he must be prepared to act promptly and intelligently.

Before a man can consider himself a real soldier he must have acquired a self-mastery which will make him intuitively ready to obey loyally and at the same time to command effectively. This comes only after long and hard training. Donning a uniform, with or without shoulder straps, and knowing something of military drill does not make a soldier. Soldierly qualities may be cultivated in ordinary school life—with or without strictly military drills.

Through the ages there has developed in all nations a system of training and of customs designed to aid in the installation and cultivation of discipline. The courtesies demanded between soldiers is one of these aids. Military courtesies in final analysis prove to be the same as those that should prevail in civil life between the young and the old, between the young man starting in life and the man who has already achieved distinction in his fulfilment of life's duties. In civil life, unfortunately these courtesies are too frequently neglected. In military life they are enforced. In the army, rank is assumed to be the mark of distinction, and the junior pays deference to the rank of the senior. The obligation of courtesy is the same for each, but the salute must be made first by the junior. Mistaken views of democracy have led at times to attempts to do away with this observance of the difference of rank and of the deference due to rank. It was tried at the beginning of the French Revolution. Necessity soon caused the revival of the law. It is being tried now in Russia. What has been the effect on her armies?

Largest Force to Accomplish Single Purpose

An army constitutes the largest force assembled by man for the accomplishment of a single purpose, and the accomplishment of that purpose involves hazards greater than those of any other human endeavor. Hence, in an army, discipline, organization and training must be carried to the highest degree. With the great number of men gathered together for a single work, come increased problems of supply and care. The sanitation must be supplied as needed and in sufficient quantity. To supplies of this character must be added supplies in enormous quantity of all the kinds and