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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

TRADE AND HIGHER EDUCATION.

In this latter-day eagerness for supremacy in the markets of the world, it is often charged that, in this country at least, education and the intellectual pursuits which go to make up the higher culture are sacrificed to purely utilitarian considerations—in other words, seeking after gain. That this is not the case may be proved by an appeal to educational statistics. There were, during the scholastic year 1898-99, some 147,164 young men and women pursuing undergraduate and graduate courses at our universities, colleges and schools of technology. Of this number only 43,913 were enrolled as professional students in law, medicine and theology, leaving 103,251 pursuing studies in the liberal arts and applied sciences. In 1880 the number of students was 119,340, and in 1890 118,581, so that the educational advantages and the number of those who embrace them is on the increase, being in direct ratio to the upward trend in our national wealth.

To provide proper educational facilities was one of the first matters which engaged the attention of the founders of our country. Each of the colonies established in the seventeenth century took measures, more or less effective, to provide schools for the children. The Dutch West Indies Company in 1621 charged its colonies to maintain a clergyman and a schoolmaster. There were private schools in the Virginia colony at an early date, and most of the wealthy planters employed tutors in their families. The Governor of the Connecticut colony reported that one-fourth of the annual revenue of his colony was expended in maintaining free schools for the education of the children. Boston had schools as early as 1635, and they were also established in Rhode Island in 1650. With the growth of cities there began the improvement of the schools, the separation of the children into grades, educating primary children of the first year in one class, and those of the second year in another class. Facilities for higher education were not wanting. Harvard was founded in 1636; William and Mary College in 1660; Yale in 1701; Princeton University, then known as the College of New Jersey, in 1746; the University of Pennsylvania in 1751; Columbia University in 1754; Brown University in 1764; Dartmouth College in 1769. Others followed, so that by the year 1800 there were 24 colleges in the United States—8 of them in the New England States, 6 in the Middle States, and 10 in the Southern States. The early legislators, Washington, Madison and John Adams, all used their influence to forward the cause of education, and particularly of higher education. The government assists institutions in various ways, although the actual amount of money which is appropriated is small and most of it goes to agricultural colleges. Still, however, it has made large grants of land from time to time, aggregating in all 13,000,000 acres. A new seat of learning, to be called the Washington Memorial Institution, has recently been organized, both as a memorial to George Washington and to increase, in the Capital of the country, opportunities for higher education as recommended by our first President in his various annual messages to Congress, and to facilitate the utilization of the scientific and other resources of the government for the purposes of research and higher education.

To-day there are 629 universities and colleges and 43 schools of technology in the United States. The total value of the property possessed by institutions for higher education amounts to $342,888,361, a gain of about $31,000,000 over the amount for the preceding year, 1897-1898. The endowment fund amounts to $154,120,590, and the remainder represents the value of grounds, buildings, machinery, apparatus, libraries, etc., used for instruction and research. The total income for the year, excluding benefactions, amounted to $27,739,154 derived from the following sources: Tuition and other fees, $10,924,415; endowment funds, $6,673,389; state and municipal appropriations, $4,287,102; the United States Government, $3,276,731, and from other sources, $2,577,517. The value of gifts and bequests during the year 1898-1899 amounted to $21,925,436. The amounts reported by some of the institutions are as follows: University of California, $757,000; Leland Stanford Junior, University, $11,000,000; University of Chicago, $786,624; Harvard University, $1,544,330; Columbia University, $518,667; University of Pennsylvania, $510,658; Armour Institute of Technology, $750,000.

From these figures it will be seen that our plant for educational purposes is of enormous value and its efficiency is all that could be asked for. In reality some $2,500 is invested for each student who is now enjoying the advantages of any of the institutions of learning, and the work of the graduates of the last two generations shows that our money has been put out at compound interest.

It must not be supposed that all the students, however, are devoting their energies to the very serious problem of fitting themselves for their life work. On the contrary, the majority are pursuing courses which will not materially assist them to earn a living, but which have, of course, an important bearing as regards culture on their future lives. Classical courses claim by far the greater number of students: 35,595 students out of the 147,164 were pursuing such courses, while 21,860 were taking the general culture courses, 9,858 took general science courses, 2,593 received instruction in agriculture, 4,376 were taking courses in mechanical engineering, 2,550 in civil engineering, and 2,320 in electrical engineering; 1,032 students were studying mining engineering, 627 architecture, 9,501 pedagogy, and 6,698 were taking business courses.

Approximately the same figures hold when degrees are considered. Thus the number of degrees conferred during the year for work done was 15,087—10,794 being conferred on men and 4,293 on women, as follows: The degree of Bachelor of Arts leads, with 4,910 men and 1,950 women; then came Bachelor of Science, with 2,410 men and 500 women. The Master of Arts degree came next, with 1,046 men and 197 women. The degree of Doctor of Philosophy was conferred on 299 men and 26 women. Thirty-eight different varieties of degrees were conferred, and in some cases only one candidate received a degree, Musical Doctor, for example. Seven hundred and thirty-five honorary degrees were conferred.

The ratio of students to population is an interesting study. In 1872 the number of students to each 1,000,000 persons was 573; in 1880 it had increased to 770, in 1890 to 850, in 1893 it had increased to 1,037, while in 1899 the number was 1,196. These figures show that the increased prosperity of the country has a very direct effect upon education. When the splendid gifts which have been made to the cause of education in the last ten years are considered, it may safely be said that the desire for gain does not blind our wealthy men to the advantages which accrue to the country by reason of superior educational institutions.

"SHAMROCK II" AND "COLUMBIA" COMPARED.

For the first time in the history of the America Cup races it has been possible to get a line upon the two boats which will meet off Sandy Hook; for we take it for granted that unless "Constitution" can be brought to the point in which she can beat "Columbia" in a wind of more than 7 knots' strength, the older boat will be called upon for the second time to represent this country in the famous contest. In 1899 "Columbia" met "Shamrock I." nearly a dozen times off Sandy Hook, and during the present season "Shamrock II." has been tested against the old challenger in numberless trials under all possible sailing conditions.

In the present uncertainty as to "Constitution's" full capabilities, we must take "Columbia" as a basis of comparison. In 1899 she beat "Shamrock I." by 10 minutes in an average 8-knot breeze, and again beat her by 6 minutes 16 seconds in a breeze of about 20 knots an hour. Both of these races consisted of windward and leeward work with no reaching. It is generally admitted, both here and in England, that "Shamrock I." suffered somewhat from poor handling, and much more from the fact that her spars and standing rigging were too frail, and failed to keep the sails up to the wind. The only changes, we are now informed, made in "Shamrock I." preparatory to her trials with "Shamrock II." were to reduce her sail-plan and greatly strengthen and stiffen her spars, with the result that her sails set admirably and she no longer carried a lee helm. As the result of the improved set of her sails, her better helm, and the fine weatherly qualities she developed, the experts who have had charge of her trials have assured the writer that she is at least 5 minutes faster over a 30-mile course, the gain being chiefly in windward work. To this may be added a possible gain in speed due to the better handling which she received under her new captain.

In the later trials of "Shamrock II.," when her best trim had been determined, she beat the older boat by the following carefully-timed amounts in good wholesail breezes: Going to windward she gained 3 minutes in 13½ miles, the boats having split tacks to avoid interference; going to leeward in a 17-knot breeze she gained 4½ minutes in 13½ miles, "Shamrock II." being the leading boat; while on a broad reach in a 13-knot breeze, with the wind slightly abaft the beam, she gained 4¼ minutes in 7 miles. This last is certainly a remarkable performance in view of the fact that "Shamrock I.," in a tuning-up trial down the Jersey coast and back, reached for 30 knots at a speed of 13 knots an hour. These results would indicate that "Shamrock II." is about 12 minutes faster in a club-topsail breeze than "Shamrock I." in the form that the latter showed when over here in 1899.

It is reasonable to assume that another season's experience on the part of the very able skipper of "Columbia" and his crew have enabled them to get a few minutes more speed out of "Columbia;" in which case we may look for a contest, should "Columbia" be chosen, which will be worth going far to see. The question of the absolute security of the Cup is dependent just now, evidently, upon what further speed can be developed in "Constitution."

DANGER TO ST. PAUL'S CATHEDRAL.

It is seldom that modern building operations and engineering works injure a great edifice; so the news that St. Paul's Cathedral, in London, is in danger comes as a painful surprise, for it is one of the most celebrated buildings in the entire world. The report of the architect to the Dean and Chapter states that St. Paul's is cracked from top to bottom, and while the present damage can be readily repaired it shows a condition of affairs which is really alarming. Sir Christopher Wren built the cathedral after the great fire of 1666, when the older Gothic building was destroyed. Unfortunately for his fame as an engineer he failed to drive piles or to excavate deep enough to place its foundation on a firm sub-soil, so that he practically floated the cathedral on a layer of fine clay, or "pot-earth," as he was pleased to call it, resting on a strata of sand mixed with gravel and water; but he knew of the existence of a bed of hard clay some 40 feet below the surface, but did not carry his foundation so far down, owing probably to the smallness of the available funds. It would have been wise, however, to have built a slightly smaller building on a more suitable foundation. The cathedral, with its great dome, has successfully stood for centuries without perceptible damage, and if it were not for the great excavations which have recently been made in its vicinity it would probably remain in its pristine state. Sewer after sewer has been built, causing the foundation to settle. The old underground railway tunnel was some 500 feet away, and this also had its effect, but it is a later tunnel which has caused the present perceptible and alarming damage.

A number of borings have been made for a new underground line on the south side of the cathedral. It is to be hoped that means will be found to alter the course of this line, so that the noble example of Sir Christopher Wren's work may remain intact.

MODERN STRUCTURAL STEEL.

It is the popular idea that steel is a hard, polished metal like a dagger or a razor, and capable of carrying a cutting edge, but there are steels of various kinds that do not possess the qualities mentioned. Structural steel, for example, such as beams, girders and rough-rolled bars, generally has a much higher tensile strength, elasticity and tenacity than iron, and yet, in physical constitution and external appearance, it differs but slightly from it. Of two bars, one iron and the other steel, put through the same rolls at the same heat, not even an expert could distinguished one from the other if they were laid side by side. Moreover, careful analysis fails to discover the line of actual departure between steel and iron in the lower grades of each metal, or where the metal commences to be steel, so to speak, and stops being iron.

But as between the two metals, iron and steel, there is a vast difference in their endurance and ability to stand severe work, and modern engineers have a very great advantage over their predecessors of half a century ago in the possession of it. In modern open-hearth and other process-steels the amount of fatigue or continuous resistance to crucial strains of long duration which they will endure is simply astonishing—not laboratory, or test-machine strains, but the downright pounding and flogging of daily work, which is far more serious than any testing machine can deliver. This last sets up a certain stress in a straight line, gradually increasing up to failure under it; but the duty imposed upon steel by daily work in a high-speed engine, for example, is not only to resist tensile strains, but torsional and transverse burdens at one and the same time.

Consider the case of a 30,000 horse power marine