THE UTILITY OF MATHEMATICS

It is not without great surprise that we read of the efforts of modern "educators" to expunge the study of mathematics from the scholastic curriculum.

It is logical, and consistent with an already incomplete, unsatisfactory program, for the State to exclude religious instruction from the free public schools. The proscription of the study of the German language in the schools is consonant with the existing antipathy for all things German. But who has weighed mathematics in the balance of honest investigation and found it wanting?

Two American soldiers training for the great conflict "over there" visited a book shop. One purchased a German grammar. His companion severely reprimanded him for his apparent weakness, and eloquently proclaimed the uselessness of studying German. "Well," said the first soldier, "you will be in an awful fix when you reach Berlin." Without a working knowledge of the German language the victorious Allies will, indeed, be at a great disadvantage when the present drive shall have led them into Germany on the road to Berlin. But what a rocky road to Berlin! The vandalism of the retreating Hun is obstructing that road by the wanton destruction of cities, towns and villages, with their churches, bridges and every other architectural triumph of constructive engineering.

The damage must be repaired when the war is over. It will require the careful work of skilled engineers. Was there ever an engineer who attained success without the aid of mathematics? The war has wrought havoc and destruction wherever the tents of battle have been pitched. The heart of Europe has been eaten out, and must be replaced. The third decade of the twentieth century will be a renaissance, a reconstruction of devastated Europe. Plans for this work of regeneration must be drawn and put into execution by engineers who have a thorough knowledge of mathematics.

The war itself has proved the great utility of mathematics. The aeroplane, the submarine, the "tank," and all the instruments of modern warfare are the products of scientists who, unaided by mathematics, could have accomplished nothing. Modern warfare, it is estimated, is seventy-five per cent engineering and only twenty-five per cent military.

Aside from the consideration of the business of war, the commercial world is heavily indebted to mathematical science. Viewed in this light, mathematics is seen to furnish the rules of art which make knowledge practically effective.

It must not be concluded that the enormous importance of mathematics lies solely in the indispensable service it renders to the scientific and commercial world. The study of mathematical science is useful primarily as a means of intellectual training and culture, regarded as the drill-master of the intellectual faculties—the power best adapted to bring them all into order—to impart strength, and to give them organization. Secondly, mathematics affords facilities for the acquisition of knowledge, true science. It furnishes man with the keys of hidden and precious knowledge. The third argument for the great utility of mathematics is that previously suggested, namely, its influence on manufactures and engineering, in so far as it is the best means of carrying into the business and practical affairs of life the conceptions and deductions of science.

We are indebted to mathematical science as a means of intellectual training and culture even from childhood. After learning to lisp a prayer dictated by a loving mother, the child begins to count his toes, accompanying the task with a suitable rhyme. Thus the idea of number is first presented to the mind through sensible objects; but, when once clearly apprehended, the perception of the sensible objects fades away and the mind retains only the abstract idea. The child dispenses with the abacus of his fingers or his marbles and employs only the abstract ideas, which his mind embraces with clearness and usese with facility. A word of a certain number of definite letters of the alphabet is presented to the child as the name of a visible object; but, no sooner are these ideas obtained than the mind loses sight of the things themselves and operates entirely through the instrumentality of symbols.

Thus it is with geometry. A straight line is first represented by a black line on paper or a chalk mark on a blackboard, to impress the geometrical definition that "a straight line does not change its direction between any two of its points." When, however, the mind clearly apprehends this definition, it needs no further aid from the eye, for the image is forever imprinted. In a similar manner the mind abstracts from real objects the ideas of a plane, of a solid, and, quite simultaneously, the idea of space.

Although quantity, in its general sense, is the subject of mathematical inquiry, nevertheless the language of mathematics is so constructed that its investigations are pursued without the slightest reference to quantity as a material substance. The symbolical language of mathematics is an exact language; exact language prevents error. The origin of a large portion of the errors into which we fall is found in the incomplete, inexact sense of words. Mathematical science, in requiring a strict use of language, is free from such errors.

Truly, mathematical science is an efficient means of imparting strength and of giving organization to the intellectual faculties.

This is evident when we consider the two ways in which we can increase our knowledge. First, we get and settle in our minds determined ideas of those things whereof we have general or specific names. This is precisely the task accomplished in mathematical science, in which the ideas are all impressed on the mind by a fixed, definite, and exact language, and embraced by the mind as so many clear and distinct images or pictures with names suggesting at once their characteristics. Secondly, we select those ideas which show the agreement or disagreement of ideas already determined, obtaining new ideas resulting from the combination of those that are known. Mathematics offers the surest means for such organization of ideas. Its reasonings are based on self-evident truths, and are conducted by means of the most striking relations between the known and the unknown. These self-evident premises lead to irresistible conclusions. It is the demonstrative force of this science which educates and trains the understanding.

Mathematics, therefore, seems indispensable as a means of intellectual training and culture. By the careful study of this science the mind is trained to form clear conceptions of things, and to establish clearly the relations of definitions and things. It fosters and promotes the use of exact language. The science of mathematics employs no definition or axiom not evident and clear; no principle or truth is taken for granted. But every link in the argument is immediately connected with a definition or axiom, or with some principle previously established. The order established in presenting the subject to the mind aids the memory at the same time that it strengthens and improves the reasoning powers. Consequently, any proposition may be traced

to first principles, its dependence upon and connection with those principles made obvious, and its truth established by certain and infallible argument. Finally, the demonstrative argument of mathematics produces the most certain knowledge of which the mind is susceptible. By the application of the infallible rules of logic to self-evident truths it establishes conclusions that may be relied upon for verity; and the knowledge thus gained is science in its true sense.

The study of mathematics tends to raise the mind from the servility of imitation to the dignity of self-reliance and of self-action. A word of caution must, however, be noted. Mathematics is not the panacea for all mental difficulties. Like all things human, it has certain limitations. We cannot, for example, look for a mathematical demonstration of all the truths of Philosophy and Religion. In certain revealed truths an ounce of faith is worth a pound of mathematics.

We now come to consider the second great advantage derived from the study of mathematics; that is, it gives man the keys to hidden and precious knowledge.

It is in the investigation of the laws of nature that mathematics finds its largest range and its most striking applications. The entire plan of nature is governed by general laws imparted by the eternal fiat of Him who created all things; and man possesses the faculty to investigate and understand these laws.

Man discerns the laws of nature from experience, aided by observation and enlightened by experiment. Facts thus obtained are analyzed, and general laws inferred by the reasoning process called induction. General laws, extracted from many separate cases by induction, need additional proof, for they might have been inferred from resemblances too slight, or coincidences too few. Mathematical science operates on the formulas established by induction; it not only verifies the truths of induction, but also unfolds new truths, previously hidden from experiment and observation.

The usefulness of the essentially deductive character of mathematics is shown clearly in its application to the sciences of astronomy, physics and chemistry. The science of mathematics is the medium through which the mind may view, and thence understand, the component parts of the physical universe. It makes manifest all its laws, discovers its wonderful harmony, and displays the wisdom and omnipotence of the Creator. It

assures us that the universe has not been abandoned to blind chance, but that a governing Providence is ever present to effect the divine decrees of eternity.

The third advantage, which has been proposed above, seems the one favored popularly by the majority of educators. It is probably the one thread which holds many to continue instruction in mathematics. It is that phase of the science of mathematics which makes it immediately applicable to every-day life in the business and commercial world.

In this sense mathematical science furnishes the rules of art which make knowledge practically effective. Here the term practical is to be taken in its true meaning, the realization of the true ideal, the development into actual existence of the concepts of the mind. It is opposed to the common acceptation of the term which signifies a short cut to useful knowledge, and which implies the use of knowledge before its acquisition, the substitution of a handbook for the results of hard study and laborious effort.

The practical utility of arithmetic, the fundamental branch of mathematical science, is witnessed daily when the child, by its aid, numbers his toys, the housewife her accounts, and the merchant and the banker sum up their daily business. Arithmetical numbers exhibit the results on the stock exchange. The mechanic and artisan express the result of their calculations in figures before the work is begun. The mason and carpenter compute and adjust their work by the rules of practical geometry.

The rules and practise of all the mechanic arts are but applications of mathematical science. Ingenious and skillful exhibitions of complicated machinery in workshops and factories are the embodiment, by intelligent labor, of the most difficult mathematical investigations.

The discoveries of mathematics have made it possible for vessels to cross the ocean on a definite course in safety. The necessity of measuring land and determining its ownership gave rise to geometry and surveying. A knowledge of trigonometry was also indispensable. Railroads and mining engineering, in which our country leads other nations, are most striking applications of practical science in which mathematics has proved not only useful, but absolutely necessary.

We who are living in the twentieth century cannot sufficiently appreciate the tremendous service which mathematics

has rendered to civil engineering in our day. "Skyscrapers," bridges and tunnels are monuments illustrating the power, and celebrating the triumphs of mathematical science. All these great, practical achievements are the result of an antecedent ideal which had its origin in mathematics.

Great would be the loss to humanity if our text-books of mathematics should be left to the mercy of bookworms on the forsaken shelves of our libraries; rust and decay would form upon the wheels of progress if the study of mathematics should fall into desuetude in our schools.

—Innocent Smith, O. P.

A PSALM OF PENITENCE

Like Magdalene, O Lord, I come to kiss
Thy sacred feet and bathe them in my tears!
O God, I now repress my foolish fears;
And, oh, for all that I have done amiss
I ask Thy pardon, and Thy grace to give
My life, my being, and my all to Thee!
Oh, teach Thy foolish prodigal to be
Thy humble servant while as yet I live!

Oh, let me sing my psalm of penitence
And ask Thy pardon for my bold misdeeds,
For Thou alone dost know mine inmost needs,
And only Thou canst pardon mine offence.
Oh, let me sing Thy praises tho' I am
Not worthy thus to praise the spotless Lamb!

—Chrysostom Kearns, O. P.