which after all, is but an atom of the universe, directed by the pure light of mathematical science, we behold the gorgeous majesty of the Heavens, and the conviction of *God's* existence, strikes us with the certainty of demonstration. By this science alone does the universe give a clear reflection of its Creator's power. To the unmathematical observer, the mechanism of the heavens is shrouded in obscurity, or stamped with imperfections.

A superficial view of its architecture, may produce a doubt of its perfection as the work of an infinite intelligence, since it appeais to be marked with variations, which threaten its stability. But seen under the light of mathematical science, every change becomes constancy; every diversity, uniformity. The supposed irregularities which characterize the motions of the heavenly bodies, are shown to be the necessary consequences of the great commanding law, established for the government of the universe, and, instead of indicating instability in the system of worlds, are absolutely necessary to preserve it from dissolution.—While, therefore, pure mathematics elevate the mind above the sensible world, into a world of its own creation, in which the spiritual is pre-eminently exalted in conceiving pure forms and contemplating the beauty of everlasting truths, applied mathematics disclose the glories of tne universe as the embodied thoughts of the infinite mind in whom all things "live and move and have their being,"—they unveil the *terrestrial*, and it points to a *God*—they pour a flood of light upon the celestial, and "the Heavens declare His glory and the firmament showeth His handiwork."

II.

Let us now proceed to notice more particularly, THE VALUE OF MATHEMATICS AS AN INVIGORATOR OF THE INTELLECTUAL POWERS.

(1.) *And first as to Memory.* That the faculty of memory is highly cultivated by the study of mathematics, appears evident from the method of their processes and the unity and extent of the knowledge they embrace. In consequence of the necessary connection of principles which gives the science its peculiar unity, the memory must be constantly ready with previously acquired knowledge, to assist the reason in its efforts for the discovery of new truths. For if any of the previous truths be forgotten, the numerous results founded upon them, cannot be attained, and the mind is forced to return to the forgotten truths, till they are made thoroughly its own. Hence appears the error of the assertion, that the mind is required to retain only its last results as a foundation for further investigation, and that thus the memory becomes "stupified" from want of exercise!—To believe the assertion, originated in a speculative unbelief of the utility of the science, that mathematics tend to stupify the memory, requires a credulity born of dense ignorance of the subject. The synthetic processes of pure Geometry demand the constant excercises of this faculty; for how can there be *progress* unless memory supplies the necessary principles from those already attained and classified by the understanding? From the comparatively few first principles of the science, we proceed to the more elementary propositions, and thence to higher truths, till a perfect web of pure science is produced by the necessary laws of thought. And, since every succeeding proposition depends upon many preceding ones which are absolutely necessary to its demonstration, how can it be said that the memory is stultified by progress in the science? But if the memory is exercised in acquiring a knowledge of already demonstrated truths, how much more, in searching out new methods of demonstration, and establishing new truths,—exercises which form a leading part in every mathematical training deserving the name. Is it said that we are required to remember only the results deduced and not the trains of reasoning involved? Then we cannot claim to have received a truly mathematical training, and the science cannot justly be held responsible for results which it never had an opportunity of accomplishing. Still, even under this assumption, the memory is exercised, though certainly not to so high a degree as a rational training in the subject would ensure. For so numerous are the results deduced—the rules and formulas and principles—and so frequently and necessarily are they employed, that the constant exercise of the faculty of memory is imperatively demanded. But is the charge under consideration of any greater weight, when urged against arithmetic and the analytic methods? I reply in the negative. From the primary operations of arithmetic—from the multiplication table—to the highest applications of the Calculus, a necessary condition of progress is the distinct recollection of the results already acquired. Is it said, that in arithmetical investigations "the second mark being discovered, we no longer think of the first," and therefore, but little exertion of memory required? I ask how do we arrive at the discovery of the second mark, but through the active exercise of memory? Every process of the kind, is but the evolution of new truths from principles, which having been once discovered, are rendered effective for higher investigations, by a trustworthy memory. As to the algebraic analysis, even admitting, that as soon as the second mark is discoveed we ignore the first, does it follow that the faculty in question is not exercised, or if at all, only in the lowest possible degree? Is the mind driven onward, by an irresistible agency, through a series of processes and results, in which it is a "mere spectator?" On the contrary, all algebraic investigations, like those of arithmetic, but still more imperatively, are founded on results previously deduced, and must call into continuous exercise the retentive powers. But it is of no more true of mathematical reasoning than of any other, that the second mark being discovered we no longer think of the first. In any process of reasoning, whatever be the nature of the truths involved, is it necessary, or even possible, to recollect at *every instant*, all the results previously obtained? Or do we not rather, withdrawing our attention from steps already taken, concentrate our energies on those about to be taken and recall previous reasonings when necessary, by a special exertion of mental power.

In the transformation of equations—a process which at first sight may seem to demand but a slight effort of this faculty—it must furnish the materials for ingenuity to work upon, and bring up from its depths the principles necessary to effect the synthesis of the known with the unknown. And, in the investigation of general principles it is exercised in a still higher degree. For, though its individual principles are analytic, the science as a whole is synthetic—it proceeds from the simple to the complex—and therefore every investigation depends on a multitude of preceding truths which memory must be constantly ready to supply, or the desired results, with the consequences that flow from them, are completely unattainable Thus it may be shown that each of the mathematical sciences demands as an indispensable condition of its attainment, the vigorous exercise of the faculty in question.

But as each of the mathematical sciences possesses a logical unity which absolutely compels the exercise of memory, so the same unity binds them all into an harmonious whole, and hence the farther we progress in the boundless realms of knowledge they spread before us, the more completely is this faculty cultivated and its tenacity and power increased. Each branch of the science has certain principles peculiar to itself, but in addition to these, it demands the truths already demonstrated by subordinate departments, and therefore an abiding knowledge of these truths is absolutely necessary. From these and like considerations which, if time permitted might be abundantly illustrated, it seems clear that mathematics *demand* the constant exercise of memory, and stand pre-eminent as an invigorator of its powers. Yet it has been asserted that instead of exercising the memory they actually dwarf its powers. I have no doubt that every man who has anything more than a superficial knowledge of even the elementary branches will acknowledge the groundlessness of the assertion, and consider it but another instance of the fallibility of metaphysical speculators: especially when, like the sophists of old, they lay claim to universal wisdom, and dogmatize on subjects of which they are either totally ignorant, or view only through the distorted vision of the bigot.

2. *But Mathematics also cultivate in a high degree the powers of abstraction and generalization.* Although quantity, in its general sense, is the object of mathematical investigation, the conceptions involved are not connected with material substance nor limited by its finite nature. They are the product of the reason itself, and possess an immutability and a universality that cannot originate from material forms, though they may comprehend them. Sensible objects may give us our first ideas of numbers, but the mind soon passes to the abstract conceptions, and the particular is comprehended in the universal. So intuitions may be supplied, in the first instance, by imperfect geometrical figures, to give the mind conceptions of fundamental definitions, but the perception of the particular figures fades

(CONTINUED PAGE 10.)