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pretty little volume with its illustrations appeals, of course, chiefly to Wykehamists; but it contains what perhaps entitles it to a niche in the literature of the history of education, and that is a more complete account of the practice of "fagging" in its palmy days than is anywhere else easily accessible. Mr. Tuckwell—as we need hardly say of so good a Radical and so true a lover of flowers and gentle things—condemns the system unsparingly, chiefly by means of a simple recital of his own experiences: "Slavery is the only word which summed the three years' experience of a college junior. The details, whether cruel or grotesque, were all so contrived as to stamp upon the young boy's mind his grade of servile inferiority, and his dedication to the single virtue of abject, unquestioning obedience." Yet, as he remarks, it was "the best corrective," when once "the initial blunder" was fallen into of "leaving a mob of boys to self-government during great part of the day." A book like this helps us to understand how it was that such evils could arise as marked the beginnings of the factory system: the men of two generations ago were brutal in the treatment of the children not only of the poor but of their own class. It may be noticed that even the "ancient customs" of Harvard contained rules which might easily have developed into a fagging system like that of the great English schools; such as the rule that "all freshmen shall be obliged to go on any errand for any of their seniors." The ages at which boys entered Harvard and Winchester a century ago were probably not very different.

—'La Vita Italiana nel Rinascimento' is the publication of certain lectures delivered at Florence in 1892. They are third in a still continuing series of popular talks on Italian life, literature, and art. Preceding the present volume there has appeared one entitled 'Gli Albori della Vita Italiana,' and another, 'Vita Italiana nel Trecento'; the conferences of the present year were on the 'Cinquecento.' The publishers are Fratelli Treves, Milan. The titles of the several volumes suggest the scope and purpose of the whole series: too summary to aid much the scholar, it is, nevertheless, a useful compendium for the general public. The volume in hand deals in three parts, roughly equal, with history, literature, and art during the fourteenth century. The methods are naturally more suggestive than exact. According to Signor Masi, the Italians of the Quattrocento were the typical Renaissance people, and, among the Italians, *par excellence* the Florentines, and among the Florentines the Medici, and among the Medici Lorenzo the Magnificent. By this somewhat facile method of elimination, accordingly, study of the Italian Renaissance is reduced for the most part to a study of the immediate time and surroundings of Lorenzo de' Medici. His own poetry is the characteristic Renaissance lyric; his tutor, Politian, the characteristic humanist; his somewhat neglected protégé, Leonardo da Vinci, the characteristic artist. Certainly this concentration of interests, if from a scholarly point of view dubious, is conducive to sharpness of outline and to unity. Of Lorenzo as the protagonist of the Renaissance, there is much florid eulogy in the volume. Signor Masi, in his opening essay, does not hesitate to revive in its fullest intention the contemporary epithet of *pater patrie*. Signor Neponi compares the poetry of Lorenzo with that of Robert Burns. Lorenzo's shortcomings are ascribed to the spirit of the times; his excellences to his own credit. In fact, the whole volume,

with one exception, has overmuch of the air of the rostrum: the lecturers hardly aim higher than their readers' ears. The exception is Vernon Lee's interesting account of the sculpture of the Renaissance. As usual, this gifted writer handles her subject in the large, running easily up and down the ages and bringing side by side their respective ideals, manners, methods, in such wise that we are enabled to compare them in a single *coup d'œil*, like specimens in a museum. For this essay alone the volume is worth examining.

MACH'S SCIENCE OF MECHANICS.

The Science of Mechanics: A Critical and Historical Exposition of its Principles. By Dr. Ernst Mach, Professor of Physics in the University of Prague. Translated by Thomas J. McCormack. With 250 illustrations. Chicago: Open Court Publishing Company. 1893.

DR. ERNST MACH'S 'Die Mechanik in ihrer Entwicklung historisch-kritisch dargestellt' has for its ostensible purpose elementary instruction in the principles of mechanics. A secondary purpose is to narrate the history of that science. The ulterior design is to illustrate the author's views of the philosophy of science. This is the vital spark of the book; and doubtless this it is which recommends it to those who by "homilies" and "catechism" are engaged in propagating a "religion of science."

Considered as a history of mechanics, the work is admirable. It mentions all the great steps in the development of the science, down, at least, to 1847; it sets forth their nature, and explains them so lucidly that every reader will easily get a general understanding of them. We do not mean to defend all the criticisms upon the reasonings of Archimedes, of Galileo, of Newton, of Lagrange, of Gauss, and of many others, which cannot always meet the assent either of physicists or of logicians. Thus, when Mach objects to the assumption of Archimedes, that two equal weights at the ends of two equal arms of a lever will balance, that it is not evident, because the different colors of the lever-arms might affect the phenomenon, the obvious reply is that Archimedes did not mean that the two weights would balance in spite of everything. He did not mean, for instance, that nobody could push or blow one side down; nor, when we repeat the statement to-day, do we mean to deny that the magnetism of the lever might interfere with the experiment. When a physicist says that a certain phenomenon will happen under certain general conditions, he never means that no circumstances can possibly prevent it. What Archimedes meant was to lay down a proposition in regard to the geometrical relations of lever-arms to which nobody could object. Nor was he writing about the theory of cognition. He said nothing about the origin of the belief. He simply put forth the proposition as one to which, it was safe to assume, every sane man would assent.

Again, Galileo, being not much over twenty years old, investigated the law of falling bodies. It was not until he was past the age of eighty, and with failing powers, that he wrote out his reasonings. One point he made was that if the velocity of a falling body were proportional to the distance it had fallen from a state of rest, then, after it had fallen a unit of distance in a finite time, it would in precisely the same time have fallen double that distance. But the aged Galileo had evidently forgotten

how the young Galileo had reached that conclusion, and his attempt to reproduce his former reasoning is impotent. Nevertheless, that conclusion does truly follow from that assumption. Mach flatly denies this, but he is wrong. Galileo's original reasoning was probably somewhat like this: Imagine two bodies, which we may designate as Achilles and the tortoise, to have fallen from the same height, but at such instants that at another and given instant the tortoise has fallen one yard and Achilles two. Then, on the assumption that the velocities are proportional to the spaces fallen from rest, Achilles will be falling twice as fast as the tortoise. Now, Galileo could easily show that this implies that Achilles had at every instant been twice as far from the starting point and had been falling twice as fast as the tortoise. Consequently, Achilles must have performed his total fall of two yards in the same time that the tortoise performed his total fall of one yard. But both bodies are supposed to fall by the same law. Hence, this is a law which would make them fall one foot in the same time as two feet. These instances illustrate how important it is that the reader should be upon his guard against Mach's very inaccurate reasoning.

The author declares that it is quite impossible to get a full comprehension of the different mechanical principles without being acquainted with the discussions which originally led to their acceptance. Probably he would extend the same remark to many other sciences. We might name this the embryological principle in pedagogy, since the embryologists inform us that each individual animal has in his growth to pass through a series of transformations which roughly copy those through which his race has passed in the pal ontological development. No doubt, this principle is important in teaching all those subjects in which the conceptions are really difficult, such as metaphysics, logic, ethics, political economy, and several branches of mathematics. Yet it might very easily be carried too far, and it probably has been carried too far in this very treatise. If a student's sole object is to learn mechanics as thoroughly and quickly as possible, there are certainly text-books enough in our own language which would better serve his turn.

For a good many years Germany has in philosophical matters been quite as anglomaniac as England and Anglo-Saxon America have been tudescomaniac. Dr. Mach's metaphysics belongs to the good old Lockian sect of sensationalism. The proposition that all our knowledge rests upon and represents experience is nowadays accepted by sensualists and their opponents alike, the latter taking "experience," in its ultimate sense, for whatever has been forced upon our minds, willy-nilly, in the course of our intellectual history. To major force we can only submit, and it is idle to dispute the reality of such things as food, money, beds, shoes, friends, enemies, sunshine, etc. But the anti-sensualists, or perhaps the most advanced of them, say that, having once surrendered to the power of nature, and having allowed the futile ego in some measure to dissolve, man at once finds himself in syncretic union with the circumambient non-ego, and partakes in its triumph. On the simple condition of obedience to the laws of nature, he can satisfy many of his selfish desires; a further surrender will bring him the higher delight of realizing to some extent his ideas; a still further surrender confers upon him the function of coöperating with nature and the course of things to grow new ideas and institutions. AL-

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most everybody will admit there is truth in this: the question is how fundamental that truth may be. There are those who hold that while the brute compulsiveness of things may be said to constitute their reality, yet the whole fact of reality, with the relation of the ego to the non-ego, is not described until the individual Will is recognized as merging into the environing non-ego, as the individual instant of time merges into its past and future. For these thinkers, the line between fact and figment (which may or may not resemble and represent fact), so far as it can be drawn at all, is to be drawn between the involuntary and the voluntary parts of cognition; so that products of sense-perception—this chair, this table, this inkstand—belong to the realm of unquestionable reality. But they do not fail to remark that the process of compulsion exercised by the non-ego upon the ego is not altogether instantaneous. A part of it is continued through centuries. Nor is this compulsion always definitive. Resolute endeavor, aided by ingenuity and by favorable experiences, will often succeed in throwing off a part of the yoke. As for immediate experience, the individual sensation, it is the affair of an instant; it is transformed before it can be recognized; it is known to us as immediate only inferentially.

The sensationalists, and Dr. Mach with them, draw the line between fact and figment otherwise. Individual sensation is for them the only reality; all that results from the elaborative action of the mind is unreal. "Nature," says Mach, "is composed of sensations." A chair or a table is not real. "The thing," he tells us, "is only an abstraction." And again: "The world is not composed of things as its elements, but of colors, tones, pressures, . . . in short, what we ordinarily call individual sensations." Thus, all knowledge is based on and is merely representative of individual sensations, and all thought, all intellect, is of value only as subservient to peripheral or visceral sensation.

It was a favorite opinion of the pre-scientific sensationalists—Hobbes, Locke, and others—that abstraction and generalization were mere matters of convenience. Mach pushes this idea so far as to see no value in science except as an economy. "The end of science," he says, "is to save experiences, by the reproduction and anticipation of facts in thought." He does not make it quite clear why he should wish to save experiences, unless they are disagreeable, nor how he can save experiences except by slumbering. However, it is not our purpose to make objections, but only to outline Dr. Mach's opinion. It would seem that, all thought, memory, and higher feeling being held by the sensationalists as merely subservient to "individual sensations," if they could only be assured of a series of highly agreeable individual sensations for the rest of their lives, they should be content to forego all thought and all memory, and pass the time in an "Epicurus style" of individual sensations.

In science, metaphysics may be useful in furnishing a system of pigeon-holes in which all possible facts may be conveniently arranged, but what the scientific inquirer chiefly asks of it is that it should efface itself, as the French say, and not block the road of experimental inquiry. But Dr. Mach's sensationalism appears upon most important points quite at odds with the conclusions of science, the nature of the difference being this, that the scientific men wish to leave questions to be settled by experiment, while Mach wishes to forestall this by deciding them by metaphysics.

For instance, the crowning doctrine of physics is that all the events in the physical universe are motions of matter. Heating and cooling, changes of color, sounds, electrification, all may have their physical qualities; but so far as they are extra-mental they are nothing but motions of particles in space. Many a metaphysician will offer to show you in advance that it must be so. The physicists at first propounded it as a question, and then went on to put that question to Nature in experiments. By this time they are pretty well satisfied that the answer is affirmative. But still they keep up their eternal teasing of the great mother, to see if the same answer will always be given. Mach, however, decides it is not so; his metaphysics has revealed that to him. He seems to deny the kinetic theory of gases, and regards the whole atomic theory as destined to be overthrown.

Again, Sir Isaac Newton formulated the three laws of motion which stand to-day in all the text-books. The first, due to Galileo, is that a body left to itself continues for ever to describe equal spaces in equal times on one straight line. The third, Newton's own achievement in great measure, the law of action and reaction, is that one body cannot be drawn back without other bodies on the same line being drawn forward to balance it. Now Newton, with his incomparable clearness of apprehension, saw that the third law implies that spatial displacement is not merely relative, and further that, this being granted, the first law implies that temporal duration is not merely relative. Hence, Newton drew the conclusion that there were such realities as Time and Space, and that they were something more than words expressive of relations between bodies and events. This was a scientific conclusion, based upon sound probable reasoning from established facts. It was fortified by Foucault's pendulum experiment, which showed that the earth has an absolute motion of rotation equal to its motion relative to the fixed stars. Moreover, Gauss and others were led to ask whether it be precisely true that the three angles of a triangle sum up to two right angles, and to say that observation alone can decide this question. Now, the mathematicians demonstrate that if that sum is not precisely two right angles, there is such a thing as an absolute velocity of translation. Whether there be or not is to the minds of scientific men a question for experiment and observation to decide. But Mach will not let it go so. His metaphysics tells him that there is no such thing as absolute space and time, and consequently no such thing as absolute motion. The laws of motion must be revised in such a way that they shall not predict that result of Foucault's experiment which they did successfully predict, and the non-Euclidean geometry must be put aside on metaphysical grounds. Is not this making fact bend to theory?

The English of this translation has received the emphatic approval of Prof. Mach himself.

VILLARI'S FLORENTINE HISTORY.

I primi due secoli della Storia di Firenze. Ricerche di Pasquale Villari. Vol. I. Florence: G. C. Sansoni. 1893.

THE history of Italy has still to be written, even if we regard the peninsula, with Metternich, as simply a geographical expression. No history, moreover, is more difficult to write, for, in place of the development of a single nation under institutions fairly well known and intelligible, we have a congeries of States, each

working out its own ideals under social organizations and impulses of the most diverse and often of the most transitory character, and all of them dominated on the one side by the Holy Roman Empire and on the other by the Holy See. To accomplish this clearly and creditably is a task to daunt the courage of the most enterprising scholar, for he must not only assemble his material from an enormous mass of printed documents and an equally voluminous series of papers as yet accessible only in the archives, but he must coördinate an infinite variety of petty details, he must trace effects to remote and obscure causes, and he must weigh the interaction of opposing influences more complicated than those which have operated on the moral, social, and political evolution of any other nation.

So far has any adventurous historian been from accomplishing this task as a whole, that Prof. Villari informs us in his introduction that it yet remains to be done for the individual communities which formed the aggregate of mediæval Italy. His own undertaking is more modest, and yet it is by no means an easy one, viz., to ascertain and set forth the origin and the vicissitudes for two centuries of the community which shared with Venice the glory of being the most remarkable of the Italian republics—the little State which, under the name of Florence, at no time numbering within its walls a population of over a hundred thousand souls, made its influence felt from farthest Thule to central Asia, which organized a commerce embracing the then known habitable globe, and used the resultant wealth in stimulating literature and the arts till it became the acknowledged leader and teacher of European culture. The external facts of Florentine history are fairly well known and accessible, though the critical student has often to dissociate them from the legends which have encrusted them; but to seek the causes and occasions of those facts and to trace the influences which raised the little Florentine commune to a position so commanding, to investigate the social and moral condition of its people, and to find the key to the changes in its political organization which succeeded each other with such phantasmagoric rapidity, is a labor worthy of the well-known learning and acumen of the author.

The questions involved are of more than mere local interest, for though we may not wholly agree with Prof. Villari, that to the commune is due the idea of free institutions and the structure of modern political organizations, there can be no doubt that the free cities of the early Middle Ages exercised no little influence in determining the form and direction in which society has developed itself; and no study, by so able a writer, of the process in so active and intelligent a population as that of Florence can be without instruction for the student of human institutions in other lands. Florence, in fact, affords a peculiarly interesting field for such an investigation, for during the formative period its municipal constitution was remarkably plastic. One experiment succeeded another with a rapidity almost bewildering, as the people advanced towards the conception of a democratic republic. Yet this republic was in reality only an aristocracy. Even as late as the year 1494, not long before its final downfall under the power of the Medici, full citizenship was accorded to only about three thousand men.

This aristocracy consisted of merchants and manufacturers. The gradually growing independence of the Tuscan cities had become virtually complete in the disorders following the

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