relative amounts of the different dissolved salts also vary widely, these variations being related to climatic and lithological differences. Clarke computes the amount of sodium annually carried down by rivers to be 175,040,000 metric tons, and the total amount of sodium in the sea $14,130 \times 10^{12}$ tons, which gives as a quotient 80,726,000 years. He apparently considers possible corrections to be unimportant, or to balance one another, for he believes this crude quotient to be "as probable as any other value that might be chosen." As representing the age of the ocean, he considers this figure, for reasons set forth in Becker's memoir, to be "certainly a maximum."

The fundamental weakness of all such calculations, whether based on sedimentation or on solvent erosion, lies in the assumption that the present annual rate represents with sufficient approximation the mean rate throughout geological time. To the present writer this consideration deprives the conclusions of even a remote relevance to the actual problem. We know, for instance, that, even during the accumulation of a single formation at a given spot, the rate of deposition may vary widely, and in a shallow-water formation may be at one time positive and at another negative. To accept the thickness of a formation as a measure of its time of accumulation, with whatever qualifications and allowances, must inevitably lead to error, and probably to a greatly exaggerated estimate of the rate of sedimentation. Like reasoning applies to all processes of chemical as well as mechanical erosion and deposition, which are necessarily controlled by varying conditions. Even if we could eliminate the effects of relatively rapid and local variations, we have still to consider probable secular changes and others of a broadly periodic kind.

A partial recognition of this side of the problem has led Dr. Becker to discard Joly's assumption of a constant rate of increment of sodium in the sea, and to adopt instead a secular change of rate. He lays stress on the fact that at present the felspathic rocks are, over great areas, covered with a blanket of rotten rock in place, which contains only a negligible amount of sodium; and he pictures a distant future, when all massive rocks may be decayed down to sea-level, and addition of sodium to the ocean will practically cease. He thus reaches the remarkable conclusion that the rate of increment of sodium in the sea is progressively *declining*, and he accordingly represents it by a descending exponential expression. The age of the ocean is calculated, according to different hypotheses, as from 74·4 millions of years. The argument is not one which is likely to convince geologists. A decayed crust covering large continental areas must certainly have existed at many past epochs, and, indeed, the present time seems to be peculiarly favoured, in that extensive tracts have been recently scoured by ice. Further, stratified deposits yield more sodium, per square mile, than crystalline rocks, and, throughout geological time as a whole, the sediments have certainly made an increasing proportion of the whole land-surface. Most geologists believe, moreover, that the total area of land-surface has, on the whole, been growing. It would be possible, therefore, to make out a strong case for a secular *acceleration* of the rate of addition of sodium to the sea. There is another consideration of even more weight. The larger vicissitudes of the earth's history indicate a certain rough periodicity, and there is good reason to believe that we are living in a time of geological activity above the average. The author himself remarks that the continents stand at present above their average level, which, of course, greatly promotes erosion; and he also recognises that the recently glaciated regions of the globe are contributing soduim to the ocean at a rate which must raise the average. Unfortunately, he is content to leave these important considerations without discussion, assuming that they are sufficiently offset by an increased marine erosion.

The second part of Dr. Becker's paper, in which he revises Kelvin's refrigeration argument, we must pass over very briefly. It is ingenious in treatment, but involves too many precarious hypotheses to carry much weight. The special feature is that no assumption is made relative to the present superficial temperature-gradient. This is eliminated by making use of Hayford's "level of isostatic compensation," which is computed to lie at a depth (71 miles) beyond any disturbance from radio-activity. Of several special cases considered, the author prefers one which gives sixty million years since the *consistentior status*, and leads to a present temperature-gradient of 1° F. in 77 feet. We may take this latter value as a crux of the whole argument. Dr. Becker remarks that it is low as compared with observation, but he fails to see that, for the gradient *due to refrigeration*, it must certainly be far too high. Here at least radio-activity cannot be left out of consideration, and, indeed, Strutt has maintained that the observed gradient can be wholly accounted for by heat generated in the outer crust of the earth. If we allow some fraction of the annual loss of heat to represent secular cooling, it still appears that the age of the earth must be enormously greater than any estimate included in Becker's suppositious cases.

A. H.

PROF. ANGELO MOSSO.

THE School of Physiology in Leipzig was the Mecca that attracted young men from all quarters of the globe to study physiology under that great master, teacher, and experimenter, Carl Ludwig. A steady stream of young, ardent, able, and talented students crossed the Alps from Italy to prosecute research and acquire a knowledge of the methods in use in the Leipzig School. Amongst the earliest of these Transalpine scholars was L. Luciani—happily still amongst us—and a little later came Angelo Mosso, one of the most illustrious of Italian physiologists, whose death at the age of sixty-four the whole physiological world to-day deplores. He was born on May 31, 1846, in Turin. After studying at his native university—with no advantages of wealth, fortune, or high social position—he, by the exercise of his own high intellectual and brilliant gifts, soon became distinguished amongst his compeers, and he was selected by Moleschott to be his assistant in the university. He also acted as assistant to Prof. M. Schiff in Florence.

Before coming to study under Ludwig in the early 'seventies of last century, Mosso had already published his well-known researches on the movements of the Œsophagus, and determined in the dog the weight that could be lifted in the process of swallowing an olive-shaped ball (1872). In fact, the study of movements of all kinds always proved to him a fascinating and fertile subject of study. At an early period of his career he made observations on the movements of the Iris, and he attributed part of the change in size of the pupil to the filling of the blood-vessels of the membrane itself. Ludwig set him the problem to study the peculiarities of the movements of the vascular wall as they can be inferred from the results of the perfusion of blood through an excised organ, such as the kidney, a method which already had yielded such brilliant results in other organs. His results were published in 1874.

Another subject of study was plethysmography. A. Fick previously had used a plethysmograph to study variations in the volume of an organ. Mosso, under Ludwig's direction, modified this apparatus, and made an elaborate study on the alterations of the volume of the human limbs under various conditions, mental and physical, or with intellectual work, for the volume of a limb does vary with mental work, as Mosso conclusively showed. Later on, years after his return to Italy, in 1884, he published his famous paper on application of the balance to the study of the circulation in man. He constructed a balance so subtle that when a person was extended on it and delicately poised, mental work caused the head end to descend from an afflux of blood towards the brain.

In 1876, after his return to Italy, Mosso became professor of pharmacology in Turin. In 1880, when Moleschott was called to fill the chair of physiology in Rome, Mosso succeeded his old teacher as professor of physiology in Turin, a post he held with the highest distinction until his death. During the last few years illness incapacitated him from working in his laboratory, a matter of the acutest mental anguish to one whose untiring brain had ever new problems to investigate and solve.

The fact that in search after health he was able to devote his enforced leisure to the study of the result of excavations made in Sicily, and, above all, in Crete, was some compensation. He has left behind him a standard work on prehistoric anthropology in his "Palaces of Crete," published in English in 1907. His first laboratory was in a convent, but his boundless activity, productiveness, and the increase in the number of scholars, as well as the growing importance of his subject, led the Government to provide him with a palatial laboratory, one of the finest, most artistic, and æsthetic and best equipped in Europe. In 1882, along with Prof. Emery, he founded the well-known "Archives italiennes de Biologie," in which many of his now classical investigations were published. The first volume contains, Bizzozero's article on the blood platelets, and that of Mosso and Pellacani on the movements of the bladder. His unrivalled activity found vent in many directions in physiology; nor was this all. He was elected a senator, and often travelled to Rome to Monte Citorio to attend to his parliamentary duties, returning at night to undertake his more academic duties in Turin next morning.

The physiology of respiration early, and indeed constantly, occupied his attention. He studied the relations between abdominal and thoracic movements in 1878, periodic respiration, Cheyne-Stokes breathing in 1886. He had a special laboratory in the Regina Margherita hut on the top of Monte Rosa, 4560 metres above sea level, for the study of life at high altitudes, and the results of his prolonged and arduous labours he published in his "Life of Man on the High Alps," which was translated into English in 1898. As human beings cannot live much more than two months at a time in these altitudes, he had a fully-equipped laboratory erected on Cold'olen at 3000 metres, where much physiological, physical, and biological work was done.

In his "Diagnostik des Pulses" (1879) he made a careful study of the pulse, and in 1895 he invented his sphygmo-manometer for the study of the blood pressure in man. Amongst the most interesting of his studies on the circulation are those on that of the brain. The temperature and psychical activities of this organ he studied in 1894, and the researches formed part of the subject of his Croonian lectures in 1892.

Perhaps his work best known in this country is that on fatigue—translated into French, German, and English—as studied by the use of his ergograph, a most valuable contribution, written with a charm of diction that one rarely finds in physiological memoirs. Mosso was a master of style, happy in his phraseology, wide and catholic in his literal tastes, a keen and loyal admirer of the poets of his beloved Italy. The bust of Dante was always present on his laboratory writing-table. His interesting work on "La Paura" ("Fear") was also translated into English. Amongst his other popular writings are "L'Education physique de la jeunesse," "Les Exercises physiques et le développement intellectuel," and "Materialismo et Misticismo."

Amongst his chemical investigations the best known are those on ptomaines (with Guaresche, in 1882), and the discovery of the fluorescent serum and the powerful toxic venin—which he called ichthyotoxin—which occurs in the blood of the Murinideæ, such as the conger eel.

In Angelo Mosso the world loses a great and distinguished physiologist, who was beloved by all who knew him, was venerated by his pupils, and by his work, both in its theoretical and its practical applications, secured for himself a reputation as an investigator and expositor such as to place him alongside that illustrious galaxy of his countrymen who have added so much to the domain of natural knowledge.

JULES TANNERY.

THE unexpected death of M. Jules Tannery on November 11, at the age of seventy-two, will be sincerely regretted by a much larger circle of admirers than he would have anticipated. He belonged to a type of mathematician which is not too common, because he was at the same time an original thinker, a successful teacher, and a writer endowed with an unusually clear, brilliant, and attractive style.

In England, at any rate, he is probably best known by his mathematical text-books. Of these, the "Leçons sur l'Arithmétique" is a masterpiece in its way, combining rigour of method with a charming lucidity and ease; the "Traité sur la théorie des fonctions elliptiques" (written in conjunction with M. Molk), is one of the best works on the subject suited for a beginner; while the value of his "Introduction à la théorie des fonctions" is shown by the fact that a second and revised edition has recently appeared. Tannery was essentially an arithmetician, and one main object of his work on function-theory is to show that (as Dirichht asserted) all its results are deducible from the notion of a whole number. A more philosophical work, dealing with the same class of ideas, is his "Rôle du nombre dans les sciences," which he appears to have regarded as his greatest work. As might be expected, he took a part in the controversies aroused by Cantor's invention of transfinite numbers.

M. Picard, in announcing the death of their colleague to the Academy of Sciences, referred in appreciative terms to the notices of mathematical works and memoirs contributed by Tannery to the *Bulletin des Sciences mathématiques*. He said:—"Elles ne sont pas toutes signées, mais on ne peut s'y tromper, car elles portent sa marque si personnelle. En les réunissant, on aurait un tableau fidèle d'une partie importante du mouvement mathématique dans ces vingt-cinq dernières années."

Tannery's last official post was that of vice-principal of the Higher Normal School, and he was elected an Academician in 1907. M. Picard bears witness to his amiable, witty, and engaging character in private life.

G. B. M.