

swan and to be in turn defeated by it, we may understand the constellation Aquila, which rises in the east immediately after Cygnus, but sets in the west a little while before that (more northern) constellation. A like astronomical explanation applies to many other cases, which, if we attempt to explain them as facts for the naturalist, lead only to bewilderment. Such explanations are further illustrated and demonstrated by the symbolism of many Greek coins, such as that of Agrigentum, representing the eagle and the crab, or the tetradrachm of Eretria, figuring a bird on a bull's back (the Pleiad in the sign Taurus). The significance of these is clearly astronomical, as has lately been proved in detail by M. Svoronos in an article we had occasion to summarize in these columns.

As a corollary to this reasoning, Prof. Thompson, instead of increasing the number of species commonly identified, is disposed to diminish them. The Chrysaëus, for instance, he regards as mystical and fabulous, like the Phoenix, and apropos of such myths he refers us to the somewhat hopeless scepticism of Grote. The study of myths has certainly made some satisfactory progress since Grote's day. We are inclined to think that the origin of some fabulous types may be explained by the primitive notions of metamorphosis which M. Houssay pointed out in a recent paper in the *Revue Archéologique* (January, 1895). It is quite clear from certain ambiguous forms figured on Mycenaean vases that the people of that period had already evolved the superstition of the barnacle-geese, and the general idea that sea-creatures are capable of transforming themselves into terrestrial birds, insects, or animals to whose forms they bore some resemblance; that the horse, for example, could spring from the hippocampus.

Amid the discourse of information which he presents, Prof. Thompson suggests many etymologies which might deserve more attention if he had taken some pains to reinforce them. What good reason, for example, is there to identify Thamyras with Thammuz, or Atthis, as an epithet of the nightingale, with Atys?

*Great Astronomers.* By Sir Robert S. Ball. London: Isbister; Philadelphia: Lippincott, 1895.

A book of fourteen essays on the lives and works of as many astronomers, ancient and modern, but all deceased. It would have been a great subject for a great writer, for a scientific Sainte-Beuve. We cannot quarrel with the list of men treated. It was certainly best the writer should choose those whom he liked to write about. They are Ptolemy, Copernicus, Tycho Brahe, Galileo, Kepler, Newton, Flamsteed, Halley, Bradley, W. Herschel, La Place, Brinkley, J. F. W. Herschel, Rosse, Airy, Hamilton, Le Verrier, and Adams. Some of them are pretty well-worn subjects. Brinkley, Adams, and Airy are probably the only ones concerning whom any new facts are here made known. Still, for the majority of the others, masterly critical accounts would have been welcome. It would have been better to make half as many essays twice as long.

No one method of treatment is followed, so that to get an idea of the book it is necessary to examine several of the lives. Sir Robert Ball is himself a brilliant mathematician and a very competent astronomer. He does not seem to be aware that several of the personal traits of Claudius Ptolemy can be made out from a diligent study of his writings. He does not even

mention the fact that there is an astrological treatise, bearing the name of Ptolemy, which resists every test of genuineness. It has the great astronomer's method, style, and language; it bears his name and is addressed to the same person as the 'Almagest.' The geography of Ptolemy is only just mentioned, without any account of it. Sir Robert Ball cannot be ignorant that Ptolemy was a great mathematician, that he created spherical trigonometry, and calculated tables for the application of it. Was not this worth saying in a sketch of twenty-three pages? With what are these pages filled? Chiefly with an account of the Ptolemaic system of the world. But—we must suppose for the sake of simplification, for it cannot be that Sir Robert Ball is so ignorant—this account is falsified in such a manner that all that really was contributed to it by Ptolemy is erased, and what is provided is the rough description of the motions which was invented by Hipparchus, and which Ptolemy made his own by one of the most wonderful and profound pieces of mathematical ingenuity ever devised. Namely, Hipparchus had two circles, one carried round on the other, the planet being carried round the former. One of these motions is in geometrical truth nothing but the motion of the sun round the earth, or, what is the same thing (since in mere geometry all motion is relative), the motion of the earth round the sun. The other motion is the motion of the planet round the sun. The orbits are really ellipses; but they are so near circles (except for Mercury) that the difference in shape was not perceptible to the ancient observers. But the foci of the ellipses are perceptibly remote from the centre; and, moreover, since equal areas are described in equal times, the motion is physically more rapid near one focus than near the other. Now, Ptolemy almost perfectly represented all this by placing the orbit eccentrically from the earth, and then making the body that was supposed to move round the circle describe equal angles in equal times about a centre twice as far from the earth as the centre of the circle, and lying in the same direction. Nor was the motion in the second circle taken to be uniform. These hypotheses gave an essentially different character to the theory. The system of Hipparchus was a mere harmonic analysis; the Ptolemaic system needed only minor corrections to represent the true relative motions, or appearances in the heavens (which Ptolemy declared was all he aimed at), with a high degree of accuracy. At any rate, this, and this only, was the contribution of Ptolemy. It is a strange account of the man which attributes to him what was really done by another, and omits all mention of what he really did.

The account of Copernicus is hardly better. There is no allusion to the practical side of his life, his management of the vast estates of Frauenberg, his parliamentary career.—His planetary system is not explained at all, although this has been successfully done in several elementary books. The differences between the points of view of Ptolemy and Copernicus are not explained. Ptolemy really only cared to account for the appearances of the heavens; and he clearly saw that it made no difference, with those appearances, whether the earth moved or not. It was a mere surplusage—a curious inquiry, somewhat metaphysical—to ask whether the earth moves or not. Then, in Ptolemy's time, everybody assumed that there is one substance of things celestial and another substance of things terrestrial. The stars were mere lights. There was no matter in them, such as we see on earth. There was thus no

analogical argument to be drawn against their moving ever so rapidly. On the other hand, if the earth moves, then real terrestrial objects are moving with a velocity very many times greater than any of which we have any experience. Copernicus, on the other hand, lived at a time when the discovery of the New World inclined men to think that things remote were a good deal like things near at hand. Moreover, reflection upon Ptolemy's system, just as he had described it, would show that the general conception of it could be much simplified by making all the planets revolve round the sun. Ptolemy would not care for such simplification, as long as the computations of places remained the same, as they would remain. But in Copernicus a deeper philosophical spirit pervading Europe was beginning to awaken.

The life of Galileo is marked by the same inadequacy. Galileo's greatest discovery, that of the uniformly accelerated fall of bodies, is not mentioned. Kepler receives still worse treatment. One of the most interesting personalities that ever lived, and the author of the most wonderful piece of inductive reasoning, with the exception of Mendeleef's law, ever performed, he is so feebly described that the reader gets but a glimpse into the nature of the man and none at all into the course of his thought. The modern essays are no better. The men, too, are smaller and less interesting. The chapter on Brinkley has two and a half pages about Brinkley and ten and a half about other things. It is modern superficial writing about a subject that would formerly have engaged the best talents, carried to its last point of newspaper-paragraphing.

*Buckle and his Critics: A Study in Sociology.* By John Mackinnon Robertson. London: Swan Sonnenschein.

MR. ROBERTSON is so possessed with the idea that injustice has been done to Buckle that he has prepared a volume of 566 pages—not very closely printed pages fortunately—to refute his critics, big and little, one after the other. We are inclined to ask him, now that the task has been accomplished, whether on reflection he really thinks that this is the best way of reaching his end. He believes, and probably with justice, that Buckle is too little read nowadays, and that it is too much the fashion to disregard or pool-pool him. Then, would it not be better for him to try to tell us, in as brief and forcible a way as he can, what he himself conceives to have been Buckle's contribution to human knowledge? As it is, we are left to piece together Mr. Robertson's interpretation of his master from scattered indications up and down 566 pages of acrimonious controversy. Few people will have the patience to do this; and, from Mr. Robertson's point of view, it will be a great pity.

It is the more to be regretted that Mr. Robertson's book should be thus repellent, and, indeed, ludicrous, because he is a writer of wide reading and of much penetration, and the master of a vivacious style. Even as it is, 'Buckle and his Critics' is a book that our professional 'Sociologists' will do well to get; it will widen their horizon, and give some of them, especially in theological seminaries, a not unwholesome shock occasionally. But the book is a curious and characteristic product of a certain phase of English life. Mr. Robertson is the biographer of Mr. Bradlaugh, and a writer in the *National Reformer*; and we are probably not mistaken in supposing that he has more or less identified himself with the