sorption and adjustment. "The attention moves throughout the series of elements, grasping, relating, retaining, selecting, and when the integration it effects swells and fills consciousness — that is the fiat" (p. 355). That is to say, the decisive point is reached, the rending strife is over, when the distracting character of the elements has been subdued, the unsettled claims satisfied, and the "attention gets its hold upon its integrated content as a grand related situation."

It is necessary to pin the attentive act down still closer. What can attention do in the matter of initiation of motives? Is attention unmotived? Is it independent of the internal and external conditions of endowment and environment? Professor Baldwin replies in the negative: an analysis of the two general classes of "apparent initiation of motive intensity"— cases of involuntary attention and cases of deliberation — renders an affirmative answer untenable. Strengthened intensity in the former cases is easily shown to be involuntary; in the latter, "as soon as any such preference comes in — any physical, mental, or emotional motive for wishing to intensify this particular alternative — then my choice is already made and I am fooling myself in thinking that I am reaching an unbiased decision."

Consequent upon these preliminaries comes the author's formal statement of the problem of freedom, in which he unfolds with great clearness of thought and transparency of expression the following four alternatives: (1) indeterminism, (2) external determinism, (3) immanent determinism, (4) freedom as self-expression. The contingent or indeterministic view, with its theory of unconditioned choice, meets with a very summary but warranted rejection. It is not only crudely unpsychological, but defeats the very end in whose interest it is projected; moral responsibility has the very ground cut from under its feet on any such theory; the conception of an agent whose voluntary expression involves moral judgment because he is agent, is emptied of all meaning. Professor Baldwin gives us here nothing new — nor was it necessary. This controversy has already been "thrashed out to the very last fragments of chaff."[1]

The external deterministic are all those who explain volition in terms of natural causality, and thus consider the problem of volition a problem in physical dynamics. "Motives are forces in reference to one another, effects in reference to the brain, in which they have their causal support; volition is the consciousness of the outcome of a conflict of forces" (p. 370). The objection to this theory is that it floats in the air. To give it weight, an assumption is necessary, which neither science nor philosophy can substantiate. The theory assumes the possibility of a continuous movement under natural causality across the physical into the mental world. Whatever may be believed as to a "uniform psychophysical connection," there is no warrant for assuming that consciousness is an epi-phenomenon. So, too, there is no legitimate ground for believing motives to be mere natural phenomena. Baldwin is as positive as Green, though from a very different standpoint, that a motive is vastly more than a natural phenomenon. As to moral action, therefore, that view of it is false which supposes "that the motives which determine it, having natural antecedents, are themselves but links in the chain of natural phenomena."[2]

The analysis of motive exhibits three important results: 1. Choice is never motiveness. 2. The end chosen is always a synthesis of all present motives, and is adequately expressed by no one of them. 3. This synthesis is an activity *sui generis:* it finds no analogy in the composition of physical forces. With these results clearly in view, he finds that "freedom, therefore, is a fact, if by it we mean the expression of one's self as conditioned by past choices and present environment." "Free choice is a synthesis, the outcome of which is, in every case, conditioned upon its elements, but in no case caused by them"[3] (p. 373).

To read Baldwin's chapters on the will (for these were well worth the space of a separate review) is to feel that a mind of admirable scientific temper has been at work throughout. Approaching the phenomena of mind from the naturalist's point of view, he has guarded against the tendency, all too common in these days, of trying to drive the principle of physical causality through a multitude of facts, naturally and philosophically recalcitrant to such treatment. The great lesson of his two volumes is, that in psychology the application of scientific methods and canons to mental phenomena affords no results which a cautious metaphysic may interpret as casting discredit on spiritualism in philosophy.

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[1] Jonathan Edwards, Day, etc.

[2] Green's "Prolegomena to Ethics," p. 93.

[3] cf. James, Vol. II., pp. 571–2.

SIR GEORGE BIDDELL AIRY.

THE cable has just flashed across the ocean the announcement of the death of Sir George Biddell Airy, the eminent astronomer of England. He was born on the 27th day of June, 1801, at Alnwick, in Northumberland, and had, therefore, just passed the half-mile post that would bring him to his ninety-first birthday.

Sir George Airy's life and work will always be looked upon as one of the most prominent pillars in the astronomical edifice erected in the nineteenth century. He had almost lived to see what had been done in that hundred of years. He had stood upon the pile of débris thrown up from the foundation, and looked down upon the formation of a structure, little dreaming that he would live to see the finishing touches put upon an edifice to which he had added so much material.

Airy was educated first at two private academies, Hereford and Colchester. From the latter, at the age of eighteen, he entered Trinity College, Cambridge. Three years afterwards he was elected to a scholarship. In that college he developed his remarkable mathematical ability, graduating as Senior Wrangler. His degree of M.A. was taken in 1826, and, with it, he was elected as Luscasian professor at Cambridge. Illustrious philosophers like Barrow and Newton had preceded him as occupants of that historic chair. Just previous to his election to that chair he published his mathematical tracts on the "Lunar and Planetary Theories," "The Figure of the Earth," etc., and "The Undulatory Theory of Optics."

Professor Airy, having been installed in the position just mentioned, followed his appointment with a series of popular lectures upon experimental philosophy, which were delivered with remarkable effect, and which greatly enhanced his scientific reputation. The university, recognizing in him one whose investigations were of a high order, elected him two years afterward to the Plumian professorship. This election gave him charge of the Cambridge astronomical observatory, and now is inaugurated an epoch in his life that is to elevate him to one of the highest positions held by English scientific men

Having been placed in the position above cited, Professor

Airy began those great improvements in the methods of calculating and publishing the astronomical observations made, which have led other observatories to take copy after him. Airy was a methodical man, a professional and a business man. He made his work conform to a scheme laid out the year before, and that plan was strictly followed. His work as an astronomer and a calculator is valuable, because it is unbroken and comparable. The astronomical instruments that have so long stood within the walls of Cambridge Observatory were made after his own plans and under his own directions.

In 1835 Professor Airy, then in his thirty-fourth year, was appointed Astronomer Royal. For forty six years he filled that position with marked ability. Under his master-mind it is needless to say that the astronomical observatory at Greenwich was completely changed. He placed the manner of reducing the observations upon a more satisfactory basis, and equipped the observatory with instruments of a higher order of precision. In the year 1850, under his guidance, a new meridian circle was erected. It has an object glass of eight inches aperture and eleven feet six inches focal length. In 1855, at his earnest solicitation, a large equatorial telescope was placed in the observatory.

Professor Airy was a man that not only combined the philosopher with the mathematician, but was one that had an inventive mind as well. This may be seen in the many forms of astronomical instruments and their accessories due to his very active brain. The value of the observations made by him during his occupancy of the position of Astronomer Royal at Greenwich, rests not only upon their accuracy and dispatch in being published, but on their continuity. This may be seen in his reduction of lunar observations from 1750 down to a late date, a most valuable series of observations.

Airy was a man in whom his government had the utmost confidence when it came to deciding questions of grave import. He was the chairman of the royal commission empowered to supervise the delicate process of contriving new standards of length and weight, the old standards having been destroyed in the burning of the House of Parliament in 1834. He was called in consultation soon afterwards in respect to removing the disturbance of the magnetic compass in iron-built ships. He thereupon contrived a mechanical combination which has been universally adopted. His researches on the density of the earth, his fixing the breadth of railways, his care in the equipment of the British expedition to observe the transit of Venus, and the reduction of the observations after having been made, — all voice the great confidence placed in him by his countrymen, and his worth as a practical astronomer.

The writings of Sir George Airy cover a great deal in the field of philosophical and mathematical thought, and are thorough in their discussion of each subject. His pen was ever busy, and one has but to turn to the volumes of the Cambridge Transactions, the Memoirs of the Royal Astronomical Society, to the *Philosophical Magazine*, and the *Athenæum*, to find its fruits. But in the volumes issued from the Greenwich Observatory we find the great life-work of Sir George Airy. They are the polished stones, the finely carved pillars that have been used in building up the astronomy of the nineteenth century. His principal works, which have become books of reference, are: "Gravitation," "Ipswich Lectures on Astronomy," "Errors in Observations," "Figure of the Earth," "Tides and Waves," "Sound," and "Magnetism."

One whose reputation as a man of such scientific attainment as Sir George Airy has deservedly received recognition, both from his own country and abroad. He has received the Lelande gold medal of the French Institute in honor of his important discoveries in astronomy. For his successful optical theories he was awarded the Copley gold medal of the Royal Society. The royal gold medal of the same society has been given him in return for his tidal investigations. Twice the gold medal of the Royal Astronomical Society has been given him — first, in return for his discovery of an inequality of long period in the movements of Venus and the earth; second, to reward him for his reduction of the planetary observations. He has been enrolled among the most honored members of the Royal Astronomical Society, of the Cambridge Philosophical Society, and of the Institute of Civil Engineers. For many years he has been among the foreign correspondents of the Institute of France, and other scientific sccieties on the continent. He has secured the honorary degree of D.C.L. and LL D. from each of the great universities of Great Britain — Edinburgh, Oxford, and Cambridge. In May, 1872, he was gazetted a Knight of the Bath.

When the years shall have passed into centuries, and coming astronomers are searching the records for valuable data to be used in the discussion of questions in astronomy, the observations and results determined by Sir George Biddell Airy will be found of the highest value.

GEO. A. HILL.

STRUCTURE OF THE TRACHEÆ OF INSECTS.[1]

MR. LACHLAN'S article on insects in the "Encyclopædia Britannica" reproduces Blanchard's error of a double chitinous wall for the tracheæ with a spiral thread between. Blanchard and Louis Agassiz superadded a peritracheal circulation of blood. Joly's refutation of this view, in 1850, failed to give the real cause of the error: this was not, as suggested by him, due to bad injecting; but it resulted from observing insects when moulting. At time of moulting the trachea contains the old chitinous wall, dark and enclosing air, and surrounded with exuding fluid between it and the new chitinous wall; thus the appearance of things is much as described by Blanchard, who mistook the exuded fluid for circulating blood, and also mistook a temporary state of matters for the normal state.

The view published by me in the *American Naturalist*, in 1884, that the spiral thickenings of the trachea are really crenulations, channel-like transverse folds open outwards (i.e., away from the lumen of the trachea) by a slit or fissure, was supported by indirect evidence, and needs to be enforced so as to leave no doubt. Miall and Denny, in their monograph on the cockroach, write as if they had been able to unroll the spiral like that of a vegetable trachea, without tearing the connecting membrane, and copy Chun's very inaccurate figure, which ascribes a free continuous spiral thread to the trachea of insects just as we find it in the plants.

A re-examination of the case brings out the singular result that the whole machinery can be distinctly seen by the microscope to be such as I have described it. The profile of a medium-sized trachea of any insect can be easily seen to be grooved like the edge of a screw: all the more clearly if the trachea is slightly stretched under the cover-glass. In the living insect we may observe that the resiliency of the transversely chanelled walls responds to the muscular contraction

[1] Abstract of a paper read by G. Macloskie before the American Association of Naturalists, Dec., 1891.