man engaged to work the wings is an acrobat of effective muscular power. The experiment will very likely take place at Enghien, on the lake, where the balloon will be retained by a small floating buoy.

WE have received a "Catalogue des Ouvrages d'Astronomie et de Météorologie," found in the principal libraries of Belgium, prepared at the Royal Observatory of Brussels. It extends to upwards of 630 pages, and will be found of great service to those interested in astronomy and meteorology. The publisher is Hayez, of Brussels.

IN our report last week (p. 323) of the Physical Society meeting of June 22, in Mr. W. Baily's paper, the expression A cos θ should be A cos 2θ, so that the equation to the ellipse of polarisation would be

$$1 + A\cos 2\theta + B\sin 2\theta = r^{-2}\{1 - (A^2 + B^2)\}$$

The author of the paper on Complementary Colours was Mr. John Gorham, not Graham.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. Enoch; a Rhesus Monkey (*Macacus erythræus*) from India, presented by Miss Davis; a Cape Zorilla (*Ichonyx zorilla*) from Africa, presented by Mrs. J. J. Monteiro; a Common Cuckoo (*Cuculus canorus*), European, presented by Mr. G. D. Careless; three Alligator Terrapins (*Chelydra serpentina*) from North America, presented by Mr. J. H. Thompson, C.M.Z.S.; a Chimpanzee (*Troglodytes niger*) from West Africa, a Golden-headed Marmoset (*Midas chrysomelas*) from Para, two Egyptian Flamingos (*Phœnicopterus antiquorum*) from North Africa, deposited; an Eland (*Oreas canna*) born, five Amherst Pheasants (*Thaumalea amherstiæ*), an Argus Pheasant (*Argus giganteus*) bred in the Gardens.

JOSEPH BLACK[1]

THE study of the history of a science is of great importance not only from a psychological point of view, but also as throwing light on the present position of the science. In science, as in other natural products which have *grown*, we find survivals which can only be understood when the development is known. Such historical studies may very conveniently be associated with the biographies of the great scientific leaders under whom progress has been made, and whose individual mental peculiarities have left permanent impressions. I intend on this occasion to direct your attention to the life and work of Dr. Joseph Black both because he was one of the first to give to chemistry the direction which it still preserves, and because his life is of special interest to us as Edinburgh students of chemistry.

Joseph Black was born at Bordeaux, in 1728. His father, John Black, was a native of Belfast, a member of a Scottish family settled in Ireland. His mother belonged to the family of Gordon, of Halhead, in Aberdeenshire, and was a cousin of Dr. Adam Ferguson. In 1740 he was sent home and educated at the Grammar School of Belfast. In 1746 he matriculated at the University of Glasgow, where he remained till 1750, studying in the faculties of arts and medicine. He then removed to Edinburgh, where he graduated as doctor of medicine in 1754. In 1756 he was appointed Professor of Anatomy and Lecturer on Chemistry in the University of Glasgow. He soon exchanged with a colleague the duty of teaching anatomy for that of physiology, and continued to lecture on physiology and chemistry till 1766, when he was called to Edinburgh to succeed his friend and teacher, Dr. Cullen, in the Chair of Chemistry. He died November 26, 1799. Such is a brief sketch of his quiet and uneventful life. His contemporaries Dr. Robison and Dr. Adam Ferguson, give us some account of his manner of life and study. He was minutely accurate and careful in everything he did, and this punctiliousness and his feeble health account for the small *quantity* of work of which he has left a record. As a student he is said to have kept two sets of note-books; into one he entered observations, experiments, hints of experiments, extracts from the works of others, in fact all the miscellaneous additions to his knowledge. These he afterwards transcribed into the other set, arranging them in order of subjects. "In short," to quote Dr. Robison, "he kept a journal and ledger of his studies and posted his books like a merchant." It has occurred to me that possibly this mention of Dr. Black's business-like habit may have been present to the mind of Sir Walter Scott when describing the interview of Francis Osbaldistone on his return from Bordeaux, with his father. "—but what have we here? 'Bordeaux founded, castle of the Trompette, palace of Galienus,'—well, well, that's very right, too. This is a kind of waste book, Owen, in which all the transactions of the day, emptions, orders, payments, receipts, acceptances, drafts, commissions, and advices are entered miscellaneously." "That they may be regularly transferred to the day-book and ledger," answered Owen; "I am glad Mr. Francis is so methodical."

His style as a lecturer is well described by Dr. Robison:—

"He endeavoured every year to make his courses more plain and familiar, illustrating them by a greater variety of examples in the way of experiment. No man could perform these more neatly and successfully. They were always ingeniously and judiciously contrived, clearly establishing the point in view, and never more than sufficed for this purpose. While he scorned the quackery of a showman, the simplicity, neatness, and elegance with which they were performed were truly admirable . . . his students were not only instructed, but (they knew not how) delighted; and without any effort to please, but solely by the natural emanation of a gentle and elegant mind, co-operating, indeed, with a most perspicuous exhibition of his sentiments, Dr. Black became a favourite lecturer." His private life was one of unvaried regularity and order, and was brought to a fit close by his death, which is thus described by Dr. Adam Ferguson.

"His own constitution never was robust, and every cold, or any approach to repletion, affected his breast so much as to occasion a spitting of blood. This he guarded against by restricting himself to a moderate or abstemious diet. As his infirmities increased with age, he met them with a proportionate attention and care, regulating his food and exercise by the measure of his strength; and thus preventing the access of disease from abroad, he enjoyed a health, which was feeble but uninterrupted, and a mind undisturbed in the calm and cheerful use of his faculties. A life so prolonged had the advantage of present ease, and the prospect, when the just period should arrive, of a calm dissolution. This accordingly followed on the 26th of November, 1799, and in the seventy-first year of his age, without any convulsion, shock, agitation, or stupor, to announce or retard the approach of death. Being at table with his usual fare—some bread, a few prunes, and a measured quantity of milk diluted with water, and having the cup in his hand when the last stroke of his pulse was to be given, he appeared to have set it down on his knees, which were joined together, and in this action expired, without spilling a drop, as if an experiment had been purposely made, to evince the facility with which he departed. So ended a life which had passed in the most correct application of reason and good sense to all the objects of pursuit which Providence had prescribed in his lot." . . . "He had long enjoyed the tender and affectionate regard of parents whom he loved, honoured, and revered, with the delightful

[1] Abstract of Lecture to the Edinburgh University Chemical Society, by Prof. Crum Brown, F.R.S.

consciousness of being a dutiful son; one of a family remarkable for sweetness of disposition and manners, he had lived with his brothers and sisters in terms of mutual love and attachment. He had never lost a friend but by the stroke of mortality, and he felt himself worthy of that constancy of regard. He had followed a profession altogether to his taste, and had followed it in a manner, and with a success which procured him the esteem and respect of all competent judges, and set his name among the most eminent, and he was conscious that his reputation was not unmerited; and with a success, in respect of emolument, which secured the respect even of the ignorant; which gave him the command of every rational gratification, and enabled him to add greatly to the comforts of the numerous descendants of his worthy parents—heirs not only of their name, but likewise of their unambitious moderation and amiable simplicity of character."

Such was Dr. Black as described by those who knew him intimately. We at a greater distance from him can, perhaps, more accurately estimate the character and value of his work. This may be considered under the heads of his three great discoveries. 1. The nature of the difference between the mild and the caustic alkalies; 2. The latent heat of liquids; 3. The latent heat of vapours.

As a student of medicine in this University his attention was early drawn to the chemical characters of caustic potash and caustic soda, the merits of which as remedies in cases of urinary calculus were then much discussed.

Two kinds of alkalies, the caustic and the mild, had long been distinguished. The former act in a burning, caustic, destructive way on animal and vegetable tissues, the latter do not; the latter effervesce when mixed with acids, the former do not; the former are typified by quick or in slaked lime, the latter by chalk or calcareous earth. Previous to Dr. Black's experiments the difference was thus explained:—When calcareous earth is burnt it becomes quick-lime by taking up from the fire a fiery, caustic matter; some of this is given off as heat when lime is slaked, but some of it remains and gives the causticity by which slaked lime is distinguished from calcareous earth. This causticity is transferred (because the caustic matter is transferred) from the lime to other alkalies. Thus, when slaked lime is mixed with a solution of potashes we obtain caustic potash and the lime becomes mild, is re-transformed into calcareous earth, having parted with its *causticum* to the potash. Similarly when sal ammoniac is heated with calcareous earth we obtain sal volatile; but when we act on sal ammoniac with slaked lime the *causticum* passes from the lime to the volatile alkali and caustic ammonia is produced. In all these cases the caustic matter or *causticum* originally obtained from the fire was believed to be transferred from one alkali to another. The effervescence which occurs when a "mild alkali" is treated with an acid was of course observed, but it was looked upon merely as a symptom of the violent movements caused by the mutual saturation of acid and alkali.

When slaked lime is exposed to the air it gradually returns to the condition of calcareous earth. On the hypothesis stated above, it must therefore gradually give off its *causticum* into the air. Black's first experiment seems to have been an attempt to catch the *causticum* as it escaped. We have no details of these early experiments, but from a note-book which can be shown to be of the date 1752 Dr. Robison extracts the following statement of the result:—"Nothing is given off, the cup rises considerably by absorbing air." Another memorandum occurs a little later: "When I precipitate lime by a common alkali, there is no effervescence. The air quits the alkali for the lime, but it is not lime any longer, but C.C.C. It now effervesces, which good lime will not."

A full account of his experiments and conclusions is contained in his graduation thesis (1754), and in a more extended form in 1756 in "Essays and Observations, Physical and Literary, read before a Society in Edinburgh"—the society which afterwards became the Royal Society of Edinburgh. In this classical paper he shows in the clearest manner that the mild alkalies differ from the caustic by containing in addition a large quantity of "fixed air," a particular kind of gas, which we now know as carbonic acid gas. This gas is given off, causing effervescence when the mild alkali is dissolved in an acid, and the caustic alkali does not effervesce because it does not contain fixed air. Wherever causticity is acquired this fixed air is lost, and *vice versâ*. When slaked lime is mixed with a mild alkali the lime takes the fixed air, and is converted into calcareous earth, while the mild alkali by the loss of fixed air is rendered caustic. In the same way sal ammoniac with calcareous earth gives a mild volatile alkali, the fixed air being transferred from the lime to the ammonia, but with slaked lime a caustic ammonia, because there is here no fixed air to be transferred. The origin of the causticity in the lime is shown to be due to the loss of fixed air which the heat separates from the limestone, and the loss of weight which is observed when limestone is burnt is shown to be exactly accounted for by the loss of the fixed air. Thus Black proved the "causticum" to be *minus* fixed air. Addition or subtraction of the former is really subtraction or addition of the latter, and transference of *causticum* from A to B is really a transference of fixed air from B to A.

It is impossible to look at such a sketch of this part of Black's work without being struck with the resemblance between the theory of causticity which he overthrew, the nature of the truth which he discovered, and the method by which he discovered it, on the one hand, and on the other the theory of Phlogiston, the true nature of combustion, and the method by which it was discovered by Lavoisier; indeed, Lavoisier himself, in a letter to Black, speaks of the new chemistry as "Une carrière que vous avez ouverte, et dans laquelle nous nous regardons tous comme vos disciples."

The discovery of the latent heat of liquefaction and of vaporisation, was made by Dr. Black while professor in Glasgow. I have occupied so much time with the purely chemical part of my subject that I shall only here point out: (1) That Black's determination of the latent heat of water agrees very closely with the most recent results of experiments conducted with all the refinements of modern science; (2) That he studied the fusion and solidification of bodies, such as resin and sealing wax, which pass *gradually* from the liquid to the solid state, or *vice versâ*; and (3) That it was his teaching which induced Watt to commence the series of experiments and speculations which led to the discovery of the dependence of the latent heat of steam upon the temperature, and to the invention of the condensing steam-engine.

A SCHOOL LABORATORY

FACTS, not theories. This is the special point in the recent "Head Masters' Report" on science teaching, and, by his interesting account of it in NATURE, vol. xvii. p. 317, Mr. Tuckwell has afforded some opportunity of counting the cost to head-masters projecting a development of their science side, but apparently the Report gives no detail, and it is in this direction, perhaps, that many seek chiefly for information; they would like to know more fully what facilities may be obtained for a particular outlay.

In the hope of giving reliable information of this sort I submit the following particulars:—

The governors of Exeter School, hoping to rekindle the torch of science, lately so unhappily extinguished in the West by the Taunton College authorities, have recently