Two Historical Notes

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Humphry Davy's Experiments on the Frictional Development of Heat

In practically all textbooks on heat, certain experiments of Humphry Davy are cited as constituting early experimental proof of the dynamical theory of heat, and they are generally said, either directly or by implication, to be of major importance. There is a certain amount of variety in the description of what these experiments were: several authors (for example, Poynting and Thomson, Grimsehl, Loeb and Adams and Hoare) say that he rubbed the pieces of ice together in a vacuum, while others (for example, Edser and Preston) say that he performed the experiment in air, and afterwards carried it out *in vacuo*. Now any physicist who contemplates repeating the experiment will, I think, at once be struck with the difficulty, if not impossibility, of carrying it out in such a way as to produce anything in the nature of a convincing result. If the ice is covered with a film of water, the friction is so small that scarcely any work is done, while if it is really dry it is liable to stick. In any case, to make the frictional heat appreciable, it is necessary to have a normal force holding the two surfaces together, and then one gets the well-known lowering of freezing point and consequent melting, if the surroundings are at the ice point, with all the possible dangers of regelation at the edges. Again, the amount of work required to melt 1 gm. of ice is very large: the criterion is an extraordinarily insensitive one. All these difficulties are, perhaps, sufficiently summarised in the fact that nobody, apparently, has ever tried to repeat the experiment, and I, for one, would not care to undertake it.

It is, then, perhaps worth while pausing a moment to inquire just what Davy did, and in what circumstances. The account of these and certain other experiments was the author's first contribution to science, and was published (in "Contributions to Physical and Medical Knowledge, principally from the West of England", edited by Thomas Beddoes, father of the poet Thomas Lovell Beddoes) early in 1799, when he was twenty years old. The work was, then, presumably carried out when he was nineteen. The first experiment described is directed to show that light is not an effect of heat; he held that he had proved experimentally that particles of iron can be heated to the melting point without giving out light! The second and third are the celebrated ice experiments.

In the first of these, described in less than three hundred words, without any detail, Davy says that he fastened two pieces of ice by wires to two iron bars and that "by a peculiar mechanism" the ice was kept in violent friction for some minutes. The pieces of ice "were almost entirely converted into water" which, strangely enough, was found to be at 35° "after remaining in an atmosphere at a lower temperature for some minutes", or, in other words, the friction of ice can raise water many degrees above the melting point! Even supposing that the stroke of the 'engine' was 5 cm., and that it executed 100 strokes a minute, and that the coefficient of friction was 0·5, this would mean, if for "some minutes" we read "ten minutes", that the force pressing the pieces of ice together would have to be equivalent to an additional pressure of about 4 atmospheres. The whole experiment is fantastic. This is said in no disrespect to Davy: how could one expect an untrained boy in 1799 to carry out an experiment which even to-day would tax an experienced physicist, to say the least? No doubt the whole effect observed by Davy was due to conduction.

The second experiment, the one in a vacuum, was not concerned with ice at all, but with the melting of wax. The wax was apparently attached to a metal plate, against which rubbed a clockwork-driven wheel. The clockwork stood on a piece of ice in which was cut a channel containing water, and the whole was under an exhausted bell-jar. The argument was that if the heat required to melt the wax had passed from the ice to the clockwork, the water would have frozen. As, however, the heat required to produce the rise of temperature observed in the clockwork amounted to but 12 calories, only 0·15 c.c. of water would have frozen in any event, which actually could not be observed by eye in a rough channel cut in a piece of ice. The experiment proves nothing at all.

I may be held to have spent too much time on a point which some may say is of historical interest only. I hold, however, that it is very inadvisable that students should be taught to attach a fundamental importance, not to experiments crudely carried out, which were afterwards improved, but to experiments of which one probably cannot be carried out at all, while the other is so ill-designed as to prove nothing. I am no denigrator; I do not think that it detracts from the greatness of Davy to point out that his first experiments, carried out when he was a country lad, were uncritical and lacked all quantitative basis. It is time, however, that they ceased to be ranked with such convincing demonstrations as those of Rumford, and disappeared from the textbooks. Or, if they are quoted, do let us have instructions as to how to melt two pieces of ice by rubbing them together in a vacuum.

NEWTON'S EARLY NOTEBOOK

In the Isaac Newton Memorial Volume, produced in 1927 to commemorate the two hundredth anniversary of Newton's death, there was published for the first time the contents of an early notebook, compiled by Newton as a boy or young man. The first part consists of a collection of rules and hints relating to drawing and painting (how to shade, how to enlarge a picture, to make a russet colour and so on) ; of receipts for cements, baits and other odd things ; of cures for certain troubles ; and of tricks. Prof. David Eugene Smith, who edited this matter, attributes it to some time within the period 1655–58 and apparently takes it to have been compiled by Newton. Prof. Louis Trenchard More, in his life of Isaac Newton, published last year, comments : "The most interesting, perhaps, of the items in this book, are those referring to drawing and the making of pigments, as they show the great interest he took in the art, and to the chemical and medicinal recipes which he jotted down".

This part of the notebook is, however, no collection of Newton's own, but is copied out from a book of receipts popular at the time, namely, John Bate's "The Mysteries of Nature and Art", of which the first edition was printed in 1634, and the third and last edition (a copy of which is in my possession) in 1654, shortly before the period to which we must attribute the part of the notebook in question. With this edition I have checked off all Newton's rules for drawing and painting, and many of his odd receipts—in fact, everything down to and including "To ingrave on a flint" in Prof. David Eugene Smith's reprint. The small remainder of this part of Newton's notebook consists of a few medical prescriptions and conjuror's tricks, which he may have picked up while lodging with Mr. Clark, the apothecary. I have not been able to trace them.

Another point of interest in Bate's book is that it contains full directions for making a water clock, which correspond to the account which Dr. Stukeley* gives of the water clock undoubtedly made by Newton. There is no doubt, then, that the "Mysteries of Nature and Art" was a book which young Newton freely consulted, and I conjecture that profounder historians than myself will find that it well repays study.

I may add that I find it a little difficult to accept Prof. Smith's attribution of date, 1655–58, for the first part of the notebook. On the first page of the book is the inscription :

ISAAC NEWTON HUNC LIBRUM
POSSIDET.
TESTE
EDVARDO SECKER.
PRET : 2^d OB.
1659.

Now, while a boy might write his name in a notebook, with his signature witnessed, as a schoolboy joke, some time after purchase, he is very unlikely to put the price, in this particular instance $2\frac{1}{2}d.$, except at the date of purchase. We know that Newton was very careful in his accounts of expenditure. I think we must take it that this inscription was inserted when the notebook was bought, and gives the date of the first entries.

* See Brewster's "Life of Sir Isaac Newton", vol. 1, p. 9. Louis Trenchard More, "Isaac Newton", p. 12.

Centenaries of Newcomb and Schiaparelli

SIMON NEWCOMB and Giovanni Virginio Schiaparelli were born within two days of one another, the former at Wallace, Nova Scotia, on March 12, 1835, and the latter at Savigliano, Piedmont, on March 14, and they died within a year of one another, Newcomb passing away on July 11, 1909, and Schiaparelli on July 4, 1910. Counting among their most distinguished contemporaries Lockyer, Huggins, Gill, Janssen, Loewy, Otto Struve, Auwers, Asaph Hall, Langley and Young, Schiaparelli was long regarded as the foremost of Italian astronomers, while Newcomb became to be recognised as the most eminent man of science in the United States.

They devoted themselves to widely differing branches of astronomy. Newcomb, as a member of the staff of the Naval Observatory, Washington, and as head of the "American Ephemeris and Nautical Almanac", during the course of forty years, contributed greatly to the advancement of gravitational astronomy, while Schiaparelli added immensely to the knowledge of meteors, comets and the planets. Honours were bestowed on them by many societies and institutions ; both were associates and medallists of the Royal Astronomical Society, both were foreign members of the Royal Society and foreign associates of the Paris Academy of Sciences, while Newcomb's connexion with the United States Navy was recognised by Congress granting him the rank of a rear-admiral.

Of Newcomb, many appreciations were written after his death in 1909, but the most fascinating