Respiration and Life Duration

Fruits of a short life-cycle, such as the strawberry, exhibit a higher respiratory activity than fruits of a longer life-cycle such as the apple. Variation occurs, however, even within a species. For example, in apples, the variety Bramley's Seedling respires at about two-thirds the rate of the Worcester Pearmain. The life duration of the latter is about one and a half times that of the former. Respiratory activity also varies with the nutrition of the fruit during growth. Therefore, if respiratory activity during cultivation of the fruit be increased by increasing the nitrogen content of the soil, life during storage is shortened, and vice versa. A more striking example, however, is the result obtained by gathering fruits at various stages during the second period of growth. At the beginning of this period, the cytoplasm and the cane sugar per cell are at their minimum, and so therefore is respiratory activity. Fruit gathered at this stage will thus have a longer life during storage than fruit gathered at any subsequent stage.

A young apple, in spite of the fact that it contains little carbohydrate when gathered, loses more carbon before death than does a full-grown fruit. A full-grown fruit does not usually lose more than 0·2–0·4 per cent of its carbohydrate and acid prior to death. It appears likely that it is the 'rate of living' which kills and that the machine breaks down from wear and tear and not from lack of fuel.

From these observations, three new agencies have come into use for the purpose of controlling the span and speed of life in fruits, namely: (1) use of ethylene as an accelerator of ripening; (2) use of carbon dioxide as a depressor of respiratory activity, thus retarding ripening and lengthening life; (3) the use of atmospheres poor in oxygen, thus reducing respiratory activity, delaying the climacteric and retarding ripening.

The possible use of ozone in controlling ripening is still in the experimental stage.

The Teaching of Optics*

OPTICS and mechanics are twin Cinderellas in the teaching of elementary physics. The beginner finds with growing disappointment that each covers ground remote from those thrilling matters of real life that they promised to deal with—remote from engines and machinery and from real optical instruments such as telescopes and microscopes. To make matters worse, a confusing fight rages round the teaching of each: a battle of units in mechanics, in which the mass and the weight of the projectiles employed seem inextricably mixed, and a battle of signs in optics, with $1/v-1/u=1/f$ and $1/v+1/u=1/f$ as its war cries. Mechanics has been rescued by the toy manufacturers—if we may call admirable constructional apparatus such as 'Meccano' toys—and the mathematical studies of mechanics which seem so artificial if attacked too early are left until the later school stages when they can bring a real delight unspoiled by disappointed hopes of romance.

Optics may follow a similar path with constructional sets of lenses and mirrors as Christmas toys to provide the practical delights that formal teaching often misses; and for several years such sets have been on sale, with optical components and adjustable framework for making a variety of working optical instruments. We grudge no toyshop such excellent wares, yet we cannot help feeling that elementary optical teaching is at fault and should itself capture and use some of the thrills that belong to actual instruments, before attempting to build a formal structure—an attempt long ago condemned in other branches of teaching. Many teachers, feeling this, now begin optics with a course that is not merely simplified but wholly changed in order and emphasis; yet even they must feel the drag of examination demands, textbook styles and the weight of tradition. So it is pleasing indeed to find that the Physical Society's Report urges that "The early approach to lens and mirror optics is best made along experimental lines, and every effort should be made to implant a sound conception of the main physical phenomena of image formation before mathematical formulæ are introduced", and suggests that an *experimental* start, free from mathematics, might be made with, "for example, elementary illumination and photometry, and the action of simple instruments such as the telescope, microscope and projection lantern". The Report says regretfully, "In only too many cases the beginning and end of optical instruction in schools seems to be bound up with $1/v - 1/u = 1/f$", a type of formula which, as one of the authors says later in the Report, is not much used in real optical work!

While the Report expresses these hopes for the future of elementary teaching, its main concern is with the conventions of signs in optical formulæ.

* Report of the Committee appointed by the Physical Society to consider and make Recommendations on the Teaching of Geometrical Optics. Pp. v+86. (London: Physical Society, 1934.) 6s. net.

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At present six or more different conventions are in use in textbooks in English. Most teachers, and presumably all examiners, must wish that some competent authority would choose one convention and enforce its universal use. But each wishes the chosen rule to be the one he uses himself, so the only chance of effecting a successful choice is for the pronouncement to come from a body of such high authority as to compel the agreement of teachers, examiners and authors alike. This Report gives just such a pronouncement. It is the result of five years work by a distinguished committee which included representatives of a wide range of optical and educational interests. It carries such a weight of authority that its recommendations, though they can only be made as suggestions, ought to be accepted as law.

The Report considers the current conventions of sign relating to formulæ such as $1/v \pm 1/u = 1/f$. From the half-dozen actually in use the Committee chooses two—the members themselves were unwilling to reduce their choice to one. Reasons are given for this preference, and it is urged that one of these two should be adopted in future in elementary optical teaching, and so far as possible, in advanced teaching. The Committee is unanimous in recommending that teachers in schools and universities should be asked to employ the practical opticians' convention which gives a positive power to a 'converging' lens, negative to a 'diverging' one. As most school teaching at present uses the opposite convention, neither of the two general sign conventions recommended is in use in any school textbook, but both are as good and clear and easily grasped as those now in use. So in schools the recommended changes will be slightly unwelcome to all at first, but ultimately very welcome.

The recommendations include the following:

(1) Converging lenses should be assigned positive power; diverging negative. Focal lengths should have the same signs as powers, as far as possible.

(2) That 'power' (equal in elementary cases, in air, to $1/(f$ in metres$)$) should be used in preference to focal length, where convenient.

(3) That an instrument (without erecting mirrors or prisms) should be assigned positive power if it produces an inverted image of an infinitely distant object; negative if the image is erect.

(4) That the numerical value of the power of a system be measured by the small angle subtended by an infinitely distant object divided by the length of its image. (A corresponding definition gives the focal length, and the Report suggests that this be made the basis of a laboratory method for estimating—but most school laboratories lack the space and the measuring microscopes necessary for accurate use of this method.)

(5) That in more advanced work when refractive indices are inserted, all formulæ should be made homogeneous in μ or μ'. For mirrors we should write $\mu/v + \mu/u =$ power, and power $= \pm 2\mu/r$.

(6) That the convention of signs be changed, in the course of time, to either of two recommended rules, described below as Group I (i) and Group II (i).

GROUP I (i) Distances measured from the lens or mirror are assigned *positive* values when measured in the *same* direction as the incident light and *negative* values when measured in the *opposite* direction. For example, if a lens placed 20 cm. from a real object forms a virtual image 30 cm. on the other side, then $u = -20$ and $v = +30$. To obtain the signs for power required by the convention mentioned in (1) above, we must use $1/v - 1/u = 1/f$ for a lens, and $1/v + 1/u = 2/r$ for a mirror.

GROUP II (i) Distances are measured *along a ray* (instead of along the axis; but this makes little numerical difference in elementary practice and need not complicate the teaching) and are assigned *positive* or *negative* values according as the object or image to which they relate is *real* or *virtual*. Distances are positive if light has travelled along them and negative if it only appears to have done so. Thus u has a positive value if the object is real and v has a positive value if the image is real, wherever it is. This convention emphasises the distinction between the image space of, say, a lens, and the object space. Each space extends on *both* sides of the lens, having positive distances on one side and negative on the other. For a lens the positive portions of object space and of image space are on opposite sides, for a mirror on the same side. For example, if a lens placed 20 cm. from a real object forms a real image 30 cm. on the other side, then $u = +20$ and $v = +30$. We must use $1/v + 1/u = 1/f$ for a lens and the same formula for a mirror.

Both conventions apply equally to wave, ray or other treatments. Both provide criteria for the signs of angles, magnification, etc. I (i) requires only a change of sign from the form common in school teaching; but II (i) promises certain extra attractions, since it uses the same formula for lenses and mirrors, seems to be able to carry a beginner through the thick and thin of an optical system at least as easily as I (i), welcomes the beginner's wish to call both u and v positive when he first experiments with a lens forming real images, and even allows him to forget which is which. On the other hand, II (i) requires a re-writing of texts, and some students may not find it so easy in advanced work.

We feel that the change to at least some measure of uniformity in optical teaching must be made—school teaching and the whole of commercial and ophthalmic practice cannot both have their own way unless the present diversity is to continue—and these recommendations provide the chance to make it. They deserve the support of all future textbooks, and even, so far as possible, advanced treatises. The revising of existing textbooks to conform with them would give trouble to publishers rather than to authors. Every publisher of scientific textbooks should keep a copy of the

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Report, for the benefit of authors as regards new textbooks, and for his own benefit, as regards reprinting existing books. Examining bodies could help by expressing, with increasing firmness, their preference for the new conventions. But the real demand for willing help must fall on the teacher, and we hope that all concerned with the teaching of elementary optics will be willing to welcome the change when the opportunity for it reaches them, and even, if they feel they can, to initiate it themselves meanwhile. All such teachers should examine this Report. At first glance it seems to sweep with dismaying rapidity through a mathematical optics that is quite beyond a school syllabus, but on careful reading it shows its authority and its value even for the most elementary teaching. The appendixes should be read together, and not taken as restricted each to its own convention. Each develops methods and proofs applicable with any convention. The examples seem rather ill-chosen for illustrating the use of signs in elementary work, but on closer examination do reveal the working of the rules, and as solved independently by two experts they are really entertaining.

The Committee does not wish to restrict the liberty of the teacher as regards methods of approach and treatment of the subject. The only restrictions it wishes to impose are concerned with routine matters such as conventions of sign. There has been ample opportunity for discussion of rival conventions, and now that a pronouncement has been made it is to be hoped that in the course of time all will comply with these recommendations. Not to do so would seem to be to deny the readiness of scientific workers to accept a simplification of unnecessarily complicated affairs.

E. M. R.

Obituary

DR. MICHAEL GRABHAM

IN the death on January 28 of Dr. Michael Grabham at the great age of ninety-five years, the island of Madeira has lost its most influential personality and the world an enthusiastic naturalist. Dr. Grabham, who was educated at King's College, London, and the University of London, qualified in 1861 at St. Thomas's Hospital and served there as house surgeon. He married Mary Blandy, one of the well-known family of merchant shippers, in 1865, and took up permanent residence as a practitioner on the island of Madeira. In that favoured island he produced a book dealing with its every aspect—natural and sociological—a treatise that is still of outstanding value despite the changing times.

Dr. Grabham usually paid a flying visit to his home country every summer, where he was recognised by many distinguished bodies. He received the degrees of M.D. and LL.D. from the University of Aberdeen; F.R.C.P. from the Royal College of Physicians, which he represented at the Geological Society's centenary meeting in 1907. In 1921 he delivered the Bradshaw lecture before the College. He delivered discourses at the Royal Institution and read papers on the climate and natural history of Madeira before the British Association, of which a few years ago he became the senior member. His last paper before the latter body was read in his eighty-eighth year and dealt with the subtropical deep sea food fishes of Madeira.

The Zoological Society of London some years ago established a collecting station in Madeira and to-day can show an unrivalled series of 'Madeira tanks' in its aquarium, each displaying some aspect of the wonderful fauna which exists in the island's coastal waters. For this exhibition Dr. Grabham is partly responsible, since he was first to suggest making Madeira a base of operations. Dr. Grabham, although not a professional marine biologist himself, was an enthusiastic aider and abettor of all who made marine biology their peculiar interest.

Among Dr. Grabham's numerous activities were music and the collection of clocks. In the former art he proved himself specially gifted, and when visiting London had on more than one occasion the privilege of giving organ recitals in St. Paul's Cathedral. His collection of chiming clocks numbered more than two hundred, and the writer well remembers his sensations on first spending a night at his host's home at Quinta do Val, when the numerous timepieces solemnly announced the midnight hour for fully sixty minutes before and after Greenwich had agreed with his own watch as to the precise moment of that event.

Dr. Grabham leaves two sons and one daughter, one of the former, Mr. Walter Grabham, being the Government geologist in the Sudan; his daughter, Mrs. E. B. Carter, has her own home in Madeira at Santa Cruz, where she spends her holidays and supervises the collecting operations on behalf of the Zoological Society.

Dr. Grabham had many friends, and the loss of his charming and energetic personality will be deeply felt by a large circle of friends both in Great Britain and in his island home.

E. G. BOULENGER.

MR. HERBERT G. PONTING

THE death of Herbert G. Ponting on February 8, at the age of sixty-four years, removes from us perhaps the greatest of all polar photographers, a pioneer in the application of artistic photography to the purpose of a scientific expedition.

The early part of Ponting's life was spent in a diversity of occupations; and he took to photography from the unusual atmosphere of agriculture and mining in the western United States. He rapidly made a name for himself by his pictures in Japan

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