The light which the flower of that name sends to the eye undoubtedly includes red rays.

The apparatus employed is on the model of the first described in an early paper,[1] the only difference worth mentioning being that the side upon which the movable slits are disposed is made oblique, to meet the variation in focal length along the spectrum. By this means any desired mixture of spectrum colours can be exhibited in juxtaposition with any other. For example, the violet can be shown alongside the blue, and any addition can be made to either. A few trials in 1907 confirmed my anticipations, an approximate match being easily attained by addition of *red* to the blue or of *green* to the violet. The slits by which the light entered were protected with suitable coloured glasses, cobalt glass being used for the blue and violet slits. In this way, as already mentioned, the danger of false light is obviated. I do not affirm that the mixture of blue and red looked *exactly* the same as the violet. I thought that I could recognise the violet as being more saturated, but the difference, if real, was very small and certainly a mere fraction of the original difference between blue and violet. Needless to say, the blue chosen was a full blue, showing no approximation to green.

The point of greatest interest lies in the contrast between my observations and those of Mr. Gerald Balfour, who was with me at the time. Mr. G. Balfour is one of the three brothers whom I found in 1881 (*loc. cit.*) to make anomalous matches of mixtures of red and green with spectrum yellow. To effect the match they use much smaller amounts of red than is required by normal eyes. But their colour vision is as acute as usual, and the abnormality is quite distinct from what is called colour-blindness. To Mr. Balfour's vision the violet of the spectrum is *not* redder than the blue, and such addition of red to blue as I required to make the match gave, in his estimation, a "reddish purple." Curiously enough, Mr. Enock, who was my assistant at that time, bore similar testimony, no addition of red on either side improving the match, which was indeed nearly complete as it stood. It is probably not a coincidence that Mr. Enock is also abnormal in his red *plus* green=yellow match, coming perhaps about half-way between myself and the Balfours.

When a few months ago I commenced to write out an account of these observations, it occurred to me that it would sound strange if I described my own judgments as normal and those of two other male observers as abnormal, and I sought to confirm my own judgment by that of others, especially of women. As to this, there was no difficulty. I usually showed first the simple blue and violet with about equal illumination [2] and asked the observer to describe them. In nearly every case the names blue and violet were correctly given. Can you describe one as redder than the other? was the next question. In most cases the answer came, "the violet is the redder"; but in some others all I could get at this stage was a negative. When, however, the same addition of red light that I require was made to the blue, every female observer that I have tried agreed that now the difference had practically disappeared. I can say with confidence that in this matter my own vision is normal.

Lately I have had another opportunity of repeating the observation with Mr. G. Balfour. It is certain that he sees no colour difference at all between the blue and violet. When to the blue an addition of red (less than I require for a match) is made, he describes the mixture as a reddish-purple, strongly distinguished from the violet. Mr. A. J. Balfour also could see no difference between the blue and violet, but he seemed rather less sensitive to additions of red. A determination of wave-lengths gave for the (mean) violet 415 (above G), and for the blue 440. The red was rather extreme.

That ordinary normal vision is very approximately trichromic cannot be doubted; but a question may be raised as to the possible existence of a very subordinate fourth element of colour. Thus Dr. Burch's descriptions might suggest that in his vision the sensation of violet depended upon such a fourth element. I am speaking here of fundamental sensations, not of such judgments as make yellow appear a distinct sensation to normal eyes, although certainly resolvable into red and green. The only way to get a final answer to such questions is by making matches with superposed colours; but to this method some workers seem singularly averse. In my own case I am certain that there is no fourth element of colour practically operative.

The character of the three primary sensations in normal vision is another and a much more difficult question. Perhaps in recent years we have rather lost sight of the argument which weighed with Maxwell in the passage above quoted. The better to see its significance, let us suppose that the spectrum is *accurately* represented on Newton's diagram by two sides of a triangle, and inquire into the significance of this disposition. The only explanation which does not involve highly improbable coincidences seems to be that in each spectrum colour only two of the three elements are involved. If the third is involved at all, how comes it to be involved in such a way as to make the spectrum straight? And the fact that near the red end variation of wave-length entails no variation of colour, makes in the same direction. That the green corner is rounded off and that (if it be so) the sides are not quite straight, may diminish, but cannot destroy, the cogency of the argument, while the less precise character of the conclusion is not without advantages.

RAYLEIGH.

[1] NATURE, vol. xxv., p. 64, 1881; Sci. Papers, i., p. 544.

[2] This adjustment can be made by partially cutting off the light on the side required by means of strips of glass interposed. By varying the number (up to 5 or 6) or inclination, the proportion of light transmitted can be regulated. This procedure was found more convenient than altering the widths of the slits.

MORE ANTARCTIC NATURAL HISTORY.[1]

(1) THE fifth, probably the penultimate, volume of the natural history results of the voyage of the s.s. *Discovery* has followed its predecessors without loss of time, and it resembles them in quality and interest, reflecting great credit on all concerned. The first memoir, by Dr. H. W. Marett Tims, deals with the embryos of Weddell's seal. The author finds in the musculature some additional support for Mivart's suggestion of a lutrine origin for the Phocidæ, and he has discovered in a very early embryo what seems to be the vanishing point of a vestigial external ear. Prof. Herdman deals like an old hand with the small but interesting collection of tunicates, comprising twenty-two species, of which ten are new to science. None of them are very remarkable forms in any way, but they confirm the impression which other collections

[1] (1) National Antarctic Expedition, 1901–4. Natural History, vol. v. Zoology and Botany. (London: British Museum [N.H.], 1910.) Price 30s.
(2) British Antarctic Expedition, 1907–9, under the command of Sir E. H. Shackleton, C.V.O. Reports on the Scientific Investigations. Vol. i., Biology, parts i.–iv. Pp. 1–79, 13 pls., 3 figs. (London: Published for the Expedition by W. Heinemann, 1910.) Price 12*s*. 6*d*. net.
(3) Expédition Antarctique Belge. Résultats du Voyage du *S.Y. Belgica* en 1897–8–9. Sous le Commandement de A. de Gerlache de Gomery. Rapports scientifiques. Botanique—Diatomées. By H. Van Heurck. Pp. 128+13 plates (1909). Geologie—Petrographische Untersuchung der Gesteinsproben, 1 Theil. By A. Pelikan. Quelques Plantes Fossiles des Terres Magellaniques. By Professor A. Gilkinet. Pp. 50+2 pls. +6 (1909). Oceanographie—Les Glaces—Glace de Mer et Banquises. By H. Arctowski. Pp. 55+7 pls. (1908). Zoologie—Schizopoda and Cumacea. By H. J. Hansen. Pp. 20+3 pls. (1908). (Anvers: J. E. Buschmann.)

have suggested, that "the ascidian fauna of the far south is characterised by the abundance and the large size of the individuals of a comparatively few species." In the present collection we have a number of gigantic forms, such as *Styela spectabilis*, of 18 cm.

Mr. T. V. Hodgson, who did so much hard work in collecting from under the ice-sheet, reports on the isopods, and has some very interesting discoveries to relate. Thus seven species, out of the total of twenty-five, have their eyes on enormous peduncles, which rather takes the edge off the "sessile-eyed" character of isopods! Striking also is the sexual dimorphism of one of the Arcturidæ, *Antarcturus franklini*, the male and female of which appear on one of the plates (remarkably fine pieces of work) as two species, and not very like one another either. "It was only when all the specimens of both sexes, or as it was then thought to be, both species, came to be overhauled that the error was noticed." Prof. L. Joubin has made the best of a bad business in his report on the nemerteans, for by misadventure he had only the remains of a collection to work with, which indeed only a courageous enthusiast would have touched.

Mr. Edward T. Browne has a finely executed and beautifully illustrated memoir on the Hydromedusæ and Scyphomedusæ of the *Discovery* and *Southern Cross* expeditions, seventeen species in almost as many genera. All are either new species or have been recently described as new species from the Antarctic. Some of the general results are noteworthy: there is no proof that a single species is common to Arctic and Antarctic; there is definite evidence of relatively primitive features in some Antarctic Medusæ, corroborating the view that evolution lags in the cold; it is doubtful if there are any "deep sea" Medusæ in the usual sense of that term. Among the anatomical results of interest is the discovery that the interior of the stomach in the hydromedusan genus Koellikeria is covered with minute endodermal papillæ, but whether these have the same function as the gastric filaments of the Scyphomedusæ remains to be found out. Very curious, too, is the new species of Sibogita, with its stomach completely converted into a reproductive organ when the gonads are ripe. "The stomach then ceases to function as stomach, and its cavity is filled with endoderm. The gonads are apparently in ectodermal pouches, which are embedded in the endoderm, and the pouches have openings to the exterior for the discharge of their contents." But we must pass from these exciting things to notice that the volume ends with a report by Mr. O. V. Darbishire on a collection of twenty-five species of lichens, of which five are new. As he says, they are "the outposts of plant life," occurring where no other plants at all are met with; *e.g.*, at a height of 5000 feet on the ridge of the Western Mountains. It is interesting also to notice that of four species collected on Mount Erebus at a height of 1500 feet, three are also Arctic.

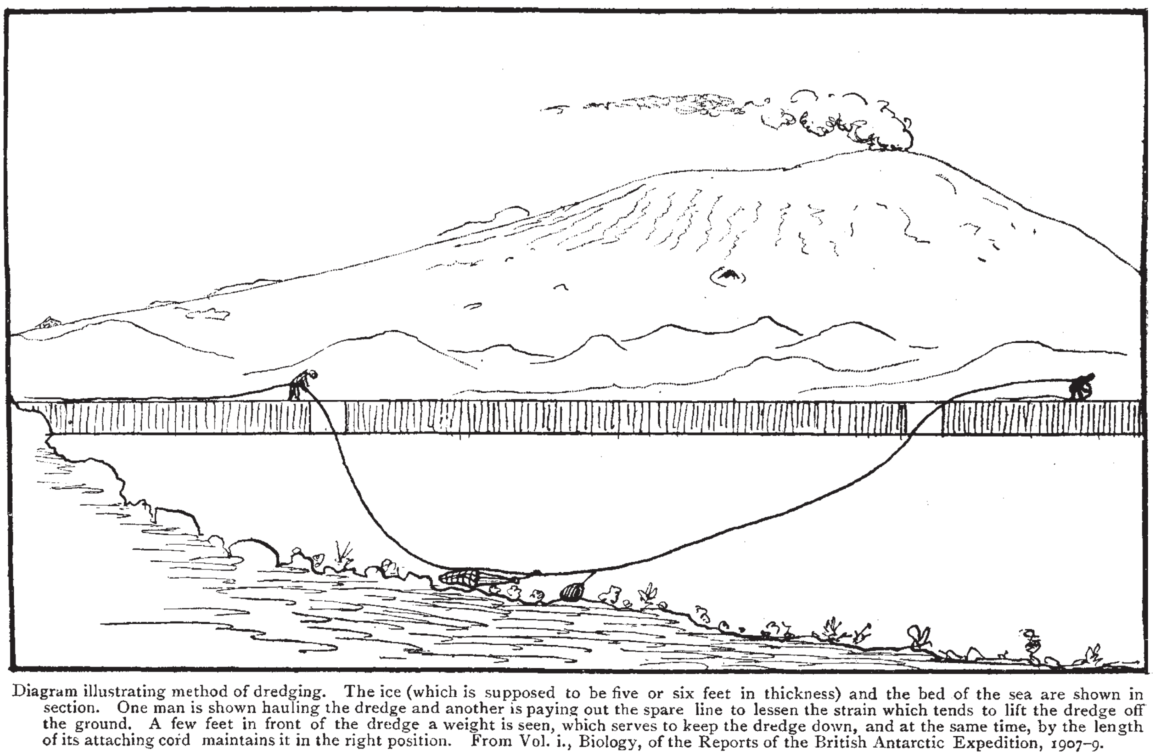

Diagram illustrating method of dredging. The ice (which is supposed to be five or six feet in thickness) and the bed of the sea are shown in section. One man is shown hauling the dredge and another is paying out the spare line to lessen the strain which tends to lift the dredge off the ground. A few feet in front of the dredge a weight is seen, which serves to keep the dredge down, and at the same time, by the length of its attaching cord maintains it in the right position. From Vol. i., Biology, of the Reports of the British Antarctic Expedition, 1907–9.

(2) We turn from what is almost the last of one series to the first of another—the reports on the scientific investigations of the British Antarctic Expedition, 1907–9, under Sir E. H. Shackleton. The editor, Mr. James Murray, has lost no time in bringing out a part of the "Biology," and what he has to tell is of much interest. The collecting at Cape Royds (about lat. 77° 32′ S., long. 166° 12′ E.) was done under great difficulties. There was no vestige of life on the beach itself, where an ice-foot persists most of the year. The black lava inshore yielded only a few tufts of moss and some lichens. The small lakes had a sheet of vegetation at the bottom, but it was hard work reaching this through over fifteen feet of ice. Some laborious collecting was done in the sea by hauling a dredge between two holes cut in the ice. Traps were also baited, which brought up amphipods, molluscs, and the like.

The mean temperature of a summer day at Cape

Royds rarely rises above freezing-point, and there is no vegetation higher than mosses. It is therefore surprising to hear of an abundant microscopic fauna and flora. Mr. Murray's experience stood him in good stead, for he made much of a very unpromising centre of operations. "The kinds of animals which are usually to be found among mosses have at Cape Royds a shelter of another sort, which, judging from their numbers, appears to suit them better. This is furnished by the foliaceous vegetation which grows so abundantly in the lakes and ponds." Thus Mr. Murray reports:—"I have never anywhere seen bdelloid rotifers so plentiful as are the two dominant species at Cape Royds (*Philodina gregaria* and *Adineta grandis*). . . . The water-bears are of only a few kinds, but one of them (*Macrobiotus arcticus*) is extremely abundant. There are nematode worms of two or more kinds, mites of several kinds, and two crustacea belonging to the Entomostraca. The ciliate infusoria are very numerous, there are a good many flagellata, but only two rhizopods were observed." Numerous microphotographs were taken under disadvantageous conditions, and some of these are printed—showing not only rotifers, water-bears, and the like, but some other creatures which the editor has wisely refrained from naming.

Some sixteen species of rotifers were distinguished, representing all the orders, though mostly bdelloids. This is the first definite record of rotifers within the Antarctic Circle, and five of the bdelloids are new species. The most interesting facts are those regarding the toughness of the rotifer constitution. Thus *Philodina gregaria* n. sp. is normally frozen in the ice of the lakes for the greater part of the year, and revives at any time that the ice is thawed. It may be alternately thawed and re-frozen at weekly intervals for several months. In England it was subjected to a temperature of −78° C. for many hours, by Mr. J. H. Priestley, of Bristol, and survived. Of *Adineta grandis* n. sp., which survived the lowest temperatures experienced at Cape Royds (−40° F.), and repeated freezing and thawing, and immersion for a month in sea-water, it is further recorded that "a proportion of them lived after the bottle containing them (in the dry condition) was immersed in boiling water for a short time. It was one of the rotifers which was to be seen alive and active in London in September, 1909, after being dry for about a year, and spending some months in tropical and sub-tropical climates." This toughness of constitution is interesting in several ways; *e.g.*, in showing that these Antarctic rotifers can stand very adverse circumstances in the course of dispersal. Another point of interest concerning the rotifers is that the two dominant species, named above, are viviparous, which seems therefore the mode of reproduction best adapted to secure success in the struggle of existence under the severe conditions at Cape Royds. M. Jules Cardot reports on four mosses; the rest of the report is due to Mr. Murray, to whom we offer congratulations.

(3) From a third Antarctic expedition, the *Belgica* (1897–9), some additional reports have been recently received. Thus Dr. H. J. Hansen, who has done such good work among the crustacea, describes some new schizopods and cumacea. He indicates, as other authorities on crustaceans have done, that the familiar title schizopods will have to go, and that the orders of Euphausiacea and Mysidacea, which it includes, are far from closely related to each other. In regard to *Euphausia superba* he notes that it is the staple food supply of seals, such as *Lobodon carcinophaga*, and that it seems to live everywhere in the Antarctic Ocean. A. Pelikan gives a petrographical account of diorites, gabbros, porphyrites, and other types of rock collected by the expedition. Prof. A. Gilkinet reports on a few fossil plants from Magellan; Fagus, Nothofagus, *Myrtiphyllum, Saxegothopsis,* which seem to be of relatively recent age, and bear a close resemblance to members of the present-day flora of that region. H. van Heurck reports on the diatoms and adds to the value of his work by a survey of polar diatoms in general. Henryk Arctowski gives a beautifully illustrated account of his personal observations on the different kinds of ice and their transformations. These observations are all the more interesting since very little was known of southern ice before the voyage of the *Belgica*. As the author indicates, a good deal has been done since.

ATOMIC WEIGHTS.[1]

DR. CLARKE continues to put all chemists under an obligation to him by reason of the zeal and care with which he collects and disseminates information concerning the most important of all chemical constants—the atomic weights of the elements. In the volume before us—the third edition of a work with which his name is inseparably associated—he has brought to a focus all contemporary knowledge on the subject, discussing, digesting, and weighing the experimental evidence with the same lucidity, completeness, and impartiality which have characterised his previous publications.

It is interesting and instructive to compare the present issue with the original one of 1882. The number of the chemical elements has not greatly increased during the last thirty years. Even including the inert gases of the atmosphere and such of the radio-active elements of which the individuality may be said to be established, the increase is not more than about a dozen, and such values of their atomic weights as we possess are only of the order of first approximations. The most significant feature of the difference between the two issues is seen rather in the far higher standard of accuracy which is now required in such estimations. It is absolutely useless nowadays for anybody to engage in such determinations who is not prepared to impose upon himself the most rigorous checks, the most scrupulous attention to detail, and an inflexible determination to put forward no result that will not stand the severest scrutiny.

Atomic weights to-day are required for other purposes than chemical arithmetic, and comparatively rough approximations serve for the greater number of the operations of quantitative analysis. The errors due to manipulation, and to the use of methods faulty in principle, are, as a rule, far larger than those due to the employment of incorrect values for the atomic weights. Instances, indeed, might be quoted where it is apparently necessary to adopt a confessedly inaccurate value for an atomic weight in order to compensate for the error due to an imperfect method of quantitative estimation. Certain large trade operations could not be equitably arranged on any other basis. This, of course, does not concern the chemist as a man of science, and is certainly no argument for the retention of an inaccurate constant in our tables

[1] (1) The Constants of Nature. Part v., A Recalculation of the Atomic Weights. Third Edition. Revised and Enlarged. By Frank Wigglesworth Clarke. Pp. iv+548. (Washington: Smithsonian Institution, 1910.)

(2) Determinations of Atomic Weights. Further Investigation concerning the Atomic Weights of Silver, Lithium and Chlorine. By Theodore W. Richards and Hobart Hurd Willard.

The Harvard Determinations of Atomic Weights between 1870 and 1910. By Theodore W. Richards.

Methods used in Precise Chemical Investigation. By Theodore W. Richards. Pp. iv+113. (Washington: Carnegie Institution, 1910.)