

Livius, and Catullus being *Caligula*, *Livii*, and *Catulli*, I cannot accept such specific names as *Doriai*, *Retziusi*, *Catulloi*, but consider that they should be corrected to *Doria*, *Retzii*, *Catulli*."

With regard to genera, Dr. Thorell considers that such terms as *Scorpio* and *Aranea*, cannot be used in a generic sense, because in the plural form they are applied respectively to the orders of Scorpions and Spiders. This view, however, is, we venture to think, untenable. For the terms were used by Linnæus generically before they were used ordinarily; therefore, if it be considered necessary to change either the generic or the ordinal name, it is surely the latter that should be abolished. Moreover, in the interests of nomenclature it is more important that the generic name should be stable than the other. And curiously enough, Dr. Thorell, with apparent inconsistency, seems to take this view of the case when there is any clashing between the name of a family and of one of its genera. For he always, and we believe correctly, forms the family-names with the termination—oidæ, such as *Lycosoidæ* instead of the more usually accepted *Lycosidæ*. But he affirms that if there be a genus termed *Lycosoides* contained in the family *Lycosoidæ*, the latter name must be altered, and a new one constructed from some other genus, e.g. *Trochosoidæ*, be adopted. The practical application of this view has led him to abandon such long-established family-names as *Epeiroidæ*, *Thomisoidæ*, *Attoïdæ*; but if it were to be consistently and universally adopted, it is clear that all the family-names now in vogue, and every successive substitute, might have to be changed and again changed *ad infinitum*.

One other point deserving of notice is Dr. Thorell's opinion that the priority of *species*-names should be reckoned from 1751, when Linnæus, in his "*Philosophia Botanica*," proposed and gave rules for his binomial nomenclature. Most zoologists now refer back to 1758, the date of the publication of the tenth edition of the "*Systema*." But Linnæus's disciple Clerck published in 1757 his classical work "*Aranei Suecici*," in which he describes and gives good coloured figures of about sixty species of Swedish spiders, with binomial names according to Linnæus's system, and no arachnologist can admit that these names ought to be rejected simply because they were published *before* the tenth or twelfth edition of the "*Systema*." Such questions as these, however, we may perhaps leave with safety and confidence in the hands of the two recently appointed bibliographical committees, from which so much is expected.

R. I. P.

### COLOUR VISION.

*Colour Vision: being the Tyndall Lectures delivered in 1894 at the Royal Institution.* By W. de W. Abney, C.B., D.C.L., F.R.S. (late R.E.) Pp. ix. + 231, 8vo. (London: Sampson Low, Marston, and Co., 1895.)

CAPTAIN ABNEY has long been known as the authority upon the scientific measurement of colour, and his researches have naturally involved a continual attention to the problems of colour-vision. This, too, he has made the subject of measurement in numerous ways, and in observations extending over many years. The

results of his work in the domain of colour-vision were systematically expounded by him in the "Tyndall Lectures" of 1894, and have now been recast in their present form. The volume, which is sumptuously printed in double-ledged type, is illustrated not only by numerous cuts and process-blocks, but by an excellent chromolithographic spectrum chart of the typical cases of colour-vision. It is worthy of the reputation of the President of the Physical Society, and constitutes a distinct addition to the literature of physiological optics.

The work, as published, is now arranged in chapters without reference to the original disposition of the subject-matter when delivered in the form of lectures; and a very large portion of the book is devoted to the various cases of colour-blindness, both congenital and acquired, including the species of amblyopia due to excessive use of tobacco. In the opening chapter, which deals with the anatomy and physiology of the eye, the fascinating theory of the "visual purple" is mentioned, only to be at once dismissed as incompatible with the fact that that part of the retina which is most sensitive both to light and colour, the *fovea centralis*, is destitute of the structures which alone contain the substance which possesses the purple reaction. The second chapter deals with the wave-lengths that correspond to the several colours of the spectrum, and with the apparatus devised by the author for producing any desired mixtures of spectrum tints for the purpose of colour-matching. The physical proofs that green is a primary colour because it cannot be made up by mixing any two other colours, and that yellow is not a primary because a yellow can be made by a mixture of two others, are given very clearly. On p. 24 the author remarks that "we are all familiar with the fact that there are three primary colours," whereas the fact is not that the colours are primary, but that the sensations are primary; and he assumes, without any proof save that of indirect inference, that these primary sensations are three in number. Indeed, in another passage the admission seems to be made that the sensations which are primary are four in number.

Quoting from Prof. Michael Foster's epitome of Hering's theory of colour-vision, the author gives the following statement.

"The sensations caused by different kinds of light, or by the absence of light, which thus appear to us quite distinct, and which we may speak of as 'native' or 'fundamental' sensations, are white, black, red, yellow, green, blue. Each of these seems to us to have nothing in common with any of the others, whereas in all other colours we can recognise a mixture of two or more of these. . . . Hering's theory attempts to reconcile, in some such way as follows, the various facts of colour vision with the supposition that we possess these six fundamental sensations. The six sensations readily fall into three pairs, the members of each pair having analogous relations to the other. In each pair the one colour is complementary to the other, white to black, red to green, and yellow to blue."

Commenting on this theory as so stated, Captain Abney says that it should be described as "tetra-chromic" (should it not be chromatic?) rather than "tri-chromic," for as far as "colour" is concerned, the black-white sensation must be excluded. But, surely

there is much more to criticise in so crude a presentation of the case. Is not brown just as truly a "native" or "fundamental" sensation as green or blue? Without an education it would be impossible to pronounce it to be a mixture of any other two of the "native" sensations. The writer would go further, and include amongst native sensations that of purple, the pure full purple so rarely occurring in nature. To him, indeed, violet suggests a mixture of blue and purple, while crimson suggests a mixture of the sensations of purple and red. Further, it is not strictly true of the six supposed native sensations connoted by the six names given above, that they are in each pair complementary to each other. The true complementary to yellow is violet, not blue; the true complementary to blue is orange, not yellow. The true complementary to red is not green, but blue-green or peacock; and the true complementary to green (full green) is not red, but a crimson tending toward purple.

In other parts of the work, Hering's theory is compared with Young's theory; and a really decisive point in favour of the latter is made on p. 136, where it is shown, from the experiments made on the gradual extinction of luminosity down to the tints that persist last when all others have become invisible, that the finality of disappearance in the case of persons of monochromatic vision is inexplicable on Hering's physiological assumptions.

Many other points in the work show acute observation. The remark that no colour-match can be accepted unless we know the portion of the retina used in the operation is an instance, for the match will be different if the portion used is the macula lutea instead of a larger area of retinal surface; while, again, the colour-vision at 10° obliquity differs even in the normal eye from that of the fovea centralis. The instructions how to pick out from the spectrum tints those which excite sensations that are primary, on p. 93, though not too clearly expressed, are readily understood; and of great value to future workers. The experiment of producing the neutral or a-chromatic sensation of light by means of a glow-lamp under a shade of blotting-paper, is both novel and neat.

Unfortunately the author occasionally uses words and phrases in a special or technical sense of his own devising, and which he does not define. It is left to the reader to discover, if he can, what the meaning is. For example, on p. 112, the words "the extinction" are used not to mean the disappearance of the light, but to mean, apparently, the percentage degree to which the light has to be reduced in order to be practically imperceptible. Unless one finds out by some sort of intuition that the word is being used in this unusual sense, one is puzzled to read three pages further on that "if we multiply the extinction by the luminosity, we shall get what we want." Indeed, the word "luminosity," used so often throughout the work, needs to be better defined; and it ought to be used, when defined, only in one sense. There are several passages in which the word occurs, where it is not evident whether the term "luminosity" refers to the number of candles per unit area (the sense in which one would speak of the intrinsic or specific luminosity of the crater of the electric arc, or of the flame of a lamp), or whether it

refers to the illumination of a surface in terms of the illumination due to a standard light at a standard distance, or, lastly, whether it refers to the apparent luminosity as viewed by a person of possibly abnormal vision. Yet at the bottom of p. 115 we are told that the author has taken "the luminosity of the yellow light near D [in a particular experiment] as one amyl acetate lamp." Taken literally and grammatically, luminosity here means simply "one lamp" of a kind that is known to be equal to about 0.87 of a standard candle. The plaintive remark on p. 181, that the word "brightness" is misleading to some people who are uneducated, is a curious commentary on the use of a word that will mislead some who are not uneducated. In a certain "criterion by the luminosity method" (p. 182), red is placed beside white, and the subject is asked to say which he considers the *darker*. This is to avoid asking him (lest it should be misleading) which he considers the brighter. Does the word luminosity as here used mean anything more than brightness? Again, on p. 110 we read: "The spectrum was of such a brilliance that the intensity of the square patch . . . of the orange light (D) was exactly that of an amyl-acetate lamp, placed at one-foot distance from the receiving screen. Knowing this, the actual luminosity of all other rays of the spectrum can be derived from the curve of luminosity." In this passage, has not the word "intensity" precisely the same meaning as "luminosity"? And does not the word "brilliance" again mean the same thing? Would not the passage be exactly as clear if the word "brightness" had been used instead of the three different words in the places where they occur?

The most valuable part of the work is that which relates to colour-blindness, where, for the first time, there are given charts showing the degree of *apparent* luminosity (the qualifying adjective is the reviewer's) in different parts of the spectrum to persons having one or other variety of colour-blindness. One case, mentioned on p. 85, is of exceptional interest. This is the case of a person who, though he sees each of the three fundamental colours quite correctly, red as red, green as green, violet as violet, is relatively less sensitive to green than other persons of normal vision. "He is defective in the green sensation, although it is present to a large extent." Here is a person who certainly would be quite capable of doing duty as an engine-driver or as a seaman, perfectly able to distinguish green lights from red, but who yet would be condemned, if tested by the much over-rated method of Holmgren, as being colour-blind. Indeed, the least satisfactory part of Captain Abney's book is that wherein, in the face of this very case in which Holmgren's wool tests would unjustly condemn a man, he describes and praises the Holmgren method of testing colour-vision. There is not one word of warning as to its uselessness in such cases, or as to its misemployment by practitioners devoid of any training in the optical laboratory. Captain Abney says that he "is glad to say" that the Holmgren system has been adopted by the Board of Trade and by most of the railway companies in the United Kingdom. The pity is, that no one explains to those who have to use it how easily the coloured wool test may be (and actually is) misused, and how in certain cases, like that cited, its indications may inflict a serious injustice.

S. P. T.