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Guest editorial

An upright man

"An understanding of Greek physiological psychology before Plato and after Aristotle requires that one know his Theophrastus; and having studied this fragment long myself, in the attempt to learn more of the history of psychology, it seemed but a neighbourly act to lighten, if one could, the labour of other psychologists until some abler help should come" (Stratton 1917, page 5).

Figure 1. *An Upright Man.* An upright, inverted, and combined view of George Malcolm Stratton (1865 – 1957), derived from a portrait kindly supplied by the University of California, Berkeley. The combined portrait can be viewed upright or inverted, after the manner of Rex Whistler (see Whistler 1946).

The name of George Malcolm Stratton (1865 – 1957) is known to almost every student of perception. He viewed the world with an upright retinal image (optically inverting the inversion in the eye) and described his experiences over a period of days. Gregory (1998) has referred to it as "perhaps the most famous experiment in the whole of experimental psychology" (page 92). Stratton's first study was published as a preliminary report in 1896, and theoretical aspects of it were discussed in a later note (1897a). He wore lenses in front of his right eye, with the left occluded, for a period of three days. At the time he was one of Wundt's students at Leipzig, and made the initial announcement of his experiment at the Third International Congress of Psychology, held in Munich in 1896. On his return to California he extended the experiment by wearing the lenses for eight days; the resulting experiences were described in two articles (1897b, 1897c) published in the *Psychological Review*.

Upright vision with an inverted retinal image was then typically accounted for by either projection or eye-movement theories. Stratton posed the question: "*Is* the inverted image a necessary condition of our seeing things in an upright position? The method of approaching the problem was to substitute an upright retinal image for the normal inverted one and watch the result" (1896, page 611). He was the watcher. At first, objects appeared inverted, perceptual – motor coordination was disrupted and there was a distinction between where objects were seen and where they were thought to be. "By the third day things had thus been interconnected into a whole by piecing together the parts of the ever-changing visual fields" (page 616). He did not report any aftereffects when the lenses were removed after three days, and he concluded that "the difficulty

of seeing things upright by means of upright retinal images seems to consist solely in the resistance offered by long-established previous experience" (page 617).

The first experiment was conducted entirely indoors, but when he repeated it over eight days in California he ventured outdoors, too. The pattern of experiences was similar for the first three days, and the adaptation became more established thereafter. There were, however, aftereffects when the lenses were removed: "On opening my eyes, the scene had a strange familiarity. The visual arrangement was immediately recognized as the old one of pre-experimental days; yet the reversal of everything from the order to which I had grown accustomed during the past week, gave the scene a surprising, bewildering air which lasted several hours. It was hardly the feeling, though, that things were upside down" (1897c, page 470). The theoretical lesson to be drawn from the longer study was essentially the same as that from the shorter one: "harmony comes only after a tedious course of adjustment to the new conditions, and that the visual system has to build anew, growing from an isolated group of perceptions" (page 471). Stratton (1899) disrupted the harmony between touch and sight in a further study that is cited less frequently. He wore a system of mirrors mounted on a harness that resulted in him seeing his body from above; this he experienced over a period of three days and found a similar course of adaptation. The conclusion was similar to that derived from the inversion experiments: "The simplest explanation seems to me to be that a correspondence, point by point, between touch and sight, is built up associationally; and only by actual experience does a person learn what visual position corresponds to any given tactual position" (pages 498–499). He then related this interpretation to cases in which sight had been restored in the blind, after the manner of Cheselden's patient (see Wade 1998). Gregory (1966, 1998) has reproduced an illustration of the mirror system used by Stratton.

The behavioural effects of adaptation to optical inversion have generally been confirmed in subsequent investigations (see Welch 1978), but the enigma of whether the world subsequently looks upright has proved harder to resolve. Linden et al (1999) examined four subjects wearing inverting optical devices for up to ten days. They presented psychophysical evidence to indicate that the perceptual world remained inverted throughout the period of adaptation, and brain imaging (fMRI) indices displayed no changes in activity at early visual areas.

Despite widespread recognition of the inversion studies, Stratton remains a shadowy figure in the history of psychology. He seems to have evaded most standard biographical dictionaries, despite having established the Psychological Laboratory at the University of California in 1899 and he subsequently directed it, as well as being President of the American Psychological Association (in 1908). For example, the recent *Biographical Dictionary of Psychology* (Sheehy et al 1997) does not contain an entry for him. Stratton did not feature in any of the early volumes of *A History of Psychology in Autobiography*, nor is he among the *Portraits of Pioneers in Psychology* (Kimble et al 1991, 1996). Hilgard's (1987) reference to Stratton in *Psychology in America* is cursory and devoid of biographical information. His inversion experiments are described in Boring's (1929, 1942) histories, but little else is said about his work. Stratton was accorded obituaries in the *American Journal of Psychology* (Bridgman 1958) and in *Science* (Brown 1958), but the latter emphasised his writing in the area of social psychology.

Did Stratton cease to publish in perception after reporting his upright views? He did, in fact, proceed to examine aspects of pseudoscopic vision (1898), stereoscopic acuity (1900), eye movements, symmetry, and visual illusions (1906), visual direction (1907), and motion perception (1911a). A more exhaustive list can be found in Murchison (1929). The article on motion was concerned with apparent motion, and preceded the paper by Wertheimer (1912). Stratton reviewed earlier experiments by Exner and others, and reported two studies of his own; the conclusion was: "The seeing of motion is a more

elaborate, and yet at the same time more facile mental act, than the seeing of mere succession" (1911a, page 293). Stratton also wrote a series of general reviews and summaries of contemporary experiments on space perception (1911b, 1912, 1913, 1914). These would have proved particularly useful to readers of the *Psychological Bulletin* because they provided succinct accounts of experiments reported in European journals. Among the topics surveyed were: monocular and stereoscopic depth perception, peripheral vision, eye movements and visual direction, spatial illusions, hemianopsia, Hillebrand's alley experiments, motion aftereffects, Poincaré's analysis of three-dimensional space, Wertheimer's experiments on apparent motion, afterimages, and Katz's colour studies. The extensive knowledge of the literature displayed by Stratton in these reviews is impressive. For example, in discussing Wohlgemuth's monograph on motion aftereffects, Stratton noted that the historical survey "is not without omissions" (1913, page 257); among these omissions were experiments by Basler (see Wade 1994) and Stratton (1912) had summarised one of Basler's studies in an earlier review. Stratton's reviews were not without their barbs. For example, he was scornful of many published studies by "Dufour who annually reports facts, many of which are well known" (1914, page 235).

However, Stratton's greatest single commitment to perception was historical. In 1917 he published *Theophrastus and the Greek Physiological Psychology before Aristotle*. It consists of a translation from Greek into English of "Theophrastus's work *On the Senses*" because it "is the most important source of our knowledge of the earlier Greek physiological psychology" (page 15). Without it the knowledge of early theories of vision would be even more meagre. Indeed, Stratton went so far as to say that "we are indebted to Theophrastus for more than to all the other ancient authorities combined" (page 16) for a knowledge of Greek psychology before Plato. Not only did Theophrastus (figure 2) outline earlier theories of perception, but the descriptions were often accompanied by fulsome criticisms. For example, Democritus's (c 400 BC) atomic theory of colours is described thus: "The simple colours, he says, are four. What is smooth is white; since what neither is rough nor casts shadows nor is hard to penetrate,—all such substances are brilliant.... Black is composed of figures the very opposite ⟨to those of white⟩,—figures rough, irregular, and differing from one another.... Red is composed of figures such as enter into heat, save that those of red are larger.... Green is composed of both the solid and the void.... The other colours are derived from these by mixture" (Stratton 1917, pages 133–135). Theophrastus points to the contrast between this theory involving four primaries and others which proposed only two (black and white). He then concludes that Democritus "should have given some distinc-

Figure 2. Theophrastus (c 370–286 BC) after an engraving in Figuier (1866).

tive ⟨figure⟩ to green, as he has to the other colours. And if he holds ⟨green⟩ to be the opposite of red, as black is of white, it ought to have an opposite shape; but if in his view it is not the opposite, this itself would surprise us that he does not regard his first principles as opposites, for that is the universally accepted doctrine. Most of all, though, he should have determined with accuracy which colours are simple, and why some colours are compounds and others not" (page 141). As Stratton noted, "Theophrastus's work is more than a report of what his predecessors observed and thought. After a passionless and undistorted account of another's theories, there comes in almost every case a criticism, with a severity of logic that permits one better to know the kind of scrutiny to which these early psychological doctrines were subjected in the later Athenian universities. 'Absurd' or 'childish', Theophrastus does not hesitate to call them, with marshalled evidence for his condemnation" (1917, page 16).

Theophrastus (c 370 – 286 BC) was a favoured pupil of Aristotle: he was bequeathed Aristotle's library and manuscripts, and after Aristotle's departure from Athens he directed the Lyceum for the remainder of his long life. Through his teaching and writing Theophrastus sought successfully to make the Aristotelian system more widely accessible. Indeed, the ideas of the two philosophers are generally so similar that attribution of distinctions between them have often proved difficult to determine. Both ranged widely in their writing about natural phenomena, although only a few fragments of Theophrastus's have survived. Most of these have concerned the classification of plants, and he has been called the 'father of botany' (Bodenheimer 1958). He mentioned and tried to classify over 500 species of plants, often describing how they reproduce and the diseases to which they are prone. In all his enquiries he was noted for basing his conclusions on observations rather than theory. While Theoprastus echoed the views of Aristotle in most matters, he did adopt a more thorough going empiricism than his teacher. He tried to avoid any appeal to final causes and to restrict his accounts to observations of natural phenomena (see Watson 1968). Perception was said to accord with nature so that it is veridical, and objects are sensed indirectly through some medium. Theophrastus did posit the processes of perception and thought in the brain rather than in the heart, as Aristotle had contended (see Beare 1906). Prior to Stratton's translation attention had been directed principally to the descriptions Theophrastus had given about the ideas of others; Stratton brought the thoughts of Theophrastus himself into sharper relief.

Stratton's translation, as he remarked, owed much to Beare's (1906) book and to correspondence with A E Taylor of St Andrews. Alfred Edward Taylor (1869 – 1945) was Professor of Moral Philosophy initially at St Andrews and then at Edinburgh University; he was an authority on Plato, and shared with Stratton an abiding interest in the philosophical and psychological problems posed by religion.

Stratton's approach to psychology was based on his early exposure to philosophy, particularly that of George Holmes Howison whose biography he collaborated in writing. His philosophy was tempered by exposure to Wundt's experimental approach, and it pervaded his social psychology. He concentrated on the social dimensions of individual behaviour in his later writing, particularly those concerned with culture, religion, and international conflict. The books he wrote on these topics appear to have made relatively little impression on his contemporary social psychologists. Stratton's name lives on within perception in the context of his studies of vision with an upright retinal image, and within the history of science for his translation of Theophrastus. Has history treated Stratton as well as he served history?

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