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EYES SHUT AND HANDS AT WORK: NOTES ON THE USE OF WEBER'S COMPASS IN NINETEENTH CENTURY ANTHROPOLOGY

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Writing in 1891 about his expedition to Cap Horn, Paul Hyades asserted that the Yahgan's "tactile sensibility, measured with Weber's compass, seems to present some differences with regard to the results of observations obtained among Europeans" (1891: 210).¹ A physician by training, Hyades (1847-1919) could assume that his readers were familiar with this instrument.² Why was this device, designed in the 1820s for physiological and medical research, put to anthropological use in the 1880s? For what reasons did anthropologists undertake measurements of tactile discrimination, and what were the implications of the values obtained?

Although there is a vast literature on the quantitative approach in sensory physiology and on the emergence of psychophysics during the 1830s and 1840s, the impact of its methodological apparatus on anthropology has been unacknowledged. One of the instruments borrowed by anthropology from other disciplines was Weber's compass, named after Ernst Heinrich Weber (1795-1878), professor of human anatomy and later of physiology at Leipzig University (Kruta 1976). Though Weber's name is usually associated with a law, articulated by Gustav Theodor Fechner,³ his compass, designed to measure the degree of distinctness of sensation in different parts of the body, was widely used in psychological and physiological research before being turned to anthropological purposes.

No later than 1826, Weber was investigating the sense of touch at a time when most research on the senses focused on vision and hearing. It was in order to ascertain the parts of the body where the sensibility was more acute that Weber devised the compass, which allowed him to determine quantitative relationships between stimulus and sensation. The most sensitive regions of the skin—the extremities of the fingers, the point of the tongue, the lips, the hairy scalp, the palm of the hand—had more nerve endings; the degree to which a part of the body responded to stimuli was proportionate to the number of nervous fibers distributed in it. The differences Weber found led him to conclude that "discrimination is most accurate where the fibres are most dense" (Boring 1944: 110). The compass was a means to differentiate thresholds of sensation in different parts of the body.

The compass itself was a simple device, easy to manipulate; but its use in research required specific procedures. "Weber's experiments consisted in touching the skin, while the eyes were closed, with the points of a pair of compass sheathed with cork, and in ascertaining how close the points of the compass might be brought to each other and still be felt as two bodies" (Müller 2003 vol.2: 751).⁴ Proper experimentation had three main features. First, the experimental subject had to close his or her eyes. The use of the compass was intended to discern differential thresholds, distinguishing degrees of sensitivity to the fact that the compass had two points. "In the compass experiment, two points applied within the same sensory circle would give rise to the stimulation of but one fibre, and thus to the perception of a single point; two points on adjacent circles, however, would stimulate adjacent fibres and give the perception of a line; and the perception of two separate points would occur only when the sensory circles stimulated were separated from each other" (Boring 1929: 110). Subjects should not have their sensations affected by what they might be able to see. This methodological premise, pointed out in the main French medical dictionary, the *Dechambre*, does not seem to have informed French anthropological queries.

In the Questionnaire de sociologie et d'ethnographie (1883), formulated by the Société d'Anthropologie de Paris, there is no reference to Weber's compass in the section entitled "General and particular sensibility"; instead the Questionnaire recommended use of the esthesiometer, described as "the simplest device" to investigate tactile sensibility (Letourneau 1883: 581). Although Hyades used Weber's compass during his stay in Cap Horn, measuring tactile discrimination among the Yahgan, he did not mention the protocols governing its use. By contrast, the third edition of the British Notes and Queries on Anthropology did not recommend the use of a specialized instrument, but did insist on the importance of having subjects' eyes shut. "The subject having closed his eyes, apply the points of an ordinary mathematical compass to different parts of the body, varying the interspace between them so as to ascertain the minimum distance, for each part of the surface tried, at which the two points cease to be felt as one" (1899: 46).

A detailed methodological description was given by William McDougall (1871-1938)⁵ in the section dedicated to "delicacy of tactile discrimination" in the Reports of the Cambridge Anthropological Expedition to Torres Straits: "I used a small pair of carpenter's dividers with blunt metal points, the intervals between the points being measured on a millimetre scale. . . . The subject was told to keep his eyes shut, and the area of the skin operated on was further guarded from his view" (1903: 190). It is worth noting the differences in style of national traditions; whereas the French were concerned about the instrument per se (Weber's compass versus the esthesiometer), the British focused on measurement protocols and procedures. Undoubtedly, the experimenter too physically altered the subject of investigation when touching the skin with the compass; it implemented a change in the body under study and modified the conditions of a 'normal' activity. In other words, the compass test represented experimental rather than observational method.

Second, use of the compass allowed construction of a table of the degree of sensibility of different parts of the body "as evidenced by the distances at which the two points of the instrument could be felt as two distinct bodies" (Müller: 752). The smaller the difference between the two points, the greater the delicacy of sensibility. Weber identified at least forty-one regions of the body, ranging from the point of the tongue—the most sensible part—to the skin of the back, one of the less sensible regions. He also gave the average threshold of tactile discrimination for each part of the body:⁶ 1mm on the point of the tongue, 2mm on the dorsal surface of the third finger, 12mm on the back of the hand, and 5cm on the skin of the back.⁷ The reason anthropologists took to using Weber's compass was quite straightforward; values obtained by Weber, based on a "normal subject"—a European man—could serve as a basis for establishing comparisons and differences between sexes and ethnic groups. Thus, Hyades could conclude that the Yahgan were superior to Europeans in tactile sensibility.

The exploration of tactile sensibility in different parts of the body, namely at the fingertips, around the lips, and on the back was strongly recommended by the Questionnaire de Sociologie et d'Ethnographie. Since Weber's compass was not mentioned in this Questionnaire, and in the absence of an average, collectors were instructed to perform experiments on themselves in order to compile comparative data. It is interesting to note that most of the responses to the Questionnaire did not directly address the question of tactile discrimination; some travellers reported not having conducted experiments, while others confessed that they did not use the recommended apparatus to test tactile sensibility (Dias 2004: 213). From this perspective, Hyades' account is radically different.

During his stay in Cap Horn, Hyades conducted experiments on four individuals, one man and three women. On a twenty-year old man named Bibouchmagoundyis, he

measured four different skin areas—the face (near the nose), the internal surface of the arm, the external surface of the arm, and the knees. On a twenty-year old woman named Kamanakar Kipa, he measured fifteen skin areas. On a thirty-year old woman named Tçadar Kipa, he measured twelve skin areas. And on a third woman, called Chaoulouch and aged eighteen, he measured only seven skin areas. He was not concerned that his measurements of parts of the body were not identical for all subjects, even for those of the same sex, or that his sample was quite small and heterogeneous. Hyades was confident that he had established that the Yahgan's tactile sensibility was greater than Europeans. His conclusions were based on comparison between Europeans and the Yahgan using three measurements taken on the lips, the forearms and the hips. Hyades found that Yahgan's tactile sensibility was of 2mm and 3mm for the lips contrasting with 4mm in Europeans, 12mm to 21mm for the forearms by comparison with 17mm to 23mm in Europeans, and 20mm to 35 mm for the hips by contrast with 50mm in Europeans (Hyades: 212). Though he did not mention his sources of values of sensation thresholds found in European men, they were probably taken from Weber (Hyades explicitly asserted that he conducted the Weber's compass test).

Whereas Hyades measured only a few individuals, McDougall, a rigorous experimentalist, studied a sample of fifty men and twenty-five boys aged between ten and twelve, but confined his measurements to two areas—the skin of the forearm and the nape of the neck. Moreover, McDougall did not take standard generalizations about Europeans' sensibilities for granted, and did comparable experiments “on a number of Englishmen, mostly of the working classes” (192). These led him to conclude that “the skin areas tested by the Murray Islanders have a threshold of tactile discrimination of which the value, in terms of distance of two points touched, is just about one-half that of Englishmen, or we may say in other words, that their power of tactile discrimination is about double that of Englishmen” (192). The question of how to explain the variations of tactile discrimination between Europeans and non-Europeans remained open.

At the conclusion of his study, Hyades pointed to an apparent paradox: how could the Yahgan's superior tactile discrimination be reconciled with the fact that they lived almost unclothed in a rigorous climate to which their skin was exposed. Although Hyades did not solve this puzzle, the question whether the delicacy of the senses should be explained either in terms of racial features or as the product of habits of life was much debated in French anthropological circles in the 1880s (Dias 2004). McDougall provided a provisional answer: “the conclusion that this delicacy of tactile discrimination constitutes a racial characteristic receives some support from the results of similar measurements made upon the same skin area of the right forearms of ten Dayaks or Ibans of Sarawak. . . . [T]hese few cases will therefore suffice to allay any suspicion that the difference between the Murray men and Englishmen might be due to the more habitual covering of the skin among the latter” (193).

A similar debate raged about the sensitive fingertips of pianists and painters; was it a hereditary trait, as the French psychologist Théodule Ribot (1882) asserted, or the result of long experience and practice as G. Carlet, the author of the Dictionnaire des sciences médicales, argued in 1885? It is worth noting that it seemed to McDougall that “the tactile discrimination of the fingertips is much improved by practice, especially such as results from certain employments;” that was why he chose to experiment “on skin-areas that are not liable to special education of tactile discrimination through employment” (189), such as the skin of the forearms and the nape of the neck.

It is no accident that the question of tactile sensibility among non-European peoples was closely linked to the issue of susceptibility to pain.⁸ The Questionnaire de Sociologie et d'Anthropologie urged travellers to provide information regarding sensitivity to pain in two

specific situations: injuries resulting from wounds and surgery. To questions about tactile discrimination, most travellers' answers were rather vague, although they usually asserted that primitives were more tolerant of pain than Europeans. McDougall reached this conclusion in his study of the men of Murray Island: "their sense of touch is twice as delicate as that of Englishman, while their susceptibility to pain is hardly half as great" (195).

That a particular instrument, such as Weber's compass, acquires a methodological importance because the quantities it determines are valued in a specific historical moment is a phenomenon deserving of close examination (Wise 1995: 4). Underlying the very notion of differential sensory thresholds, as well as instruments to measure it, indicates an attempt to normalise and control individuals as Michel Foucault has noted (1975: 302). For anthropology, Weber's compass was undoubtedly part of a technology of power designed to solve the problems of surveillance. In addition to its disciplinary value, Weber's compass also facilitated a specific course of inquiry into the character of the human mind. In his attempt to determine quantitative relations between stimulus and sensation, Weber was aware of the role played by experience and adaptation in shaping the results of individuals' responses to tactile stimuli. The subjects' attention during tests using the compass varied with the number of experiments in which they had participated. Hyades ignored this factor; the French doctor was much more concerned about accumulating a huge number of measurements rather than with following rigorous experimental protocols. By contrast, McDougall justified confining his attention to only two skin areas. "I soon found," he wrote, "that the length of the procedure caused too great a strain on the patience of my subjects: I found too that it was undesirable to extend the observations on any subject over two or more settings, because in any setting subsequent to the first the interest of the subject was so far diminished as to make the results unreliable" (191).

Another major contrast between Hyades's and McDougall's research was the degree of attention each paid to the role played by individual variability in affecting experimental results. In his account, Hyades gave the tactile discrimination of the nipples of the three women he tested (the numbers varied from 15mm to 53 mm), but he didn't explain the differences. In their attempt to demonstrate that extraordinary sensorial skills were inherent among primitive peoples, French anthropologists disregarded the question of individual variation. By contrast, the members of the Torres Straits Expedition who were familiar with the methods and techniques of experimental psychology were very attentive to individuals' different responses to stimuli.⁹ They took into account how individuals' performances varied "from day to day, modified by transitory conditions such as fatigue" as well as variations among subjects that could be explained by "their individual differences of maturity, personality, and innate capacity" (Kuklick 1991: 143). Thus, the two national anthropological traditions differed radically in both method and theory.

Trained as physicians, Hyades and McDougall were initiated as anthropologists during their expeditions, the Cap Horn for the former and the Torres Straits for the latter. Although apparently following similar career paths and pursuing similar research projects in their investigations of tactile sensibility, they produced different results and moved in distinct theoretical directions. Making evolutionists' assumptions, Hyades concluded that the Yahgan's tactile sensibility was partly due to innate physiological differences. Had he performed tests on himself, he might not have reached the conclusions he did on the basis of experiments with the compass. Moreover, the omission in Hyades's account of the procedures he deployed precluded the possibility of replication and of verification; he paid no attention to his own "laboratory culture," making it impossible to explore "the role of the investigator's self in the making of knowledge" (Schaffer: 13). The publication of Volume

VII of the Cap Horn Expedition was almost unnoticed among anthropologists,¹⁰ and its impact on French anthropology was quite irrelevant by contrast with that made by reports of the Torres Straits Expedition. As Henrika Kuklick has pointed out, the results of this expedition and the experiments it conducted “had implications for future research in both anthropology and psychology. To anthropologists, the experiments disconfirmed conventional evolutionist wisdom about primitives’ sensibilities. To psychologists, they demonstrated the unreliability of laboratory research conducted in ignorance of subjects’ social situations” (1991: 143). It was due to his detailed account of his procedures that McDougall’s contribution paved the way for further criticism and debates among psychologists.¹¹

Retrospectively, the use of Weber’s compass appears to be a minor episode in the history of anthropology at a time when this field of investigation was trying to establish relationships and intellectual connections with other disciplines. The absence of references to tactile sensibility and to the test on two-point discrimination in the main anthropological queries of the first half of the twentieth century indicates that the issue of primitives’ sensibility was no longer a major question in anthropology. But the responses anthropologists received from their inquiries about sensorial phenomena at the turn of the century were an important element in changing the direction of the discipline.

¹ I am grateful to Henrika Kuklick for her editorial labor on this paper. The Cap Horn Expedition (1882-1883) was financed by the French government and was mainly devoted to meteorological and magnetic research. Although the report of the scientific mission was published under the names of Paul Hyades and Joseph Deniker, only Hyades conducted sensorial experiments among the Yahgan.

² Weber’s compass is widely mentioned in the main French medical and scientific dictionaries of the mid-nineteenth century such as the Dictionnaire usuel des sciences médicales - Dechambre (1885) and the Dictionnaire de Pédagogie et d’Instruction primaire (1887).

³ Weber used quantitative methods in sensory physiology, namely through the study of the quantitative relationship between sensation and stimulus intensity. Although he did not formulate any specific law, he “found that two sensations are just noticeably different as long as the ratio between the strengths in each pair of stimuli remains constant” (Kruta 1976: 201). It was Fechner who gave a mathematical form to this relationship and named it “Weber’s Law”; this law states that the perceived magnitude of a stimulus is proportional to the logarithm of its physical intensity. On the distinction between Fechner’s Law and Weber’s “simple statement that the just noticeable difference in a stimulus bears a constant ratio to the stimulus,” see Boring 1929: 280-281.

⁴ The English quotations come from the translation by William Baly.

⁵ On McDougall’s career, see Boring 1929: 465-466 and Kuklick 1991: 136.

⁶ According to Vladislav Kruta, “an important feature of Weber’s examinations and comparisons was the use of the notion of threshold (although this term was not actually used)” (Kruta 1976: 200).

⁷ The values referred to here were provided by Müller, pp.751-753.

⁸ A specific device, the dolorimeter, a rod that exerts pressure, was devised to determine pain thresholds, but anthropologists apparently did not use it.

⁹ On this expedition, see Kuklick 1991 (chapter 4) and 1996.

¹⁰ W.H.R. Rivers and Charles S. Myers discussed and criticised the experiments on visual and auditory acuity conducted on the Cap Horn Expedition (vol.II, p. 11 and p. 143), but this expedition did not stimulate other debates in anthropological circles.

¹¹ See Titchener pp. 205-208 and 233-234. For an analysis of Titchener's critics, see Schaffer pp.38-39.

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