KOSTAS GAVROGLU, YORGOS GOUDAROULIS (eds): *Through Measurement to Knowledge. The Selected Papers of Heike Kamerlingh Onnes 1853-1926.* Dordrecht *et al.*: Kluwer, 1991. (Boston Studies in the Philosophy of Science, 124.) cxv, 570 pp.

This book consists mainly of facsimilized reprints of 27 papers by Kamerlingh Onnes (1-489), classified in five categories: general, thermodynamic researches, properties of liquid helium, electrical, and magnetic researches. The papers are supplemented by brief footnotes appearing at the end of the volume (491-519).

The facsimilized reproduction is fairly good in most cases, although sometimes too faint, and occasionally digits or details are illegible (e.g., p. 481, fraction in left lower part of the table). A particularly nice feature of this volume is that in some cases, Kamerlingh Onnes's original reprints with his handwritten corrections were used for reproduction (see, e.g, pp. 149, 163). It is a pity though that the source and year of appearance of each paper is only given in the editor's notes rather than in the headings or in the table of contents, which would have made this volume a lot easier to use.

As concerns the selection of texts, the reviewer omitted Kamerlingh Onnes's Nobel lecture of 1913. It is understood that the editors had to confine themselves to brief notes in the annotations of the papers; their footnotes are fairly good for technical information on instrumental design and physics background, but weak for biographical information on coworkers or other persons mentioned. J.D.A. Boks, for example, with whom he worked on properties of liquid helium and who appeared as co-author of several of Kamerlingh Onnes's papers reprinted here (see pp. lxii, xciv, 83, 195, 221, 505), is not considered worth a single comment by the editors: we learn nothing about his dates of birth or death, not even his first names appear in the name index (a page number is missing for this name) or even in a footnote. Equally scarce are the remarks about the chief technician, G.J. Flim, who later headed the workshop of the cyrogenic department founded by Kamerlingh Onnes in 1901 (cf. pp. xix, xc footnote 13, cx), and who certainly would have deserved a great deal of the recognition which Kamerlingh Onnes enjoyed after his Nobel prize in 1913.

Some of the shortcomings of the annotations are compensated for by a good and detailed introduction to the volume by the two editors, who have worked and published on the history of low temperature physics for many years (cf. the bibliography, p. 549). Particular emphasis is given to the importance which Kamerlingh Onnes placed on Van der Waals's work on the law of corresponding states, thus plausibly presenting him as typical for Leiden's 'physics culture'. The editors' argument for the "coherence and interrelationships of the various research programs carried out at Leiden during Kamerlingh Onnes's professorship there" (p. xxi) is well received. The introduction also makes clear why this volume appeared in the 'Boston Studies in the Philosophy of Science' rather than in some history of science series: the editors strongly emphasize methodological points and characterize Kamerlingh Onnes's approach as phenomenological "within the bounds of the positivist tradition", which certainly explains his characteristic hesitation to draw any conclusions from his experiments [1]. Thereby, a pattern of work is revealed which indeed left its trace in Kamerlingh Onnes's many papers:

> Testing a law, preliminary assumption(s) to account for deviations, planning of the relevant experiments to decide on the plausibility of the assumption(s), precise measurements, new assumption(s) and the proposal of phenomenological formula(s) which

[1] Cf. pp. xliii, lxi, lxxxviii. It would have been nice to learn more about Kamerlingh Onnes's philosophical reading – only the scientific sources of Kamerlingh Onnes's work were detailed here.

describe the data satisfactorily, emphasis on the dangers which are entailed if one accepts these formulas as the theoretical explanation of the phenomenon, the status of other hypotheses vis-à-vis the experimental results, planning of new experiments.

By contrasting Kamerlingh Onnes's understanding of the value of models with the one by his main rival, James Dewar, it becomes clear that for Kamerlingh Onnes models were "not merely useful algorithms, but suggestive of the particularities of an underlying reality" (cf. pp. xix and xxxiii with p. lxix). Along similar lines, the editors provide the reader with a plausible explanation for Dewar's failure to liquefy helium despite many attempts and using in many respects superior instrumentation (p. lxiii ff.). It is in this section of the introduction, that the most interesting primary material (correspondence between Kamerlingh Onnes and Dewar) is cited (p. lv ff.).

After this 100-page introduction by the two Greek editors, there still follows a brief text by Rudolf de Bruyn Ouboter about Kamerlingh Onnes's cyrogenic achievements, mainly dealing with instrumentational issues and experimental details. Unfortunately, a lot of information is repeated in parts of the introduction (e.g., the remarks about monazite sand from North Carolina as the source of helium, obtained through the intervention of Kamerlingh Onnes's brother at the office of Commercial Intelligence at Amsterdam: cf. pp. lv, cvi, 166) and no cross references are given. Even the motto of the first holder of an experimental chair in the Netherlands gets wrung out again after appearing more than once in this volume: 'By measurement to knowledge (door meten tot weten)' (pp. xviii, xcix, cxiv).

Instead of these unnecessary duplications (cf. also footnote 93, p. xciv with p. cvi), some remarks on the reasons *why* from 1908 up to 1922 Kamerlingh Onnes's laboratory remained the *only* laboratory to produce liquid helium in sufficient quantities and preserve it for a long enough time for measuring physical parameters would have been appropriate. In fact, Kamerlingh Onnes, whose life was so full of "pressure of work" (p. lxxxviii ff.) and "who ran his laboratory with an iron hand" (p. xix), organized it very much in the fashion of later big science [2]. By omitting indispensable information for the replication of his experiments, he succeeded in making sure that his colleagues at other institutions did *not* get the means of liquefying helium – a strategy which worked for a surprisingly long time period in this case. The discovery of superconductivity in 1911 and the other pioneering work in the 'arctic region of physics' all performed in Leiden then appear under a different light, namely that of a carefully protected research monopoly.

KLAUS HENTSCHEL

[2] R. de Bruyn Ouboter mentions that he "created a big research organization for those days" (p. cxii).