

**Beams H W & Kessel R G. The Golgi apparatus: structure and function.**  
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In addition to summarizing the pros and cons of the Golgi apparatus controversy, evidence is given which led to its unequivocal establishment as an important cellular organelle and one that must be reckoned with in understanding many of the cellular functions. [The *SCI*® indicates that this paper has been cited in over 280 publications since 1968.]

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"In 1926, upon entering the Graduate College of the University of Wisconsin, I was confronted, like most beginning graduate students, with the problem of selecting an adviser and a research topic of interest to me that would also be suitable for partially fulfilling the requirements for the PhD. Among the courses in which I enrolled was a seminar in cytology taught by M.F. Guyer. The topic I was assigned to review for the class was the present status of the Golgi apparatus, a structure first described by Camillo Golgi in 1898 and termed by him the '*Apparato reticolare interno*'.<sup>1</sup> In pursuing this subject, I found that it had been estimated that over 2,000 publications had appeared relative to its nature, varying from disbelief of its reality to a complete acceptance of its existence. In the heated and sometimes vehement debate concerning the Golgi apparatus, emotional statements concerning it were sometimes made as, for example, 'The first description was the first mistake.'<sup>2</sup> The controversy concerning the Golgi apparatus was largely due to the following: it could not be consistently demonstrated in most living cells, its demonstration was mainly limited to the somewhat

capricious metallic impregnation methods (osmium and silver), and its form and position vary considerably in different cell types and under different physiological conditions.

"My thesis dealt with the secretion process in the mammary glands of rats. From this study, I became convinced that the Golgi apparatus was a real organelle, probably involved in the secretion process. This work stimulated me to undertake further studies on the cytoplasmic organelles in the pancreatic and spinal ganglion cells of the rat where it was possible to demonstrate the 'vacuome'<sup>3</sup> and the classical Golgi apparatus side by side in the same cell. In subsequent studies, various cells of both plants and animals were exposed to high centrifugal force (400,000 x g) in an air turbine ultracentrifuge developed by J.W. Beams and collaborators. The density of the Golgi apparatus differed from that of all the other cellular materials, adding further evidence in support of the view that it was a real cellular organelle. In 1934, I received a Rockefeller Foundation Fellowship to work in the laboratory of J.B. Gatenby at Trinity College, Dublin. There, in collaboration with Gatenby, a longtime advocate of the reality of the Golgi apparatus, cytological studies were continued on a number of different cell types.

"I think the paper received a large number of citations because it provided a readily available account of the Golgi apparatus controversy and pointed out how the development of the electron microscope paralleled the establishment of the Golgi apparatus as a bona fide cellular organelle.

"Much of my research cited in this review was done in collaboration with my colleagues, R.L. King and R.G. Kessel. The latter's name appears as coauthor of the cited paper. See references 4 and 5 for recent reports."

1. Golgi C. Sur la structure des cellules nerveuses. *Arch. Ital. Biol.* 30:60-71. 1898.
2. Hirsch G C. Introductory remarks. (Seno S & Cowdry E V, eds.) *Intracellular membranous structure. Proceedings of the First International Symposium for Cellular Chemistry*. Okayama: Japan Society for Cell Biology. 1963. p. 193-5.
3. Parat M & Paimlevé J. Appareil réticulaire interne de Golgi. trophosponge de Holmgren. et vacuome. *CR Acad. Sci.* 179:844-6. 1924.
4. Faruqhar M G & Palade G E. The Golgi apparatus (complex)—(1954-1981)—from artifact to center stage. *J. Cell Biol.* 91:77s-103s. 1981.
5. Whaley W G. The Golgi apparatus. *Cell Biol. Monogr.* 2:1-190. 1975.