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This Week's Citation Classic

Olins A L & Olins D E. Spheroid chromatin units (*v* bodies).
Science **183**:330-2, 25 January 1974.
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When isolated eukaryotic nuclei were spread at low ionic strength onto an electron microscope grid, they revealed a 'beads-on-a-string' appearance. This paper represented the first ultrastructural description of the repeating chromatin subunit. [The SC/® indicates that this paper has been cited in over 790 publications since 1974.]

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"During the academic year 1970-1971, we en-joyed a sabbatical at the department of biophysics. King's College, London. The Pardon-Wilkins supercoil' model[1] of chromatin was widely accepted at that time, and we eagerly met these authors and other leading British scientists interested in chromatin. During that year, we became captivated with the beautiful electron micrographs of Howard Davies describing the ordered 30 nm chromatin 'unit threads' of avian erythrocyte nuclei. [2] Also during that year, Ruth Itzhaki[3] and Gary Felsenfeld[4] independently published evidence that a large amount of chromatin DNA was exposed. In addition, our own experiments demonstrated that isolated nuclei could be 'reversibly' decondensed by removing divalent metals and by reducing the buffer ionic strength.[5] "Returning to Oak Ridge in September 1971, we set about to visualize the 'naked' stretches of DNA in chromatin, fully expecting to see very long regions between structures resembling supercoils. We initially tried the method of critical point drying but the results were hopeless; chromatin became a tangled, twisted mess under these conditions. Oscar L. Miller, Jr., was in Oak Ridge at that time, and we decided to try his method of centrifuging swollen nuclear contents onto a carbon film. For several months during the winter of 1972-1973, we accumulated micrographs of well-spread erythrocyte nuclei, never suspecting what could be revealed under a simple magnifying lens. One evening in February 1973, we happened to look closely at some negatively stained nuclei. To our excitement and surprise we saw that everywhere the chromatin looked like 'beads-on-a-string.' We called these particles *v* (nu) bodies because they were new in the nucleohistone field.

"By April 1973, we were confident of our discovery. We were teaching biophysics to graduate students at that time, and the model of hemoglobin led us to suggest the possibilities of a particle dyad axis, and of allosteric transitions. During May and June, we concentrated upon establishing that v-bodies could be seen in thymus and liver chromatin, and in July, we submitted our manuscript to *Science.* That summer we visited England and those scientists known to be interested in chromatin, describing the discovery and our speculations to our friends at King's College, to John Pardon and Brian Richards in High Wycombe, to Itzhaki in Manchester, and to Morton Bradbury in Portsmouth. We suggested to Davies that his unit threads might be a helical folding of v-bodies, rather than a folded 'supercoil.' Those were the last days before the field became charged with emotion and bristling with the claims of priority.

"In November 1973, at the annual meeting of the American Society of Cell Biology, we presented an abstract[6] on the discovery of v-bodies. Perusing the abstracts, we encountered a report by Chris Woodcock,[7] who had clearly been working on parallel lines. By 1974, the chromatin field had changed irreversibly. Ultrastructural and biochemical studies had converged, and the basic chromatin subunit was secure.[8] Our article in *Science* represented the publication of the first micrographs establishing the chromatin subunit (now called 'nucleosome'), coupled with speculations of its composition (two of each histone), a DNA packing ratio of 6:1, and its relationship to higher levels of chromatin The high citation reflects its significance toward an understanding of chromosome structure and function "

1. **Pardon J F & Wilkins M H F.** A super-coil model for nucleohistone. *J Mol. Biol.* **68**:115-24, 1972.
2. **Everid A C, Small J V & Davies H G.** Electron-microscope observations on the structure of condensed chromatin: evidence for orderly arrays of unit threads on the surface of chicken erythrocyte nuclei. *J Cell Sci.* **7**:35-48, 1970.
3. **Itzhaki R F.** Studies on the accessibility of deoxyribonucleic acid in deonyribonucleoprotein to cationic molecules. *Biochemical J.* **122**:583-92. 1971.
4. **Clark R J & Feisenfeld G.** Structure of chromatin. *Nature-New Biol* **229**:101-6. 1971.
5. **Olins D E & Olins A L**. Physical studies of isolated eucaryotic nuclei. *J. Cell Biol.* **53**:715-36. 1972.
6. **Olins A L & Olins D E**. Spheroid chromatin units (v bodies). *J Cell Biol.* **59**:252a. 1973.
7. **Woodcock C L F.** Ultrastructure of inactive chromatin. *J Cell Biol* **59**:368a. 1973.
8. **Igo-Kemenes T, Hörz W & Zachau H G**. Chromatin. *Annu Rev Biochem.* **51** 89-121, 1982.