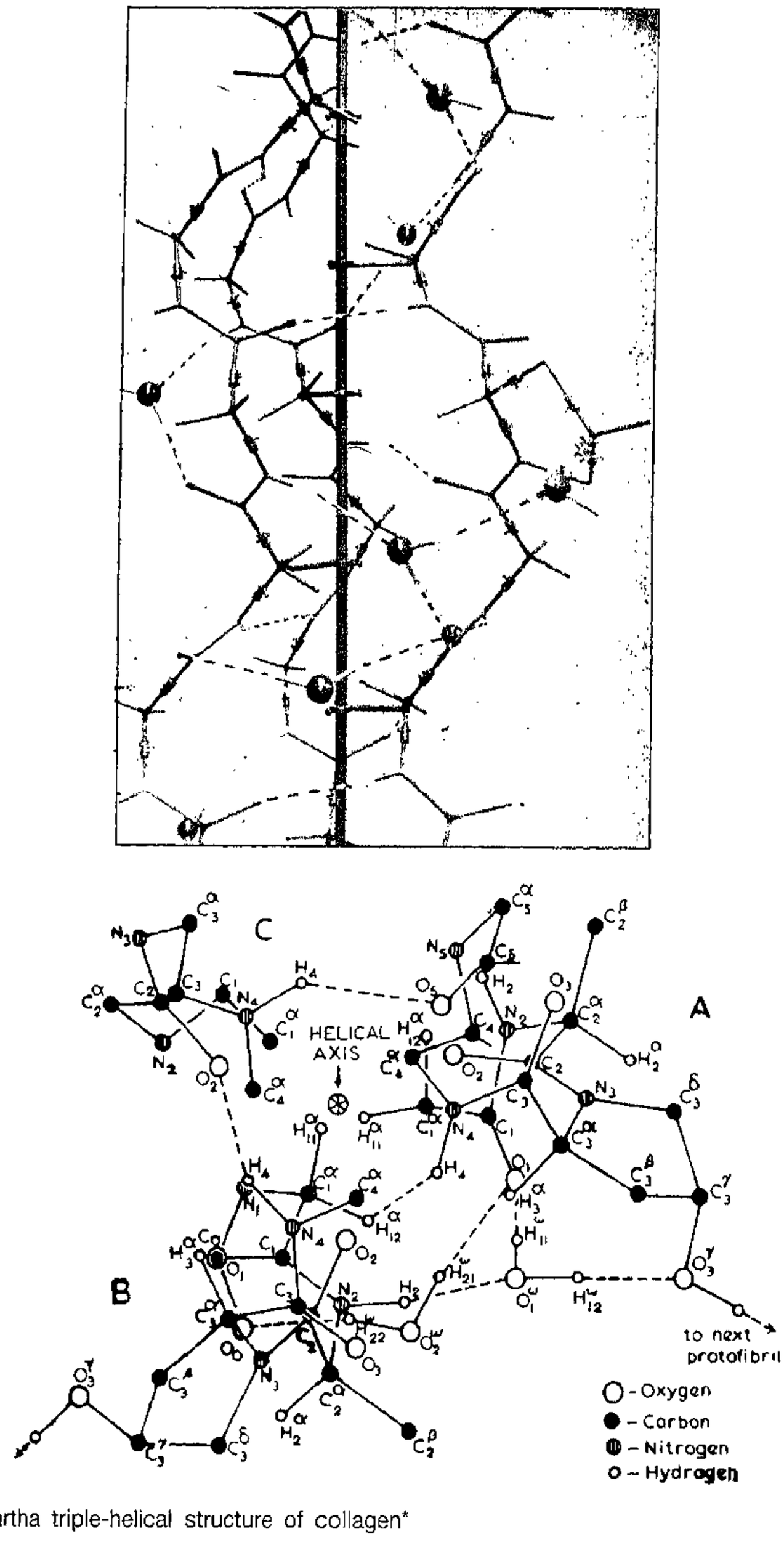

The Ramachandran–Kartha triple-helical structure of collagen*

Top: Photograph of the triple-helical collagen structure, built in G. N. Ramachandran's laboratory corresponding to the calculated atomic positions shown in the figure below.

Bottom: Projection down the helical axis of the atoms in the three-helical chains A, B, C of the collagen triple helix. The interchain hydrogen bonds are indicated by broken lines. Note the two water molecules firmly bound to the chains A and B.

Figures have been taken from the text of the Gandhi Memorial Lecture delivered by Prof. G. N. Ramachandran, at the Raman Research Institute on October 2, 1975. For a modern and glamorous visualization of the triple helix see next page.

Nature,* 1954, **174, 269; 1955, **176,** 593; *Curr. Sci.,* 1954, **23,** 349; *Proc. Indian Acad. Sci.,* 1955, **A42,** 215.

Adding colour to the triple helix

Collagen, if one accepts Francis Crick's view (see below) is not a glamorous molecule. Functional glamour and structural elegance are undoubtedly distinct attributes. But beauty, after all, lies in the eyes of the beholder. In recent years, computer graphics has provided an immensely powerful means of beautifying molecular structures. On the previous pages various views of a collagen model polypeptide, based on Ramachandran's triple-helical coiled-coil structure, are shown. The coordinates used for generation of these structures correspond to those reported for poly(Gly–Pro–Pro) by A. Yonath and W. Traub (*J. Mol. Biol.*, 1969, **43**, 461). Two water molecules per tripeptide unit are shown in Plates 1 and 2 as simple spheres. Hydrogen atoms, except those of NH groups, are omitted.

These illustrations have been generated on a PS 390 graphics system, with the molecular graphics library, by V. N. Balaji[1,2] and U. C. Singh[1].

Plate 1. Top: A side view of the triple helix. Bottom: A projection down the helix axis (20 × 3 residues/chain). Ironically, in this view the triple helix bears a superficial resemblance (particularly to the lay observer) to a famous computer graphics representation of the double helix of DNA.

Plate 2. Top: A space-filling representation of the triple helix. Bottom: This space-filling model viewed down the helix axis.

1. Immunopharmaceutics Inc., 11011 via Frontera, San Diego, CA 92127, USA.
2. Scripps Clinic and Research Foundation, N. Torrey Pines Road, La Jolla, CA 92037, USA.

Francis Crick on DNA and Collagen

I think what needs to be emphasized about the discovery of the double helix is that the path to it was, scientifically speaking, fairly commonplace. What was important was not the way it was discovered but the object discovered — the structure of DNA itself. You can see this by comparing it with almost any other scientific discovery. Misleading data, false ideas, problems of personal interrelationships occur in much if not all scientific work. Consider, for example, the discovery of the basic structure of collagen, the major protein of tendons, cartilage, and other tissues. The basic fiber of collagen is made of *three* long chains wound around one another. Its discovery had all the elements that surrounded the discovery of the double helix. The characters were just as colourful and diverse. The facts were just as confused and the false solutions just as misleading. Competition and friendliness also played a part in the story. Yet nobody has written even one book about the race for the triple helix. This is surely because, in a very real sense, collagen is not as important a molecule as DNA.

Of course this depends to some extent on what you consider important. Before Alex Rich and I worked (quite by accident, incidentally) to collagen, we tended to be rather patronizing about it. "After all," we said, "there's no collagen in plants." In 1955, after we got interested in the molecule, we found ourselves saying, "Do you realize that one-third of all the protein in your body is collagen?" But however you look at it, DNA *is* more important than collagen, more central to biology, and more significant for further research. So, as I have said before: it is the molecule that has the glamour, not the scientists.

From Francis Crick, *What Mad Pursuit: A Pesonal View of Scientific Discovery*, Basic Books, New York, 1989, p. 67.