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Molecule of the Year

When the robots of nanotechnology start playing soccer-football, they will have the perfect molecule to kick around, a buckyball, and they will have no more fun than today's buckyball scientists.

The Molecule of the Year Award was initiated to highlight contributions in science to an improved quality of life and to emphasize that most scientific discoveries are the product of many dedicated workers who lay the groundwork, design the experiments, recognize the importance of the unexpected, and exploit breakthroughs. Sometimes these discoveries are immediately applicable to practical products. In other cases they are recognized as major turning points following on a historical tradition that a basic new understanding of nature inevitably leads to practical applications. Such is the case in this year's selection of the Molecule of the Year: the C_{60} molecule, referred to as buckminsterfullerene, buckyballs, or C_{60}. This molecule, and the family of fullerenes derived from it, were named after the architect whose geodesic dome provided a prophetic vision of its atomic counterpart and who was a powerful evangelist for the relation of structure to function. C_{60} burst into physics and chemistry only a few years ago and has captured the enthusiasm of experimentalists and theoreticians. It has incredible symmetry for such a large molecule, in which 60 carbon atoms are joined with a mixture of single and double bonds arranged in 20 hexagons and 12 pentagons. Its chemical versatility is astonishing, reacting with alkali metals such as potassium and rubidium, halogens such as fluorine, free radicals, and Grignard reagents. The molecule itself and many of its derivatives are readily soluble in organic solvents, but recently amino adducts have been added which make it soluble in water.

In addition to opening up new fields of chemistry, C_{60} also is showing interesting physical properties. It is so resistant to shock that it has been suggested as a lubricant, there is evidence of superconductivity, and it may provide the added ingredient that makes diamond films more practical. There is no short step to a practical application of its superconducting properties, but the surprising finding that C_{60} does exhibit superconductivity opens up new theoretical avenues which may ultimately lead to a more profound understanding of superconductivity in general.

Science has always believed that structure throws light on function and vice versa, and therefore the appearance of a new structure presages new ideas. As it is, in the short time since the discovery of C_{60}, the chemical and physical literature has been filled with novel reactions and properties, and there is added excitement from the expectation that this is only the beginning. In a recent issue of *Science* highlighting new approaches to curing and preventing cancer, it was impressive that so many contributions came from developing a general knowledge of biology, medicine, and chemistry. Understanding of growth factors, of viruses, of mutations of DNA, of membrane receptors, and of metabolism was the forerunner of therapy and prevention of cancer. The findings in this example support the belief of scientists that basic research is almost invariably correlated with practical applications. That correlation, which could be repeated in many other fields, is a particularly important feature of the fullerene many-ring circus. The versatility of this molecule means not only that it is important in itself, but that the challenge to explain its unusual structure and properties will clarify understanding of molecules that do not look at all like a geodesic dome.

In the accompanying Molecule of the Year story, the properties of C_{60} and the nine runners-up for Molecule of the Year are discussed, but at this moment, there seems little doubt that the new horizons opened by the fullerenes make them the best choice.

Part of the exhilaration of the fullerenes is the shock that an old reliable friend, the carbon atom, has for all these years been hiding a secret life-style. We were all familiar with the charming versatility of carbon, the backbone of organic chemistry, and its infinite variation in aromatic and aliphatic chemistry, but when you got it naked, we believed it existed in two well-known forms, diamond and graphite. The finding that it could exist in a shockingly new structure unleashes tantalizing new experimental and theoretical ideas. Perhaps the least surprising might be that improving life through science is a path that would see all the citizens of the world holding hands like carbon atoms in C_{60} and like them, welcoming any newcomer, no matter how different his or her skills or challenges.

—DANIEL E. KOSHLAND, JR.