CHEMICAL SERENDIPITY

Geoffrey Bodenhausen – I'd like to say a few words about serendipity. It is an English word that was invented by Walpole. It refers to a fortunate convergence of circumstances that allows one to discover things that one did not really expect. But you have to be prepared. Pasteur wrote somewhere: *Le hasard ne favorise que les esprits préparés*: luck only favours those whose minds are prepared. I'd like to talk about a field of research that I find particularly attractive, nuclear magnetic resonance. This method allows one to characterize matter in many possible forms, be it a solid, a liquid, or a gas, at very high or very low temperatures: virtually any form of matter can be studied by resonance. Everything in the universe resonates, everything rotates about some axis, everything in spinning. Originally it was believed that the magnetic properties of nuclei were due to their rotation, a bit like the Earth spins about its axis. Indeed everything rotates: it is inconceivable that a celestial body does not spin about its axis. The same holds for nuclei, the same holds for electrons: everything spins. And therefore everything resonates, since a rotation must be associated with an angular frequency, and as soon as we deal with frequencies we must have transitions. And hence we must have spectra, i.e., arrays where transitions are ordered according to their frequencies. I'd like to say a bit more about serendipity. In magnetic resonance, so-called singlet states were discovered about ten years ago. These are also known as anti-symmetric states in the language of quantum mechanics. Indeed, in these states two spins form a pair, one positive and the other negative, or more precisely, one spin parallel to the magnetic field and the other anti-parallel. There are two difficulties. These states cannot be observed directly, so that one must imagine a means of transforming them into some observable quantity. A colleague at the University of Southampton, Malcolm Levitt, figured out how one can populate an anti-symmetric singlet state, and how one can make it observable at some later point in time. Levitt has shown many elegant approaches. His work has lead to an intense world-wide competition to discover and identify spin states with long life-times. If you could make a state with a very long life-time, you might have a chance to be mentioned in the Guinness Book of Records. On itself, this quest may not be so exciting. It was rather for the sake of the art. We eagerly participated in this competitive quest, until suddenly – by serendipity – we realized something that was quite unexpected! If a small molecule has a pronounced affinity for a large protein, they bind together with much enthusiasm, if one may say so. Well, if such a process occurs, it turns out that the life-time of an anti-symmetric singlet state associated with the small molecule is dramatically shortened. Hence this life-time allows one to see a sharp contrast between the free and protein-bound forms of the small molecule. We realized that this offers a unique means to identify small molecules that have an affinity for proteins. This turns out to meet one of the great challenges of pharmaceutical industry. So we discovered a totally unexpected application of anti-symmetric singlet states. Levitt once told me, “Gosh, that might be the only useful application of our idea.” That was merely a personal opinion, but he might actually be right…

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