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Introduction: Magnetic Resonance

The appropriate theme for magnetic resonance spectroscopy is "Die Moldau". Springing from the first simple, but elegant, experiments of Bloch and Purcell, gaining strength and momentum from applications to structural chemistry, and becoming an enormous and powerful river of knowledge and power through its enlarged scope by introduction of superconducting magnets, Fourier transforms, and multipulse excitations, today NMR is the only viable method for determining conformations of complex molecules in solutions. It has wrought a revolution in medicine through magnetic resonance imaging and will do so again as the result of the emerging noninvasive and selective magnetic resonance spectroscopic analysis of living humans. The major role of Richard Ernst (ETH-Zürich) in the latter stages of this revolution has just been recognized by the 1991 Nobel Prize in Chemistry. Further, there is clearly much, much more to come.

It is almost incredible when taking an overview of the sophistication of the papers in this volume to recall the hours and even days that we spent 35 years ago turning the horizontal and vertical cranks that positioned our NMR probes in a search for a reasonably homogeneous spot within the relatively feeble fields of our electromagnets—success in this endeavor most often being judged by the quality of the ringing down of the OH proton resonance of acidified ethanol. And, when a good spot was found, we rushed to run off 20 spectra or so, at 7 seconds apiece, with the often vain hope of finding two spectra that were nearly the same.

This volume of *Chemical Reviews* is comprised of papers covering a very broad range of NMR applications that have been submitted by many of the heavy hitters among contemporary NMR experts. The editors have selected very timely topics that should have special appeal to non-NMR specialists because they are very generally directed to providing useful information about particular states of matter under much more than ambient conditions. And, if reference is not specially made to compositions in which the reader is interested, at least readers are likely to find examples of techniques that can be applied to their systems.

An exemplary opening paper is provided by the late Andrew Derome whose recent very untimely death is a real tragedy for the NMR community. Derome's *Modern NMR Techniques for Chemistry Research* is an almost unique book, in being a combination of a comprehensive experimental guide book and an explanatory text displaying an exceptional knowledge of multipulse fundamentals. His contribution here is specially significant in reviewing what solid-state NMR is all about and then showing what low-temperature solid-state spectra can tell you about proteins under conditions comparable to those commonly used for X-ray diffraction. Excellent papers are devoted to polymers (Spiess) and to zeolites (Fyfe, Feng, Grondey, Kokotailo, and Gies), others to studies under high pressure (Horvâth and Millar) or at high temperature (Stebbins), and still another to gases (C. Jameson). Ray Freeman shows in his inimitable way how "soft" pulses can be exquisitely shaped to advantage in the simplification of complex spectra. Led and Gesmar detail examples of how linear prediction can facilitate interpretation by removing random spectral noise, and David Grant (who has had a tremendous influence on my own NMR research over the last 20 years) makes an important contribution to coupled nuclear spin relaxation. The emphasis and sophistication shown by the several papers on solid-state NMR is especially significant (Harris and Jackson, Parker, Alam and Drobny, and Klinowski). Modern pulse techniques (Gemperle and Schweiger, and Pelczer and Szalma) stemming from the work of Waugh and Pines along with improved high-speed spinners have revolutionized solid NMR. An outstanding volume!

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