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Foreword

Volume 8 of Specialist Periodical Reports on N.M.R. follows closely the format and scope of the previous volumes, with coverage of the N.M.R. literature from June 1977 to May 1978, based on the U.K.C.I.S. CA selects 'N.M.R. Chemical Aspects'.

The chapters on Theory, and Applications of the Chemical Shift, Spin–Spin Coupling, Multiple Resonance, Nuclear Relaxation in Liquids, the Solid State, Paramagnetic Molecules, and Natural, and Synthetic Macromolecules retain their previous scope and the biennial chapter on Liquid Crystals and Micellar Solutions falls in this volume.

Some minor amendments have been made, reflecting present trends in N.M.R. The major advances in experimental techniques in N.M.R. in recent years have been in multipulse and solid state work. With this in mind the Experimental Techniques chapter has been removed and the chapters on Multiple Resonance and the Solid State expanded to include advances in experimental techniques in these areas.

The important area of the N.M.R. of oriented molecules, which was previously covered in these reports, has now been re-introduced as a biennial chapter.

Also, the application of N.M.R. to conformational analysis has been and is continuing to be of major importance in chemistry, and this area is now covered specifically. With this addition it was felt that the topic of medium effect in N.M.R. could be covered adequately by this and the Chemical Shift chapters and this has been implemented in this volume.

Consequent on these and other factors Dr. P. S. Allen, Dr. D. I. Hoult and Dr. J. Homer have retired from reporting for the series and Dr. S. M. Walker (the Solid State), Professor C. L. Khetrapal and Dr. A. C. Kunwar (Oriented Molecules) and Dr. F. G. Riddell (Conformational Analysis) have reported in this volume.

Also, Mr. J. T. Jackson has compiled the Books and Reviews section.

It is a pleasure to thank them and the other Reporters for their co-operation and hard work upon which this volume is founded.

Finally, the editorial staff of the Chemical Society have co-operated wholeheartedly in our efforts to obtain as speedy and efficient a production time as possible, and I welcome this opportunity to thank them.

December, 1978 R. J. ABRAHAM

Symbols and Abbreviations

These lists contain the symbols and abbreviations most frequently used in this volume, but they are not expected to be exhaustive. Some specialized notation is only defined in the relevant chapter. An attempt has been made to standardize usage throughout the volume as far as is feasible, but it must be borne in mind that the original research literature certainly is not standardized in this way, and some difficulties may arise from this fact. Trivial use of subscripts *etc.* is not always mentioned in the symbols listed below. Some of the other symbols used in the text, *e.g.* for physical constants such as h or π, or for the thermodynamic quantities such as H or S, are not included in the list since they are reckoned to follow completely accepted usage.

Symbols

a	hyperfine (electron–nucleus) interaction constant
A	(i) hyperfine (electron–nucleus) interaction constant (ii) parameter relating to electric field effects on nuclear shielding
B	(i) magnetic induction field (magnetic flux density) (ii) parameter relating to electric field effects on nuclear shielding
B_0	static magnetic field of an n.m.r. or e.s.r. spectrometer
B_1, B_2	r.f. magnetic fields associated with ν_1, ν_2
C_X	spin–rotation coupling constant of nucleus X (used sometimes in tensor form): $C^2=\frac{1}{3}(C_\parallel^2+2C_\perp^2)$.
$C_\parallel$, $C_\perp$	components of $\mathbf{C}$ parallel and perpendicular to a molecular symmetry axis
D	(i) self-diffusion coefficient
$\mathbf{D}$	(ii) zero-field splitting constant rotational diffusion tensor
$D_\parallel$, $D_\perp$	components of $\mathbf{D}$ parallel and perpendicular to a molecular symmetry axis
D_{int}	internal diffusion coefficient
D_0	overall isotropic diffusion coefficient
E	electric field
E_n	eigenvalue of $\hat{\mathscr{H}}$ (or a contribution to $\hat{\mathscr{H}}$)
f	modulation frequency
g	nuclear or electronic g-factor
G	magnetic field gradient

H_{ij}	element of matric representation of $\mathscr{H}$
$\mathscr{H}$	Hamiltonian operator (in energy units) – subscripts indicate the nature of the operator
$\boldsymbol{I}_i$	nuclear spin operator for nucleus i
$\boldsymbol{I}_{ix}, \boldsymbol{I}_{iy}, \boldsymbol{I}_{iz}$	components of $\boldsymbol{I}_i$
$\boldsymbol{I}_{i+}, \boldsymbol{I}_{i-}$	'raising' and 'lowering' spin operators for nucleus i
I_i	magnetic quantum number associated with $\boldsymbol{I}_i$
I	(i) ionization potential (ii) moment of inertia
^nJ	nuclear spin–spin coupling constant through n bonds (in Hz). Further information may be given by subscripts or in brackets. Brackets are used for indicating the species of nuclei coupled, *e.g.* $J(^{13}C, ^1H)$, or, additionally, the coupling path, *e.g.* J(POCF)
J	rotational quantum number
^nK	reduced nuclear spin–spin coupling constant (see the notes concerning ^nJ)
m_i	eigenvalue of $\boldsymbol{I}_{iz}$ (magnetic component quantum number)
m_T	total magnetic quantum number for a spin system
M_0	equilibrium macroscopic magnetization of a spin system in the presence of B_0
M_x, M_y, M_z	components of macroscopic magnetization
M_n	moment of a spectrum (M_2 = second moment, *etc.*)
$\bar{M}_n$	the number average mol. wt.
P_A	valence p orbital of atom A
P_i	fractional population (of rotamers *etc.*)
$P_{s_A s_B}$	molecular orbital bond order between s_A and s_B
$\mathscr{P}$	probability of a transition between two nuclear levels
q	electric field gradient
Q	(i) McConnell's constant relating to a (ii) nuclear quadrupole moment (iii) quality factor for an r.f. coil
s_A	valence s-orbital of atom A
$S_A^2(0)$	electron density in S_A at nucleus A
S	(i) singlet state (ii) electron (or, occasionally, nuclear) spin –*cf.* I (iii) ordering parameter for oriented systems (iv) overlap integral between molecular orbitals
t	elapsed time
T	(i) temperature (ii) triplet state
T_c	coalescence temperature for an n.m.r. spectrum
T_g	the glass transition temperature (of a polymer)
T_1^X	spin–lattice relaxation time of the X nuclei (further subscripts refer to the relaxation mechanism)
T_2^X	spin–spin relaxation time of the X nucleus (further subscripts refer to the relaxation mechanism)

T_2'	inhomogeneity contribution to dephasing time for M_x or M_y
T_2^*	total dephasing time for M_x or M_y; $(T_2^*)^{-1} = T_2^{-1} + (T_2')^{-1}$
T_3	decay time following 90_0-τ-90_{90} pulse sequences
$T_1^X\rho$, $T_2^X\rho$	spin–lattice and spin–spin relaxation time of the X nuclei in the frame of reference rotating with B_1
T_{1D}	dipolar spin–lattice relaxation time
X_i	mole fraction of compound i
Z_A	atomic number of atom A
α	(i) nuclear spin wavefunction (eigenfunction of I_z) for a spin-$\frac{1}{2}$ nucleus (ii) polarizability
α_A^2	s-character of hybrid orbital at atom A
β^A	nuclear spin wavefunction (eigenfunction of Ii) for a spin-$\frac{1}{2}$ nucleus
γ_X	magnetogyric ratio of nucleus X
δ_X	chemical shift (for the resonance) of nucleus of element X (positive when the sample resonates to high frequency of the reference). Usually in p.p.m.
δ_{ij}	Kronecker delta ($= 1$ if $i = j$, and $= 0$ otherwise)
Δ	(i) time between field gradient pulses (ii) spectral width
δC	anisotropy in $\mathbf{C}$ ($\Delta C = C_\parallel - C_\perp$)
ΔJ	anisotropy in J ($\Delta J = J_\parallel - J_\perp$)
Δn	population difference between nuclear states
$\Delta\delta$	change or difference in δ
$\Delta_{\nu\frac{1}{2}}$	full width (in Hz) of a resonance line at half-height
$\Delta\sigma$	(i) anisotropy in $\sigma(\Delta\sigma = \sigma_\parallel - \sigma_\perp)$ (ii) differences in σ for two different situations
$\Delta\chi$	(i) susceptibility anisotropy ($\Delta\chi = \chi_\parallel - \chi_\perp$) (ii) difference in electronegativities
ε_r	relative permittivity
ε_o	permittivity of a vacuum
η	(i) nuclear Overhauser effect (ii) asymmetry factor (*e.g.* in e^2qQ/h) (iii) refractive index (iv) viscosity
μ	(i) magnetic dipole moment (ii) electric dipole moment
μ_o	permeability of a vacuum
μ_B	Bohr magneton
μ_N	nuclear magneton
ν_i	Larmor precession frequency of nucleus i (in Hz)
ν_o	(i) spectrometer operating frequency (ii) Larmor precession frequency (general, or of bare nucleus)
ν_1	frequency of 'observing' r.f. magnetic field
ν_2	frequency of 'irradiating' r.f. magnetic field
$\Pi_{s_A s_B}$	mutual polarizability of s_A and s_B

ρ^2_{sA}	spin density in s_A
σ_i	shielding constant of nucleus i (used sometimes in tensor form). Usually in p.p.m. Subscripts may alternatively indicate contributions to σ.
$\sigma_\parallel, \sigma_\perp$	component of σ parallel and perpendicular to a molecular symmetry axis
τ	(i) pre-exchange lifetime of molecular species (ii) time between r.f. pulses (general symbol)
τ_c	correlation time
τ_{coll}	mean time between molecular collisions in the liquid state
$\tau_\parallel, \tau_\perp$	correlation time for molecular rotation parallel and perpendicular to a molecular symmetry axis
τ_j	angular momentum correlation time
τ_p	pulse duration
τ_t	translational magnetic relaxation correlation time
χ	(i) magnetic susceptibility (ii) electronegativity (iii) nuclear quadrupole coupling constant ($= e^2qQ/h$)
ω_c	carrier frequency in rad s^{-1}
$\omega_i, \omega_0, \omega_1, \omega_2$	as for $\nu_i, \nu_0, \nu_1, \nu_2$ but in rad s^{-1}
ω_m	modulation angular frequency (in rad s^{-1})
ω_r	sample rotation (rad s^{-1})

Abbreviations

(a) Physical properties

a.c.	alternating current
a.f.	audiofrequency
a.u.	atomic unit
a.m.	amplitude modulation
b.c.c.	body-centred cubic
c.d.	circular dichroism
c.m.c.	critical micelle concentration
d.c.	direct current
e.d.	electron diffraction
e.f.g.	electric field gradient
e.s.r.	electron spin resonance
erf	the error function
f.c.c.	face-centred cubic
f.m.	frequency modulation
h.c.p.	hexagonal close-packed
h.f.	hyperfine

i.d.	inside diameter
i.f.	intermediate frequency
i.r.	infrared
l.c.	liquid crystalline
m.w.	microwave
mol. wt.	molecular weight
n.m.r.	nuclear magnetic resonance
n.q.r.	nuclear quadrupole resonance
o.d.	outside diameter
p.p.m.	parts per million
r.f.	radiofrequency
r.m.s.	root mean square
s.h.f.	super-high frequency
u.h.f.	ultra-high frequency
u.v.	ultraviolet
A/D	analog-to-digital converter
ARP	adiabatic rapid passage
ASIS	aromatic solvent-induced shift
BCD	binary coded decimal
CAT	computer of average transients
Ch	Cholesteric (phase)
CIDEP	chemically induced dynamic electron polarization
CIDNP	chemically induced dynamic nuclear polarization
CNDO	complete neglect of differential overlap
CPMG	Carr–Purcell pulse sequence. Meibom–Gill modification
CSA	chemical shift (shielding) anisotropy
CW	continuous wave
DAC	digital-to-analog converter
DD	dipole–dipole (interaction or relaxation mechanism)
DEFT	driven-equilibrium Fourier transform
DNP	dynamic nuclear polarization
DSC	differential scanning calorimetry
EHMO	extended Hückel molecular orbital
ENDOR	electron–nucleus double resonance
FC	Fermi contact
FET	field-effect transistor
FID	free induction decay
FPT	finite perturbation theory
FT	Fourier transform
GIAO	guage-invariant atomic orbitals
H	hexagonal (phase)
HR	high resolution
HSP	homogeniety-spoiling pulse
I	isotropic (phase)
INDO	intermediate neglect of differential overlap
INDOR	internuclear double resonance
La	lamellar (phase)

LCAO	linear combination of atomic orbitals
LIS	lanthanide-induced shift
LSR	lanthanide shift reagent
MASS	magic angle sample spinning
MINDO	modified INDO (MINDO/3)
MO	molecular orbital
MOSFET	metal oxide silicon FET (q.v.)
MP	multipulse
N	nematic (phase)
NOE	nuclear Overhauser effect
NQCC	nuclear quadrupole coupling constant
OB	orbital (contribution to scalar coupling)
PPP	Pariser–Pople–Parr
PRE	proton relaxation enhancement
PRFT	partially relaxed Fourier transform
QF	quadrupole moment/field gradient (interaction relaxation mechanism)
QPD	quadrature phase detection
RAM	random access memory
SC	scalar (interaction or relaxation mechanism)
SCF	self-consistent field
SCPT	self-consistent perturbation theory
SD	spin-dipolar (contribution to scalar coupling)
SEFT	spin-echo Fourier transform
Sm	smectic (phase)
SOS	sum over states
S/N	signal-to-noise ratio
SPI	selective population inversion
SPT	selective population transfer
SR	spin–rotation (interaction or relaxation mechanism)
SRTA	single relaxation time approximation
STO	slater-type orbital (basis set)
VB	valence bond
WAHUHA	Waugh, Huber, and Haeberlen (cycle of pulses)
WEFT	water-eliminated Fourier transform

(b) *Chemical species**

acac	acetylacetonato
ACTH	adrenocorticotropic hormone (corticotropin)
ADP	adenosine diphosphate
AMP	adenosine monophosphate
ATP	adenosine triphosphate
BSA	bovine serum albumin
CMP	cytidine monophosphate
cp	cyclopentadienyl

* Lower case initials are used when the species is a ligand.

DAP	dodecylammonium propionate
DME	1,2-dimethoxyethane
DMF	dimethylformamide
DML	dimyristoyl-lecithin
DMS	dimethylsiloxane
DMSO	dimethylsulphoxide
DNA	deoxyribonucleic acid
DPG	2,3-dipho sphoglycerate
DPL	dipalmitoyl-lecithin
dpm	dipivaloylmethanato
DPPH	diphenylpicrylhydrazyl
DSS	2,2-dimethyl-2-silapentane-5-sulphonate (usually as the sodium salt)
DTBN	di-t-butyl nitroxide
EBBA	*N*-(*p*-ethoxybenzylidene)-*p*-butylaniline
EDTA	ethylenediaminetetra-acetic acid
EVA	ethylene-vinyl acetate
fod	1,1,1,2,2,3,3-heptafluoro-7,7-dimethyloctane-4,6-dionato
HAB	4,4′-bis(heptyl)azoxybenzene
HMPA	hexamethylphosphoramide
HOAB	*p*-n-heptyloxyazoxybenzene
IHP	inositolhexaphosphate
KDP	potassium dihydrogen phosphate
MBBA	*N*-(*p*-methoxybenzylidene)-*p*-butylaniline
NADH(P)	nicotinamide adenine dinucleotide (phosphate)
NMF	*N*-methylformamide
PAA	*p*-azoxyanisole
PBA	pyrene butyric acid
PBLG	poly(L-benzyl γ-glutamate)
PC	phosphatidyl choline (lecithin)
PCB	polychlorinated biphenyl
PDMS	polydimethylsiloxane
PMA	poly(methacrylic acid)
PMMA	poly(methyl methacrylate)
POM	poly(oxymethylene)
PS	phosphatidylserine
PTFE	polytetrafluoreoethylene
PVC	poly(vinyl chloride)
PVF	poly(vinyl fluoride)
PVP	poly(vinyl pyrrolidone)
RNA	ribonucleic acid (tRNA, transfer RNA)
SDS	sodium dodecyl sulphate
TAB	trimethylammonium bromide
TCNQ	tetracyanoquinodimethane
TFA	trifluoroacetic acid
THF	tetrahydrofuran
TMS	tetramethylsilane
UTP	uridine triphosphate

Amino-acid residues

Ala	alanine
Arg	arginine
Asn	asparagine
Asp	aspartic acid
Cys	cysteine
Gln	glutamine
Glu	glutamic acid
Gly	glycine
His	histidine
Hyp	hydroxyproline
Ile	isoleucine
Leu	leucine
Lys	lycine
Met	methionine
Phe	phenylalanine
Pro	proline
Ser	serine
Thr	threonine
Trp	tryptophan
Tyr	tyrosine
Val	valine

N.M.R. Books and Reviews

COMPILED BY J. T. JACKSON

This section lists all books and reviews with N.M.R. as the principal theme published during 1977 and 1978 (following the list given in Volume 7) that were known to the compiler at the time of going to press. Titles and numbers of pages are given where appropriate, and the *Chemical Abstracts* number. In general, texts of individual lectures from symposia are not listed: likewise, references to technical bulletins, company or institute house journals, special reports, *etc.*, are omitted, since they are judged to be of little value to the scientific community in view of their inaccessibility and ephemeral nature. N.M.R. sections of general physical chemistry or spectroscopy textbooks have not usually been included. The foreign language articles are grouped together (section e) which is sub-divided for convenience into the various languages. However, the title is usually translated into English. The source of the references is in most cases the computer-based listing of N.M.R. publications provided by the U.K. C.I.S., CA selects 'N.M.R.—Chemical Aspects'. The compilation is sectionalized for the reader's convenience.

(a) *Books*

R1. R. J. Abraham and P. Loftus, 'Proton and Carbon-13 NMR Spectroscopy', Heyden, London, 1978.

R2. S. M. Aksel'rod *et al.*, 'Nuclear Magnetic Methods of Studying Wells', Nedra, Moscow (in Russian), CA 88: 194 274.

R3. G. C. Carter, L. M. Bennet, and D. J. Kahan, 'Progress in Materials Science. Vol. 20. Metallic Shifts in NMR' (4 Vols.), Pergamon, Oxford, 1978.

R4. R. Lenk, 'Brownian Motion and Spin Relaxation', Elsevier, Amsterdam, 1977.

R5. D. E. Leyden and R. H. Cox, 'Chemical Analysis: A Series of Monographs on Analytical Chemistry and its Applications. Vol. 48. Analytical Applications of NMR', Wiley, New York, 1977.

R6. M. Mehring, 'High Resolution NMR Spectroscopy in Solids', Springer, New York, 1976.

R7. J. C. Randall, 'Polymer Sequence Determination: Carbon-13 NMR Method', Academic Press, New York, 1978.

R8. C. P. Slichter, 'Springer Series in Solid State Sciences. Vol. 1. Principles of Magnetic Resonance', Springer, Berlin, 2nd Edn., 1978.

R9. P. Sohar, 'Nuclear Magnetic Resonance Spectroscopy, Vol. 1', Akademiai kiado, Budapest, 1976 (in Hungarian), CA 88: 97 301.

R10. P. Sohar, 'Nuclear Magnetic Resonance Spectroscopy, Vol. 2'. Akademiai kiado, Budapest, 1976 (in Hungarian), CA 88: 81 721.

R11. K. Wüthrich, 'NMR in Biological Research: Peptides and Proteins', North-Holland, Amsterdam, 1976.

(b) *Edited Books, Books of Partial Relevance, Symposia, etc.*

Edited Books

R12. A. L. Buchachenko, 'Chemically Induced Dynamic Polarisation', in 'Modern Physical Chemistry', ed. E. Fluck and V.I. Gol'danski, Academic Press, London, 1976, Vol. 1, p. 197.
E. I. Fedin, 'Nuclear Quadrople Resonance', *ibid.*, p. 135.
W. Meisel, 'Mössbauer Double Resonances,' *ibid.*, p. 238.
R13. A. Foris, 'NMR Spectroscopy of Synthetic Dyes', in 'Analytical Chemistry of Synthetic Dyes', ed. K. Venkataraman, Wiley, New York, 1977, p. 277.
R14. V. J. Hruby, 'Conformations of Peptides in Solution as Determined by NMR Spectroscopy and Other Physical Methods', in 'The Chemistry and Biochemistry of Amino Acids, Peptides and Proteins', ed. B. Weinstein, Marcel Dekker, New York, 1974, Vol. 3, p. 1.
R15. D. W. Jones, 'Combined Applications [of Spectroscopy] and Other Techniques', in 'An Introduction to the Spectroscopy of Biological Polymers', ed. D. W. Jones, Academic Press, London, 1976, p. 295.
J. S. Leigh, 'Nuclear Magnetic Resonance of Biological Polymers', *ibid.*, p. 189.
R16. M. Levy, 'Nuclear Magnetic Resonance', in 'Treatise Coat', ed. R. R. Myers and J. S. Long, Marcel Dekker, New York, 1976, Vol. 2, p. 299.
R17. J. I. Steinfeld, 'Optical Analogues of Magnetic Resonance Spectroscopy' in 'The Chemical and Biochemical Applications of Lasers', ed. C. B. Moore, Academic Press, New York, 1974, Vol. 1, p. 103.
R18. J. Urbanski, 'Nuclear Magnetic Resonance Spectroscopy [Applied to Polymers]', in 'A Handbook of the Analysis of Synthetic Polymers and Plastics', Ellis Horwood, Chichester, 1977, p. 142.

Symposia

R19. F. J. Adrian, 'Triplet Overhauser Mechanism of CIDNP', NATO Advanced Study Institute Series, Series C, 1977, Vol C. 34, p. 369.
R. Kaptein, 'Pair Substitution Effects in CIDNP', *ibid.*, p. 257.
R. G. Lawler, 'CIDNP from Biomolecular Reactions of Organometallic Compounds', *ibid.*, p. 267.
R. G. Lawler, 'CIDNP Exhibited by Thermally Decomposing Diacyl Peroxides', *ibid.*, p. 17.
R. G. Lawler, 'Time Dependence of CIDNP Intensities', *ibid.*, p. 29.
H. D. Rota, 'Chemically Induced Nuclear Spin Polarisation in Photo-Initiated Ion Reactions', *ibid.*, p. 39.
R20. T. L. Andrade and E. L. Hahn, 'Principles of NQR Double Resonance Detection—Applications to Deuterium', in 'Proceedings of the 4th Ampère International Summer School: Recent Developments in the Magnetic Resonance of Condensed Matter', ed. R. Blinc and G. Lahajnar, J. Stefan Institute, Ljubljana, 1976, p. 181.

R. L. Armstrong, 'Nuclear Quadrupole Relaxation and Structural Phase Transitions', *ibid.*, p. 431.

J. L. Bjorkstam, 'NMR Studies of Correlation Effects in Solids', *ibid.*, p. 315.

F. Borsa, 'Nuclear Magnetic Resonance Study of Electronic Spin Dynamics in Heisenberg Model Paramagnets', *ibid.*, p. 529.

R. R. Ernst, W. P. Aue, P. Bachmann, J. Karhan, Anil Kumar, and L. Mueller, 'Two Dimensional NMR Spectroscopy', *ibid.*, p. 89.

R. Kind, 'Steady State NQR Spectroscopy in Solids', *ibid.*, p. 389.

A. Loesche, 'The Study of Phase Transitions in Liquid Crystals by NMR', *ibid.*, p. 467.

T. J. Lowe, 'Motionally Narrowed NMR Lineshapes in Solids', *ibid.*, p. 343.

A. Pines, S. Vega, D. J. Ruben, T. W. Shattiuk, and D. E. Wemmer, 'Double Quantum NMR in Solids', *ibid.*, p. 127.

H. Rohrer, 'Resonant NMR Enhancement Near Magnetic Phase Transitions', *ibid.*, p. 515.

B. Schnabel, H. Rosenberger, and R. Mueller, 'Investigations about Structure and Motions in Hydrogen-bonded Systems by Means of the NMR High Resolution of Solids (NMR-HRS)', *ibid.*, p. 205.

R21. J. L. Calais, 'Is the Peierls Transition a Transition?'. *Internat. J. Quantum Chem., Symp.*, 1977, **11**, 547.

R22. I. D. Campbell, 'An NMR View of Protein Structure', in 'Proceedings of the British Biophysical Society, Spring Meeting, 1977', ed. R. A. Dwek, I. D. Campbell, and R. E. Richards, Academic Press, London, p. 33.

J. Dawson, D. G. Gadian, and D. R. Wilkie, 'Studies of Living, Contracting Muscle by P-31 Nuclear Magnetic Resonance', *ibid.*, p. 289.

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P. C. Lauterbur, 'Spatially Resolved Studies of Whole Tissues, Organs and Organisms by NMR Zeugmatography', *ibid.*, p. 323.

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G. C. K. Roberts, J. Feeney, B. Birdsall, B. Kimber, D. V. Griffiths, R. W. King, and A. S. V. Burgen, 'Dihydrofolate Reductase: The Use of Fluorine Labelled and Selectively Deuterated Enzyme to Study Substrate and Inhibitor Binding', *ibid.*, p. 95.

K. Wüthrich, G. Wagner, R. Richarz, and A. DeMarco, 'Completion of X-ray Structures of Proteins by High Resolution NMR', *ibid.*, p. 51.

R23. P. Cohen, O. Convert, J. H. Griffin, P. Nicolas, and C. DiBello, 'Carbon-13 NMR Studies of the Binding of Selectively C-13 Enriched Oxytocin to its Neurophyseal Carrier Protein, Neurophysin I', in 'Peptides; Proceedings of the 5th American Peptide Symposium', ed. M. Goodman and J. Meienhofer, Wiley, New York, 1977.

J. D. Glickson, R. E. Lenkinski, N. R. Krishna, D. G. Agresti, and R. Walker, 'Development of NMR and Fluorescence Methods for Determining Peptide Conformations in Solution', *ibid.*, p. 325.

R24. J. F. Cooke, 'Magnetic Excitations in Itinerant Electron Systems', in 'Proceedings of the Conference on Neutron Scattering', ed. R. M. Moon, NTIS, Springfield, Va., 1976, Vol. 2, p. 723.

R25. W. H. Eliot, 'NMR Studies on Bile Acids. Studies on 12α-hydroxylation of Precursors of Allo-Bile Acids by Rat Liver Microsomes' in 'Advances in Bile Acid Research, 3rd Bile Acid Meeting, 1974', ed. S. Matern, J. Hackenschmidt, and P. Back, Schattauer, Stuttgart, 1975, p. 31.

R26. J. Feeney, 'The Conformation of Hormonal Peptides in Solution', in 'Drug Action at the Molecular Level [Proceedings of a Symposium, 1976]', ed. G. C. K. Roberts, Univ. Park Press, Baltimore, 1977, p. 55.
G. C. K. Roberts, 'Substrate and Inhibitor Binding to Dihydrofolate Reductase', *ibid.*, p. 127.

R27. H. J. Harwood, 'Nuclear Resonance Spectroscopy of Polymers', in 'Proceedings of a Conference on the Characterisation of Polymers, 1974', Cleveland State University, Cleveland, Ohio, 1975, p. 95.

R28. Z. Kecki, 'Specific Interactions in the Solutions of Electrolytes' in 'Proceedings of the 3rd International Symposium on the Specific Interaction of Molecular Ions', Univ. Wrocław, Poland, 1976, Vol. 1, 307.

R29. A. J. Leggett, 'The New Phases of Liquid Helium-3', in 'Proceedings of the European Physics Society—Conference on Liquid and Solid Helium—1974', ed. C. G. Kuper, S. G. Lipson, and M. Revzen, Wiley, New York, 1975, p. 151.

R30. B. Lindman, G. Lindblom, H. Wennerstrom, and M. Gustavsson, 'Ionic Interactions in Amphiphilic Systems Studied by NMR' in 'Proceedings of an International Symposium on Micellisation, Solubilisation, Microemulsions—1976', ed. K. L. Mittal, Plenum Press, New York, 1977, Vol. 1, p. 195.

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