

No. 203

August, 1975

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Deadline Dates: No. 204: 1 September 1975 No. 205: 6 October 1975

All Newsletter Correspondence, Etc. Should Be Addressed To:

Dr. Bernard L. Shapiro Department of Chemistry Texas A&M University College Station, TX 77843 U.S.A.

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Sample run at the University of Chicago, courtesy of Dr. Philip Keim, Pritzker School of Medicine.
 A. Allerhand, R.F. Childers, E. Oldfield, J. Magn. Resonance, 11, 272 (1973).
 E. Oldfield and A. Allerhand, Proc. Nat. Acad. Sci. USA, 70, 3531 (1973).

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Newsletter

POLICIES AND PRACTICAL CONSIDERATIONS (Revised Version of 1 August 1975)

1. <u>Policy</u>: The TAMU NMR Newsletter (nee MELLONMR, then IIT NMR Newsletter) is envisaged as a means for the rapid exchange of information between active workers in the field of nuclear magnetic resonance. As such, it will serve its purpose best if the participants impart whatever they feel will be of interest to their colleagues, and inquire concerning whatever matters interest them. Since the participant is clearly the best judge of what he considers interesting, our first statement of policy is "We print anything". (This is usually followed by the mental reservation "that won't land us in jail".) Virtually no editorial functions are per-formed, although I feel the time has come when contributions dealing with the likes of how to clean spectrometer cooling coils, still another discovery of non-equivalent methylene protons, etc., should not be consid-ered adequate. The TAMU NMR Newsletter is not, and will not become, a journal. We merely reproduce and dis-seminate exactly what is sent in. Foreign participants should not feel obliged to render their contributions in English.

2. Finances, Subscriptions and Advertising: The Newsletter is wholly self-supporting, and depends for its funds on advertising, donations, and particularly individual subscriptions, for which we are now forced to charge the substantial rate of \$60.00 per year for a single subscription. A 50% academic or personal discount is available. Organizations and individuals are also invited to consider becoming a Contributor or Sponsor of the Newsletter and to have their organization's name appear in the appropriate list in each month's Newsletter, as well as the satisfaction of knowing they are helping keep this non-profit Newsletter in a solvent configuration. We will be happy to provide further details to anyone interested.

A major, indeed essential, source of funding to support the Newsletter is advertising. We earnestly solicit present and potential participants of the Newsletter to seek advertising from their company or institution. Our rates are modest and the need is great. Please inquire for all details.

Participation is the prime requisite for receiving the TAMU NMR Newsletter; in order to receive the Newsletter, you must make at least occasional contributions to its contents. We feel that we have to be ruthless in this connection and the following schedule is in effect: Eight months after your last contribution you will receive a "Reminder" letter. If no contribution is then forthcoming ten months after your last con-tribution, you will receive the "Ultimatium" letter, and then the next issue will be your last. If you are dropped from the mailing list, you can be reinstated by sending a contribution, and you will receive back issues (as available) and forthcoming issues at the rate of nine per contribution. Frequent contributions are encouraged, but no "advance credit" can be obtained for these. In cases of joint authorship, either contributor, but not both, may be credited - please indicate to whose account credit should be given.

PLEASE NOTE: A subject of considerable interest and concern to several present and potential TAMU NMR Newsletter participants - as well as to ourselves - is whether the Newsletter ought to contain material which either appears essentially simultaneously in the formal literature (or is presented at a meeting) or is definitely scheduled to appear very shortly (i.e., within a few weeks) after it would appear in the Newsletter. Our attitude is that a TAMU NMR Newsletter contribution should not duplicate, summarize or abstract material which has been published or which will appear in the formal literature within a small number of weeks of the Wewsletter account. On the other hand, let it be firmly emphasized that if the appearance in a journal is several months away - as is frequently the case - a brief account (as an abstract with or without a "Preprint Available" notice, a separate informal account, a selection of material from the manuscript, or what have you) sent in to the TAMU NMR Newsletter fulfills one of the very functions which we feel this Newsletter can provide. We trust that a participant will in each case himself apply the criterion of whether or not his contribution will communicate some subject matter to the Newsletter audience before they could read it elsewhere.

Public Quotation: Public quotation of Newsletter contents in print or in a talk is expressly ioibidden (except as follows), and reference to the TAMU NMR Newsletter by name in the scientific literature is never permissible. We remind you that in order to quote results or use material from the Newsletter, it is necessary, in each individual case, to obtain the prior permission of the author in question and then to refer to the material quoted as a "Private Communication".

If your copy of the Newsletter is shared with other readers, it is your obligation as the actual recipient of the Newsletter to see that these other readers of your copy are acquainted with and abide by the statements of policy and practical considerations.

4. <u>Practical Considerations</u>: (a) All contributions to the TAMU NMR Newsletter should be sent to the undersigned and will always be included in the next issue if received before the deadline dates, which appear in each issue.

(b) <u>Contributions should on the minimum (NOTE!!!</u>) number of $8\frac{1}{5} \times 11^{"}$ (21 x 27.5 cm) pages printed on one side only. <u>Margins should be between 2 and 3 cm on all sides</u> - *PLEASE* observe these limits if at all possible. <u>Black ink, typing, drawings, etc.</u>, essential. We are not equipped to deal with large size pieces of paper - e.g., A-60 charts.

Please conserve space by avoiding double spacing (except where necessary), ultra-wide margins, half-filled pages, etc. In general, please plan and construct your contribution so as to <u>fill</u> the minimum number of pages needed. On the other hand, drawings and spectra lose both eye-appeal and utility when they are too small. Only in very rare and absolutely necessary circumstances will a contribution in excess of three pages - including drawings, figures and references - be accepted. Economic necessity forces this policy.

Since reproductions of various kinds do not themselves reproduce too well, contributors are urged to submit their photographic originals to us (if the size does not exceed $8\frac{1}{2} \times 11^{"}$), and we will be happy to return these if requested. Some law of physics says that photographic reproductions of fuzzy or blurred originals never come out less fuzzy or blurred.

(c) Please provide short titles of all topics of your contributions, as they will ensure accuracy in preparing the title-page index.

(d) Please do not send in manuscripts, theses, books, etc., and ask us to be your consciences in selecting what should and shouldn't go into the Newsletter.

5. Suggestions: They are always welcome.

Shapiro

1 August 1975

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Address for all contributions and inquiries:

Professor Bernard L. Shapiro Department of Chemistry Texas A&M University College Station, TX 77843 U.S.A.

(Phone: (713)845-6944)

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July 1, 1975

Prof. B.L. Shapiro, Texas A and M University, Department of Chemistry, College of Science, College Station, Texas 77843, U.S.A.

Dear Professor Shapiro,

Investigation of the Polymerisation Product of 1, 1, 1-Trifluoroacetone using F^{17} and H¹ magnetic resonance spectroscopy

1,1,1-Trifluoroacetone is found to polymerise in the presence of aliphatic sec amines like diethylamine and dipropylamine. The polymerisation product is a mixture of four diastereoisomers of a cyclic trimer, the structure of which has been determined using F^{19} and H^1 magnetic resonance spectroscopy. The proportions of the isomers have been estimated to be 70 : 19 : 8 : 3 from the F^{19} resonance spectrum (Fig. 1). The trimer has the following pyran structure:



The major component has been separated in the pure form. The FMR spectra of the pure isomer and its various derivatives are shown in the Fig. 2. The pure isomer undergoes configurational changes in solvents like acetone, ether, pyridine and diethylamine.

Yours sincerely Alm Shingro M. Dhingra





FIG. 2 F¹⁹ RESONANCE SPECTRA OF PURE ISOMER AND ITS DERIVATIVES. (a) PURE ISOMER (b) MONO ACETATE (c) MONO METHOXY (d) ACETOXY METHOXY (e) DEHYRATED PRODUCT. 15

203-5



203-6



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DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE PUBLIC HEALTH SERVICE NATIONAL INSTITUTES OF HEALTH BETHESDA, MARYLAND 20014

July 23, 1975

Building 2, Room B2-08

Titles: High Field ¹³C; Polysaccharide Structure Elucidation; Direct Assignment of Histidine C2-H Resonances in Ribonuclease.

Professor Bernard L. Shapiro Department of Chemistry Texas A&M University College Station, Texas 77843

Dear Barry:

In response to your blue reminder I am happy to say that the ¹³C spectrometer being developed at NIH has been operational for a few months at a frequency of 69 MHz with a Bruker supercon magnet.

One of our first applications has been a structure elucidation on a meningococcal polysaccharide, Bos-12, which shares some properties of both the Group B and C meningococcal polysaccharides. The ¹³C NMR studies of Bhattacharjee <u>et al</u> (1) on the meningococcal Group B and C polysaccharides have indicated that the former consists of sialic acid units linked α_2 -8, whereas the Group C contains the sialic acid residues linked α_2 -9. By comparison of ¹³C NMR spectra at natural abundance of several samples of Bos-12 with the B and C polysaccharides, it was established that Bos-12 was either a) an equimolar mixture of α_2 -8 and α_2 -9 linked sialic acid polymer or b) α_2 -8/ α_2 -9 heteropolymer. The fact that Bos-12 failed to ppt. with anti-Group B serum would seem to exclude a). Periodate, which cleaves C-C bonds with vicinal hydroxyl groups was used to distinguish these two alternatives, and showed that Bos-12 polysaccharide is an α_2 -8/ α_2 -9 heteropolymer (2).

In a more familiar vein we have completed our work on the histidine C2 proton resonances of ribonuclease. We have made a <u>direct</u> quantitative assignment of one of the four histidine resonances to the active site histidine residue 12 in the amino acid sequence of ribonuclease. This was accomplished by a comparison of the rates of alkali-catalyzed deuterium exchange in ribonuclease S with tritium incorporation into the histidine 12 C2 position of the S-peptide portion (residues 20-21) of ribonuclease S under the same experimental conditions. As shown in the figure only one resonance, H-3, corresponds to histidine 12, and this is opposite to the assignment of the active site histidine resonances by Meadows <u>et al</u> (3) and Bradbury and Chapman (4), but consistent with the conclusions of Patel <u>et al</u> (5) and Markley (6). We have also repeated Meadows <u>et al</u>'s original assignment method of S-peptide deuteration and recombination with S-protein, and arrived at the same

Professor Bernard L. Shapiro

July 23, 1975

conclusion as Patel <u>et al</u>, although we obtained titration data over a range of pH values. A discussion of these and related results will be given elsewhere (7).

In a spirit of ecumenical NMR we now have at NIH former Varian, JEOL and Bruker employees. They are respectively, Rolf Tschudin (resident electronics specialist), Heisaburo Shindo (Visiting Fellow from Japan) and Rami Ader (Visiting Fellow from Israel).

Yours sincerely.

Jack S. Cohen Reproduction Research Branch National Institute of Child Health and Human Development

References:

- 1. A. K. Bhattacharjee, H. J. Jennings, C. P. Kenny, A. Martin and T. C. P. Smith, <u>J. Biol.</u> Chem. 250 1926 (1975).
- 2. T. Y. Liu, W. Egan, J. S. Cohen and J. B. Robbins, paper in preparation.
- D. M. Meadows, O. Jardetzky, R. Epand, H. H. Ruterjans and H. A. Scheraga, Proc. Nat. Acad. Sci. (USA) 60 766 (1968).
- 4. J. H. Bradbury and B. E. Chapman, <u>Biochem. Biophys. Res.</u> Comm. 49 891 (1972).
- 5. D. Patel, L. L. Candel and F. Bovey, Biopolymers, 14 987 (1975).
- 6. J. L. Markley, Accts. Chem. Res. 8 70 (1975).

7. H. Shindo, M. B. Hayes and J. S. Cohen, paper in preparation.

Figure Legend. A. Deuterium exchange of the four histidine C2 proton resonances of ribonuclease S at 220 MHz as a function of time at 30°C in 0.1M NaCl-D₂O at pH 8.8. Half-times of exchange (in days) were: H-1, 5.7; H-2, 8.8; H-3, 26.0; H-4, 642. B. Tritium incorporation into the C2 position of histidine 12 of ribonuclease S exchanged under the same conditions as in A. Half time of exchange was 20.9 days.

JSC:ell



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DEPARTMENT OF CHEMISTRY THE UNIVERSITY SOUTHAMPTON SO9 5NH

TEL. 0703-559122 TELEX 47661

25th July, 1975

Professor B. L. Shapiro, Department of Chemistry, Texas A. & M. University, College Station, Texas 77843, U.S.A.

Dear Barry,

Oriented Perfluorocyclopropane:

coupling constants and their anisotropies



The spectrum of perfluorocyclopropane as a solute in a liquid crystal solvent has been analysed to yield the three anisotropic couplings and separately the isotropic couplings. The isotropic values are, ${}^{2}J_{FF} = 204.4 \pm 1.3$, ${}^{3}J_{FF}^{13} = 11.1 \pm 0.4$, ${}^{3}J_{FF}^{14} = -1.3 \pm 0.3$ Hz.

The structure of this compound has been determined by electron diffraction and hence it is possible to compare the T. with calculated dipolar couplings, D_{ij} , for two out of the three couplings. One coupling, ${}^{2}T_{FF}$ was used to calculate the order parameter S by equating ${}^{2}T_{FF}$ to ${}^{2}D_{FF}$. For the two three-bond couplings the relationship

was used to determine J_{ij} aniso, the anisotropy in the coupling. The value of J_{13} was found to be near zero but J_{14} aniso was found to be -4.6 Hz, which is about 20% of T_{14} . Combining J_{14} with J_{14} aniso together with the order parameter gives,

 $J_{zz}^{14} = -60 \pm 8$ and $(J_{xx}^{14} + J_{yy}^{14} + J_{yy}^{14}) = 56 \pm 8$ Hz

Perhaps theoreticians will accept these numbers as a challenge to their methods of calculating spin-spin coupling tensors.

Best wishes,

Jim Emsley John Lundon

J. W. Emsley and J. C. Lindon

THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL 27514

DEPARTMENT OF CHEMISTRY

July 25, 1975

Professor Bernard L. Shapiro Department of Chemistry Texas A & M University College Station, Texas 77843

Dear Professor Shapiro:

Short Title: The R-Value Method and Conformational Distortions

203-12

We have been investigating conformational distortions in some 1,4-oxathianes employing the R-value and torsional angles relationships of Buys and Lambert. We have calculated torsional angles in <u>trans</u>-tetrahydro-1,4-benzoxathiane (1), the diastereoisomeric sulfoxides (2 and 3), and the corresponding sulfone ($\frac{4}{4}$). The coupling constants used in this investigation came from computed spectra (using a modified version of LAOCN 3) which were superimposable on the experimental couplings.

Interestingly, the appropriate torsional angle, ϕ , (as indicated by the heavily darkened lines in the structures) in the equatorial sulfoxide (2) is similar to that calculated for the parent sulfide (1). This would appear to suggest that the hybridization change at sulfur in 2 (as compared to 1) does very little to affect the torsional angle. On the other hand, the axial sulfoxide appears to exert a profound steric influence presumably on the two axial C-H positions (C₂H and C₀H) resulting in a diminished torsional angle (50°). The torsional angle in the sulfone is slightly greater than that calculated for the axial sulfoxide suggesting that perhaps the axial oxygen of the sulfone experiences a smaller steric effect on the axial C₂H and C₉H positions than does the axial oxygen in 3. It is noteworthy that the results of acid-catalyzed equilibration of the two sulfoxides (2 and 3) show that the <u>axial</u> sulfoxide is preferred.

10

R = 2.43

φ = 60°

3 R = 1.31

R = 1.66 $\phi = 54^{\circ}$

4

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R = 2.83

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03

Prof. B.L. Shapiro Dept. of Chemistry Texas A and M University College Station/Texas 77843/USA

¹⁵ N NMR of Living Cells

Dear Barry,

Direct observation of ¹H, ¹³C, and ³¹P NMR signals in live cells and in intact tissue specimen has repeatedly been reported over the past few years. Much of the motivation for these experiments comes from the expectation that NMR techniques may be used for in vivo studies of the metabolism, compartmentation, and transport pathways of the compounds giving rise to the observed signals. Here we would like to report on the observation of ¹⁵N NMR spectra of live cells from a culture of Ustilago sphaerogena.

The fungus <u>Ustilago sphaerogena</u> was grown at 30[°] in a low-iron medium with 95% ¹⁵N ammonium acetate as the sole nitrogen source. The cells were harvested and concentrated by centrifugation on the 17th day after inoculation. Experience indicates that such cells are perfectly healthy as they can be routinely used as inoculum to start growth of new cultures. From 3.3 1 of culture medium the total yield of cells was a tightly packed pellet of about 10 cc. This material was divided into several batches, and both the cell pellets obtained by centrifugation and the growth medium were investigated by NMR.

Fig. 1 shows three ¹⁵N NMR spectra obtained from this culture. Spectrum I corresponds to the supernatant medium after harvesting of the cells by centrifugation. Spectrum II corresponds to the cells immediately after harvesting. The spectrum III was obtained from a batch of cells which had been resuspended in the growth medium after harvesting, aged for 9 days at 3°, and then carefully washed with distilled water. Comparison of the spectra I and II shows that the signals observed in the cell slurry did not arise from ¹⁵N labelled metabolites present in the medium external to the cell, and hence had to come from compounds within the cell. The spectra II and III show that of the 4 compounds observed in spectrum II, three either diffused out of the cells or were metabolized during the aging period.

This study establishes that 15 N NMR is in principle a suitable non-destructive tool to study aspects of the cellular nitrogen metabolism, especially so since isotopic effects of 15 N, <u>vis-à-vis</u> the most abundant 14 N isotope, ought to be negligible. For the present study of <u>Ustilago sphaerogena</u> it remains to identify the compounds observed in the spectra I to III. At the present stage of the investigation it appears quite likely that the signals in the spectra II and III arise from particular components of the low molecular weight peptide pool of the cell. Please credit this contribution to the account of K. Wüthrich.

Δ

Sincerely yours,

von Philipsborn

W. Schwotzer

10 ppm

M. Llinas

luoper M. Llin

Wüthrich

M

I culture medium

Il freshly harvested cells

III washed cells

- 280 -240 - 200 -320 ppm

Fig. 1 ¹H noise-decoupled Fourier transform ¹⁵N NMR spectra of an ¹⁵N-enriched culture of <u>Ustilago sphaerogena</u>. (I) Culture medium free of cells, (II) freshly harvested cell slurry, (III) cell slurry aged for 9-days at 3°, and washed with distilled water before the NMR measurement. The spectra were taken at 32°C on a Varian X-L 100-15 spectrometer at 10.1 MHz. The chemical shift scale, given in parts per million (ppm), is referred to external ¹⁵NO₂.

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Department of Chemistry

The Florida State University Tallahassee, Florida 32306



July 30, 1975

Professor B. L. Shapiro Department of Chemistry Texas A & M University College Station, Texas 77843

A. CALL FOR ¹³C PREPRINTS ETC.

Dear Barry,

I am currently preparing the second edition of <u>Carbon-13</u> <u>Nuclear Magnetic Resonance For Organic Chemists</u>. Although the 2nd edition will follow its predecessor by not attempting to be comprehensive in literature coverage I am making an attempt to have this book be quite current when it is published next year. We are once again using a direct photocopy process and so the book should appear within six months after completion (before May or June).

I particularly want to include major developments (techniques or applications) that will appear in the next 6-12 months. I hope that TAMU-NMR newsletter readers will answer this call.....

B. A MORE "INERT" PARAMAGNETIC RELAXATION REAGENT

<u>Tris</u>-acetylacetonatochromium (III) ($Cr(acac)_3$) and the corresponding iron (III) compound have been utilized as socalled shiftless spin-lattice relaxation reagents to improve ¹³C nmr spectral sensitivity by augmenting diamagnetic relaxation pathways. The reagents have also been used to: (1) suppress unfavorable nuclear Overhauser effects (NOE's) in ¹⁵N and ²⁹Si nmr; (2) make ¹³C nmr data quantitative; and (3) act as nmr <u>spin-labels</u> to assign spectral lines in ¹³C nmr.

The conception of applications for these reagents was well thought out. However even the early 1^{3} C spin-lattice relaxation studies using Cr(acac)₃ indicated that the reagent was not truly inert and that care would have to be exercised in its use. Later work extended the first warnings.²

We describe here ¹³C and ¹H spin-lattice relaxation experiments using both Cr(acac)₃ and <u>tris</u>-dipivaloylmethanatochromium (III) (Cr(dpm)₃). The six bulky t-butyl groups make the Cr(dpm)₃ considerably more inert to physical interaction with organic substrate molecules and thus desired leveling of spin-lattice relaxation times can be achieved more reliably with this compound. 203-17

Recent studies³ have indicated that $Cr(acac)_3$ may induce significant (~0.5 to 1 ppm) chemical shifts in ^{13}C nuclei when there are weak intermolecular interactions between metal chelate and substrate molecules. With $Cr(dpm)_3$ this new complication is also minimized (see below).

Table 1 summarizes the 1^{3} C and H spin-lattice relaxation data obtained in this study.

With $Cr(acac)_3$ shorter T_1 's observed for the $^{13}CCl_xH$ carbons of chloroform and trichloroethylene relative to the CCl4 solvent molecule carbons and the strongly shortened T_1 's for OH in methanol and t-butanol as well as the CCl_xH protons in the chlorocarbons all result from hydrogen bonding between those acidic protons and the chromium chelates.

The largest internal T_1 ratio observed with Cr(acac)3 is for the proton of chloroform and the OH proton of methanol relative to the protons of the inert standard, cyclohexane. In the case of chloroform the proton $T_1(0.016s)$ is 33 times shorter than the C₆H₁₂ proton T_1 .

The ¹³C data in Table 1 might seem to imply that Cr(dpm)₃ is totally inert to H-bonding. That this may not be the case can be seen from the more sensitive ¹H data (the proton directly involved in the interaction is most affected). Even with t-butanol some weak "complexation" may be present.

In separate experiments, accurate 13C and 1H chemical shifts were obtained on solutions of CHCl₃ with (1) no added PARR, (2) with Cr(acac)₃ and (3) with Cr(dpm)₃. No measurable shifts (relative to TMS) were observed in the proton spectra. In the 13C spectrum (0.5M CHCl₃, Cr(acac)₃-0.05M) a shift of 1.0 ppm was observed; with Cr(dpm)₃ (again, at 0.05M) the PARR-induced chemical shift was <0.10 ppm (relative to TMS).

These results will appear soon in the Journal of Magnetic Resonance.



- 1. G. C. Levy and J. D. Cargioli, J. Magn. Resonance, 10, 231 (1973).
- 2. (a) G. C. Levy and R. A. Komoroski, <u>J. Am. Chem. Soc.</u>, <u>96</u>, 678 (1974); (b) G. N. LaMar and J. W. Faller, <u>ibid.</u>, <u>95</u>, 3817 (1973) [Gd(acac)₃]; (c) G. C. Levy and U. Edlund, <u>J. Am. Chem. Soc.</u>, <u>97</u>, in press.

3. P. M. Henrichs and S. Gross, <u>J. Magn. Resonance</u>, <u>17</u>, 399 (1975).

Table 1. T₁ Data with Paramagnetic Relaxation Reagents, (PARR)

a.	13 _{C DATA}		
	Compound (A) ^a Visc., CP	PARR ^b T ₁ (A)(sec) ^c	T _l (CCl ₄) (sec) ^C
	CHLOROFORM,2M 0.80	None ∿30 Cr(acac) ₃ 0.118 Cr(dpm) ₃ 1.16	∿80 0.633 1.17
	TRICHLORO- ETHYLENE,2M 0.77	None 25 ^e (71) ¹ Cr(acac) ₃ 0.309 ^e (0.53 Cr(dpm) ₃ 1.16 ^e (1.25	83 85) ^f 0.606 6) ^f 1.11
b.	<u>¹_H DATA</u>	T _l (A) (sec) ^d	T ₁ ^{OBS} (cyclohexane) (sec)d
	CHLOROFORM,1.0M 0.83	None 3.7 Cr(acac) ₃ ∿0.016 Cr(dpm) ₃ 0.542	3.6 0.528 0.642
	TRICHLORO- ETHYLENE,1.OM 0.82	None 4.5 Co(acac) ₃ 4.3 Cr(acac) ₃ 0.069 Cr(dpm) ₃ 0.530	3.7 3.8 0.501 0.659
	METHANOL, 2.0M 0.80	None. 3.0^{9} (3.5) None ¹ 4.1 ⁹ (3.9) Co(acac) ₃ ¹ 3.9 ⁹ (4.1) Cr(acac) ₃ $\sim 0.020^{9}$ (0.1) Cr(dpm) ₃ 0.250 ⁹ (0.5)	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$
	t-BUTANOL,2.0M 0.96	None 1.83^{g} (1.74 Cr(acac) ₃ 0.0479 (0.27 Cr(dpm) ₃ 0.396 ^g (0.57	1) ^h 3.10 76) ^h 0.371 15) ^h 0.526

^aIn CCl₄. For ¹H exp'ts 0.05M cyclohexane added. ^bPARR conc. 0.05M (13 C exp'ts) and 0.005M(1 H exp'ts). ^c38°C; 67.9 MHz, T₁'s ±2 to 10%. ^d27°C, 270 MHz, T₁'s ±2 to 10%. Samples without PARR where not degassed. Contribution from dissolved 0₂ to the relaxation is not significant in ¹³C-nmr if T₁<5-10 sec. In the ¹H-nmr data this relaxation process could be a major pathway (<u>12</u>). ^eT₁ <u>C</u>HC1 carbon. ^fCl₂ carbon. ^g0H proton. ^hCH₃ protons. ⁱ0.05M methanol.



UNITED STATES DEPARTMENT OF COMMERCE National Bureau of Standards Washington, D.C. 20234

July 15, 1975

Dr. Bernard L. Shapiro Department of Chemistry Texas A & M University College Station, Texas 77843

Quadrature Phase Detection Retrofit

Dear Barry:

We have completed construction of a quadrature phase detection retrofit for our Bruker and Varian spectrometers. Used together with a correction algorithm (submitted to J. Mag. Res.) it yields very good separation of the upper and lower sidebands.

The detectors are constructed from active balanced mixer IC's, and the matched lowpass filters are constructed easily by ranking (not matching) the capacitors used.

We used 2% film resistors and 10% mylar capacitors in the lowpass filter system. The capacitors were selected by ranking twelve 0.01µf capacitors in order of voltage drop in series with a 2.2 M Ω resistor at 60 Hz. Thus, the capacitor with the smallest drop (largest capacitance) was ranked 1, and that with the largest drop was ranked 12. The capacitors were then distributed as shown in the table.

A complete schematic of one channel accompanies this letter.

TABLE OF RANKS OF .01µ CAPACITORS IN FILTER

RANK

Capacitor	C ₁	c ₂	ċ ₃	C4	с ₅
Channel l	2	9	4	7	11
Channel 2	3	, 8	5	6	10

Yours very truly, Steve Park

Steve Parks Rolf B. Johannesen Inorganic Chemistry Section





203-20

UNIVERSITY OF MUNICH

8000 MUNICH 2

INSTITUTE OF ORGANIC CHEMISTRY KARLSTRASSE 23 GERHARD BINSCH PROFESSOR OF THEORETICAL ORGANIC CHEMISTRY

July 21, 1975

Professor Bernard L. Shapiro Department of Chemistry Texas A & M University College Station, Texas 77843 USA

DNMR Spectroscopists Unite!

Dear Barry:

This is a call for action addressed to the subsection of the nmr community interested in variable-temperature work.

It seems hardly necessary to bewail once again the sad state of affairs regarding commercially available variabletemperature probes. Whereas the instrument companies have over the years made a commendable effort to keep abreast of engineering developments in magnet design and in electronics, the construction of really satisfactory variable-temperature equipment has received no more than slighting attention. I rather suspect that Leonardo (the inventor of the valve flush toilet, remember?) could have done almost as well. In fact, some of the (supposedly improved) designs I recently had an opportunity to inspect struck me as positively Stone Age.

I happen to believe that this constitutes the only serious bottleneck still remaining in the area and that there can be no genuine progress unless and until it is removed. Those who hold this to be an idiosyncrasy of mine are encouraged to read what the Nestor *par excellence* of dynamic nmr, Herb Gutowsky, has to say about the situation (*cf*. the last paragraph of his chapter for the recent Academic Press book, edited by L.M.Jackman and F.A.Cotton).

On several occasions during the past 8 years I have pleaded with representatives of the relevant companies, but unfortunately failed to make an impression. The usual reply, i.e. that it would not be technically feasible to build probes meeting the required specifications, is no longer serviceable; a solution does exist, and a superb one at that. I am referring to the work of Fritz Jensen and his former and present coworkers at Berkeley (*Rev.Sci. Instr.* 43, 145, 894 (1972)), and in particular to the detailed instructions contained in the Ph.D. thesis of Dr. Richard A.Neese (1975), of which Professor Jensen kindly sent me a copy.

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Professor Bernard L. Shapiro

Before some of us go ahead in building their own probes à la Neese (with the concomitant wasteful multiplication of effort) it might be appropriate to make one last attempt at persuading the instrument companies to do the job for us. Clearly, however, this ought to be a concerted attempt. I am prepared to take the initiative and to act as a clearing house for comments and suggestions.

All those interested are urged to write to me. Make your comments as detailed or as brief as you like (a postcard with your name and the word "interested" would already be helpful). Provided the number of those responding is not too insignificant I would then draw up a suitable document (including a list of interested individuals and a summary of the comments received) and send copies of it to all manufacturers of nmr machines.

Remember: it would be satisfactory if we managed to coax into action just one of the companies. The others would then soon be forced to follow suit. At least, that seems likely if one believes that the free enterprise system is still functioning.

So don't forget to write!

Sincerely yours,

shad

Gerhard Binsch

NOTICE!!!!!

Several of our Newsletter participants are getting a little lax in the preparation of their Newsletter contributions, in that unnecessarily wide margins and unnecessary double spacing of the type is becoming more and more prevalent. Production costs force me to begin sending such contributions back for compression to the minimum number of optimally filled pages. Please help us by making such returns unnecessary.

> B. L. Shapiro 4 August 1975

Multi-budget systems for multi-discipline applications...Tracor Northern signal averagers.

Data once thought to be unobtainable due to its fringe position is now easily captured by Tracor Northern's signal averagers. The adaptability and versatility of our powerful systems is proven by their daily use in fields like spectroscopy, electronics, physics, medicine, mechanical vibration studies and analytical chemistry to name a few.



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- * 7 data processing modes.

To provide users with extensive flexibility and versatility, over 20 plug-in modules are available for:

* High resolution (9 or 12 bit) averaging of 1 to 8 signals at speeds up to 10 uSec. per address.



Left: NS-575A with Biomation plug-in module examines severe noise situation. Right: 100KHz triangular waveform is detected after 1024 sweeps (real time =8 sec.).

- * 10 nSec. per address averaging with Biomation Transient Recorder.
- * PHA/MCS analysis.
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- Parametric sweep and pre-synchronization signal averaging.
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- * Voltage distribution analysis.
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GOP NO

data processor and continuous display. The solid state memory is available in 1024 or 2048 with 2²⁰-1 counts per address.

To make sure our system operates within yours, we offer options like character generator display and NMR synchronizer with easy



Left: NS-570 in a direct averaging application examines a severe noise environment. Right: Sine wave is detected after 1024 sweeps (real time = 20 sec.).

to operate NMR controls. Like the main system, options are low cost.

Both the 575A and 570 are compatible with Tracor Northern accessories which aid data manipulation . . . readout/readin via teletype, high speed paper tape punch and reader, reel to reel and cassette magnetic tape and EIA compatible devices. And interfaces are available for DEC-11, H-P 9800 and Nova series computers.

If you're not sure about your application for signal averaging, give us a call. Our applications assistance department will be able to advise you based on years of experience and over 400 installations. We undoubtedly have worked in a situation similar to yours so we can talk results before you decide. Would you take anything less from the leader?

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The University of Western Ontario, London, Canada

Faculty of Science Department of Chemistry

August 1, 1975.

Professor B.L. Shapiro, Department of Chemistry, Texas A & M University, College Station, Texas 77843, U. S. A.

Dear Barry:

A simple microcell

In response to your red letter, I enclose a couple of examples of 13 C spectra obtained from a very simple microcell arrangement with which a few experiments have been done. The arrangement is essentially that suggested to me by D.M. Wilson during a conversation at the recent E.N.C. A microcell is made from an ordinary melting point capillary to just fit into a 5 mm receiver insert. With a little practice a glassblower can turn these out with remarkable reproducibility. The cell is then suspended in the receiver coil by means of a collar turned to fit snugly into a 5 mm nmr tube, which, of course, is in the spinner turbine. We find that the volume of these cells is nearly constant at 55 µl.

The spectra show that these cells permit one to get reasonable spectra from samples of a few milligrams very easily. The first spectrum (A) is that of 3 mg. of cholesterol in C_6D_6 obtained in a 12 hour run. The upper trace is a two-fold expansion of the high-field region. The second spectrum (B) is from the reduction product of a naturally occurring sesquiterpene diol $C_{15}H_{26}O_2$ in CD_2Cl_2 . We wanted to show that this product was essentially a 50/50 mixture of diastereomers and felt that the microcell would provide better results for the 8 mg sample (i.e.,~4 mg of each stereomer) than a 5 mm tube. Seven absorptions appear as two closely spaced signals (each marked with an asterisk) while in the spectrum of the natural diol these are singlets. The upper trace in this case is a four-fold expansion of the lower field region.

While these spectra do not comp ete with those obtained by capillary inserts, etc., these are easy to get and the cost is near zero. Of course, with quadrature detection or a crystal filter one could readily work with somewhat smaller samples.

Best regards to Lee and the girls.

Sincerely,

J.B. Stothers, Professor of Chemistry.

JBS/gsh encls.





203-26

SYNTEX RESEARCH DIVISION OF SYNTEX (U.S.A.) INC. 3401 HILLVIEW AVENUE PALO ALTO, CALIFORNIA 94304

INSTITUTE OF ORGANIC CHEMISTRY

July 21, 1975

Professor Bernard L. Shapiro Department of Chemistry Texas A & M University College Station, Texas 77843

"Determination of the Anomeric Configuration of C-glycosides."

Dear Barry:

I have measured the ¹³C nmr spectra of a number of 2-3-0isopropylidene ribose and allose derivatives in order to determine the "anomeric" configuration of the C-glycosides in Table I. When both isomers are available, the configuration is easily established by application of the well known upfield shift rules for cis groups The problem is more difficult however, if on 5 membered rings. only one isomer is available and when the l_u spectrum does not yield unambiguous results. We have found that the 13_{C} chemical shifts of the 2-3-0-isopropylidene carbons of C-glycosides are quite dependent on the C-l configuration and these shifts can be used to establish the configuration at C-1. In CDC1₂, the methyls of the β isomers occur at 27.44+ .31 and 25.55+.13ppm while the quaternary carbons are at 114.67+.25ppm. The corresponding figures for the α isomers are 24.94+.13, 26.20+.09 and 112.97+.40 ppm. The difference in chemical shift of the methyls in the β isomers is near 2 ppm while in the α isomers this difference is less than 1.4 ppm.

The compounds in this study were synthesized by Drs. Hiroshi Ohrui and John Moffatt in the Institute of Molecular Biology and a complete account of the work has been submitted to JACS.

I trust that the attached green will continue my subscription and this contribution will delay the arrival of the dreaded blue and pink.

Good luck with your fund raising.

Sincerely yours,

Michael L. Maddox

Attachment:

Table I.

т	ABLE	I
_		_

			βis	ome r	r	α	isomer	
R	R'	Туре	Me	Me	с	Me	Me	C
CH2CN	Н	Ī	25.39	27.31	114.92	24.77	26.11	113.32
CH2CN	C¢3	I	25.55	27.44	114.89	24.90	26.14	113.23
^{2H} 2 ^{CN} a	pBrC ₆ H ₄ CO	I	25.49	27.41	115.73	24.84	26.11	113.85
H ₂ CO ₂ Me	н	I	25.52	27.47	114.53	25.06	26.30	112.90
H ₂ CO ₂ Me	C¢3	I	25.75	27.63	114.37	25.19	26.33	112.58
H (CO ₂ Me) ₂	Сф ₃	I	25.75	27.60	114.30	25.00	26.24	112.68
сн (CO ₂ ET) ₂	C¢3	I	25.68	27.57	114.21	25.00	26.24	112.61
H ₂ CN	-	II	25.38	27.27	114.79	24.74	26.04	113.20
H ₂ (CO ₂ ET)	-	II	25.52	27.41	114.50	25.00	26.27	112.68
H2CO2Me		I	25.52	27.37	114.47	25.16	26.20	112.65
0= = = 0 me	Н	I	25.48	27.83	114.53			
HNUNNAT	C¢3	II	25.58	27.57	111.80			
	0		1		L			1

a configuration indepently established

b DMSO solution

203-28

T

Π

~R

J

University of Salford

Salford M5 4WT

Department of Chemistry and Applied Chemistry

Telephone 061-736 5843 Telex 668680 (Univ Salford) Valentin Dimitrov

Professor Bernard L.Shapiro

Department of Chemistry

Texas A & M University

College of Science

College Station, Texas 77843

30.July.1975

Dear Professor Shapiro,

In No.184 of the TAMU NMR Newsletters (1974) I reported on a Single Operational Parameter Formula for Exchange. Meanwhile, I changed the formula with the intention to improve it, and a brief description is given below.

Please credit this contribution to the subscription of Dr.Spassov (Institute of Organic Chemistry, Bulgarian Academy of Sciences, Sofia 13, Bulgaria).

A NEW INTENSITY RATIO (NIR) FORMULA

A new simple formula for evaluating the lifetime in a symmetric system is offered. The new formula is applicable both below and above coalescence, and the accuracy of the results is shown to be far superior to those obtained with the Rogers and Woodbrey intensity ratio (IR) formula¹.

There are two characteristic points in the spectrum of a paripartite system at slow exchange²: the point of maximum intensity occurring at $v_{i} = /2$ Hz and the saddle point at $v_{j} = 0$ Hz. In the Rogers and Woodbrey approach $v_{i} = \delta_{meas} / 2$ and this point moves towards the $v_{j} = 0$ point as coalescence approaches.

Assuming that the two points γ_i and γ_j are fixed and making some transformations and cer approximations in the Hahn, Maxwell and McConnell (HMM) equation² one gets a formula for evaluation of the lifetime:

R.T₂

$$1-2_{R} + \sqrt{(\pi_{s} S_{T_{2}})^{2} + (R-1)^{2}}$$

where $R = F_1(v_1) / F_2(v_1)$. F_1 and F_2 are functions of the scanning frequency v and \mathcal{S}_1 , T_2 and \mathcal{T}_2 -HMM equation. All these have their usual meaning.

The formula has been applied to the classical case of N,N-dimethyltrichloroacetemide (DMTCA). The results obtained by the NIR and IR formulae, as well as those reported by other authors^{3,4} are summarised in the Table.

With best regards

Yours sincerely

Valentin Dine.

Valentin Dimitrov

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ACTIVATION PARAMETERS OF THE DMTCA AT 100 MHz

Source of	TLS [*]	TLS [*]	TLS ^{*,&}	NIR	$\mathrm{IR}^{\&}$
	Ref.3	Ref.4		•	
⊿H [≠] kcal.mole ⁻¹	15 . 1 <u>+</u> 0 . 6	16.1 ± 0.3	15.6 <u>+</u> 0.1	16.2 <u>+</u> 0.2	1 2•0 <u>+</u> 0.1
▲S [≠] e.u.	0.3 + 2.3	3.7 ± 1.1	1.7 <u>+</u> 0.3	3.5 ± 0.7	-11. 7 <u>+</u> 0.2
$\Delta G_{298.2}^{\neq} \text{ kcal.mole}^{-1}$	15.0 <u>+</u> 0.1	1 5•0 <u>+</u> 0•3	15 . 1 <u>+</u> 0.01	15 . 2 <u>+</u> 0 . 01	15 . 5 <u>+</u> 0.001
Ea kca⊥.mole ⁻¹	15 . 7 <u>+</u> 0,6	16.7 <u>+</u> 0.3	16.2 <u>+</u> 0.1	16.8 <u>+</u> 0.2	12 . 6 <u>+</u> 0.1

TIS-Total Line Shape analysis

&Author's unpublished results



WAYNE STATE UNIVERSITY

DETROIT, MICHIGAN 48202

DEPARTMENT OF CHEMISTRY

July 31, 1975

Professor B. L. Shapiro Department of Chemistry Texas A & M University College Station, TX 77843

Carbonyl Anisotropy in Imides

COLLEGE OF LIBERAL ARTS

Dear Prof. Shapiro:

During the course of our investigations on the conformational analysis of imides, we have obtained some data which bear on the question of the effect of amide carbonyl anistropy on the chemical shifts of nearby protons. Data available in the literature are somewhat ambiguous.¹ While N-methyl protons cis to the carbonyl group in N, N-dimethyl amides appear upfield (shielded) relative to the trans methyl group, the cis ortho protons in anilides are shifted downfield (deshielded) relative to ortho protons in a phenyl ring trans to the carbonyl.¹

We have examined a number of compounds in the imide series and have found that in all cases protons suffer significant downfield shifts (deshielding) when adjacent to the imide carbonyl function. Three representative examples are given below.



1. In diformamide, <u>1</u>, an unambiguous assignment of the diastereotopic formyl protons can be made using the coupling constants to the proton bonded to nitrogen.² Here the proton closest to the carbonyl group, H_B , is significantly shifted to low field (0.55 ppm) relative to H_A .

2. The unsymmetrical imide, N-acetyl propionamide, exists as an equilibrium mixture (3:1) of two diastereomers 2a and 2b. We have assigned the structure



Professor B. L. Shapiro

<u>2b</u> to the major isomer on steric grounds. The relevant chemical shifts are: CH_3 , A δ 2.20, B δ 2.53 and CH_2 CH_3 , A' δ 2.50, B' δ 2.95. Thus, both methyl and methylene groups are shifted downfield by 0.3 - 0.5 ppm when cis to an imide carbonyl group.



3. N-Acyl imidazoles, <u>3</u>, R=H, CH₃, CH₂CH₃, CH(CH₃)₂, CF₃, also exist as a mixture of isomers <u>3a</u> and <u>3b</u>. The equilibrium constants range from 1.5 (R=CH₂CH₃) to 4.6 (R=H). In all cases, we have assigned structure <u>3a</u> to the major isomer on the basis of electronic factors and dipole moments. In

all of these compounds, H_B exhibits a downfield shift (deshielding) of .15 to .25 ppm in methylene chloride solvent relative to H_A , which is further from the anisotropic carbonyl function. In the more highly associating and anistropic solvent acetone reversals in chemical shifts were observed for some compounds.

In summary, our results seem most consistent with the proposition that the anisotropy of the imide carbonyl group causes downfield shifts for hydrogens, methyl and methylene groups which lie in or near the nodal plane and to the side of carbonyl bond near the oxygen atom.

Preprints of our work on symmetrical imides and N-acylimidazoles are available upon request.

Richard Kein

Sincerely yours,

Morton Raban

MR/cf.

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CHEMICAL CENTER

PHYSICAL CHEMISTRY 2

Lund, June 6, 1975

Dr. B.L. Shapiro Department of Chemistry Texas A&M University College Station Texas 77843 U S A

Dear Dr Shapiro,

Title: ¹³C NMR and rotational barriers in pyridinecarbaldehydes

We have in this laboratory, as people have in many other laboratories, for some time been studying barriers to internal rotation and conformational equilibria in aromatic aldehydes.¹ As long as we were restricted to proton NMR, the NMR bandshape analysis method was not generally usable due to the complexity of the proton NMR spectrum and the often at low temperature broad and featureless bands caused by short relaxation times. This difficulty has, however, sometimes been avoided by selective deuteration.²

With the use of 13 C FT NMR instead of, or as a compliment to, ¹H NMR there has been a drastic change in the possibilities to study exchanging systems, due to the large shift differences normally observed in carbon-13 NMR and the simplicity of these spectra when proton broad band decoupling is used. Furthermore, the less effective ¹³C relaxation at low temperature as compared to proton makes carbon-13 low temperature work less troublesome. We have for a couple of years been working with ¹³C low temperature NMR to study barriers to internal rotation in p-substituted benzaldehydes and rotamer populations in o- and m-substituted benzaldehydes, as well as their protonated analogs.³

Our most recent work in this area is the ¹³C NMR study of both torsional barriers and rotamer equilibria in the three pyridine carbaldehydes by means of complete bandshape analysis, resulting in the following data:

	∆G [≠] 150 ⁰ K kJ/mol	ΔG ⁰ 150 ⁰ K kJ/mol
4-aldehyde	24.7	0
2-aldehyde	31.4	3.6
^a ∆G ^o = G _{NO-cis} -	G _{NO-trans}	

It is interesting to note that a measurable population of

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the NO-cis rotamer of pyridine-2-carbaldehyde is found here, which is in contradiction to what has been deduced from proton long-range coupling and from the observed dipole moment and Kerr constant.⁴ From the spectra shown in the Figure it can be seen that there is no doubt in that the population of the NO-cis conformer is not negligible even though the exact position and intensity of the corresponding signal can not be given.



Figure Carbon-13 NMR spectra of the aromatic carbons in pyridine-2-carbaldehyde at some low temperatures.

Sincerely yours

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Torbjörn Drakenberg

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The nucleus observed for this spectrum is ${}^{15}N$, at 10.1 MHz. The upper trace shows 500 transients ($a = 90^{\circ}$) of a proton noisedecoupled spectrum of phenylhydrazine in $C_{\theta}D_{\theta}$. The negative magnetogyric ratio of ${}^{15}N$ produces negative NOE, hence the inverted lines in the trace. The lower trace shows 2000 transients of phenylhydrazine ($a = 90^{\circ}$); the decoupler was on during acquisition and off during the pulse delay. This technique makes it possible to measure NOE while retaining the advantages of a ¹H noise-decoupled spectrum.



degree of experimental freedom is offered for an NMR Spectrometer that combines state-of-the-art performance and ease of operation. At present, we cannot begin to assess the impact the new-found experimental scope might have on the direction of future investigations. But we expect that a lot of new ground will be broken.

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In this spectrum, the new accessory allows the observation of ¹⁹⁵Pt at 21.5 MHz; the sample was aqueous hexachloroplatinic acid. An inversion recovery ($180^\circ-\tau-90^\circ$) pulse sequence was used in the automatic measurement of the spin-lattice relaxation time (T_i) for the ¹⁹⁵Pt nucleide.

We wish to acknowledge the cooperation of Professor Paul Ellis, af the University of South Carolina, whose early experimental work contributed to development of this capability of the XL-100. instrument division

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