

ANOMALOUS MAGNETIC FIELD MIXING IN CHROMIUM (III) CHLORIDE

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Foreword

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Nuclear quadrupole resonance (NQR), although potentially an important research tool, has not yet gained widespread use or popularity. It is our good fortune to have a pioneer in this field, Dr. Lee Gregory Kent, as a member of the Creation Research Society. Dr. Kent has kindly consented to publish his latest work first in the C.R.S Quarterly because of its possible significance for creationism.

On the basis of evolutionary presuppositions (i.e., evolution in the broadest sense of the word, as "cosmic evolution"), one should expect to find a gradation in properties from one member of a family of similar compounds to the next. Yet the results presented here do not fit such a picture. Chromium (III) chloride is seen to be unique among all the compounds studied, despite the fact that over 100 substances were investigated, many of them very similar to CrCl₃ in structure. In other words, we have at this point, in any sequence of related compounds one might wish to envision, a marked discontinuity in at least one readily measurable property.

Creationism can provide a framework for comprehending either a graded series or a group of discrete entities with "random" properties. Proponents of the evolutionary approach, on the other hand, must by its very nature founder when faced with discontinuities. Because the field discussed herein is somewhat new and uncharted, and because several esoteric questions of a philosophical nature are raised, it will be left to the reader to determine whether the property investigated in this work does indeed constitute a significant discontinuity, and how strongly such evidence militates against an evolutionary explanation of origins.

The technique utilized consists of subjecting a solid sample of the compound under study to crossed AC fields, and measuring its response as the frequency of one of the fields is varied. Resonances, attributable to changes in the positions of the nuclei in the sample, are detected at characteristic frequencies. Chromium (III) chloride exhibits such a resonance as do other compounds, but in addition causes the anomalous shifting of the entire baseline of the recorder output. This remarkable phenomenon is still unexplained.

Background

Searches for nuclear quadrupole resonances (NQR) yielded insight into a phenomenon intriguing, enigmatic, apparently unique, and unrelated to the initial study. A word regarding NQR and its detection will underscore the anomaly.^{1, 2}

The nuclei of about 25 atoms are non-spherical in shape. If the chemical (electronic) environment in which these nuclei are located is also non-spherical, they will orient themselves in a "preferred" direction, since unlike charges attract. This nuclear position gives the system a slightly lower energy than would any of the less-desirable allowed positions.

Normally a system does not exist at any randomly-chosen energy. Only a small number of quantum states is possible, the exact number being determined by nuclear properties. That of lowest energy is referred to as the quantum ground state; the one or two less-desirable (i.e., higher-energy) orientations that might exist yield "excited" quantum states.

One may determine the difference in energy between the ground and first excited states by placing about five grams of solid sample into a 15 mm diameter test tube, and, in turn, inserting the test tube into the coil of a superregenerative oscillator (SRO), Figure 1, bottom. When the SRO is oscillating at a frequency exactly corresponding to the energy necessary to move the nucleus from its ground state to the next higher possible quantum state, the sample absorbs energy and the transition is temporarily effected. Information regarding chemical bonding and crystal structure is gained from the frequency, breadth, and intensity of absorption at various temperatures and pressures.³⁻⁶

NQR is analogous to nuclear magnetic resonance (NMR). The "preferred" nuclear orientation is determined by the interaction of the magnetic dipole of the nucleus with an externally-applied, magnetic field.⁷

This paper is based on NQR studies that covered the range 1 - 300 MHz; very few resonances have been found beyond these limits.^{8, 9} Detection was accomplished by placing the sample in a vacuum-sealed vial inside the coil of an SRO of the type commonly used in "hiss-box" receivers and walkie-talkies.

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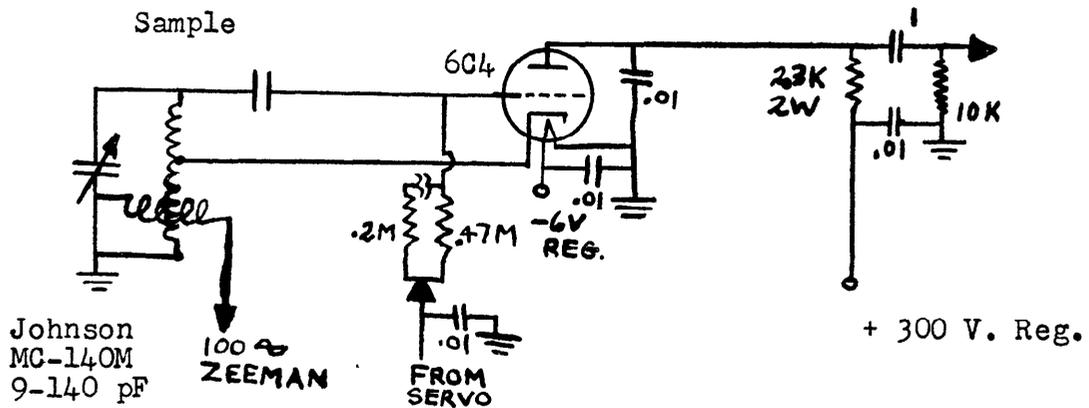
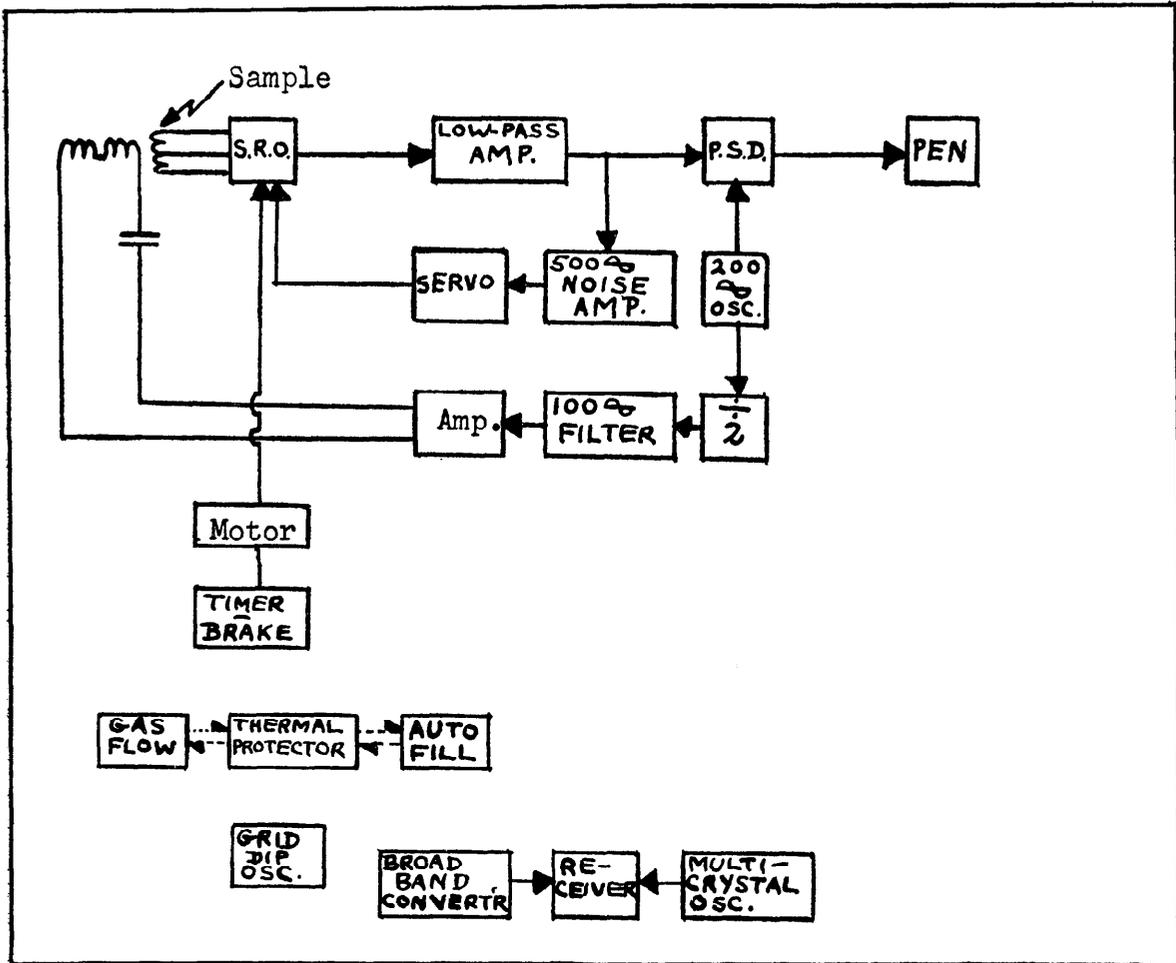


Figure 1. Top: Block Diagram of Detection System; Bottom: Superregenerative Detector Schematic.

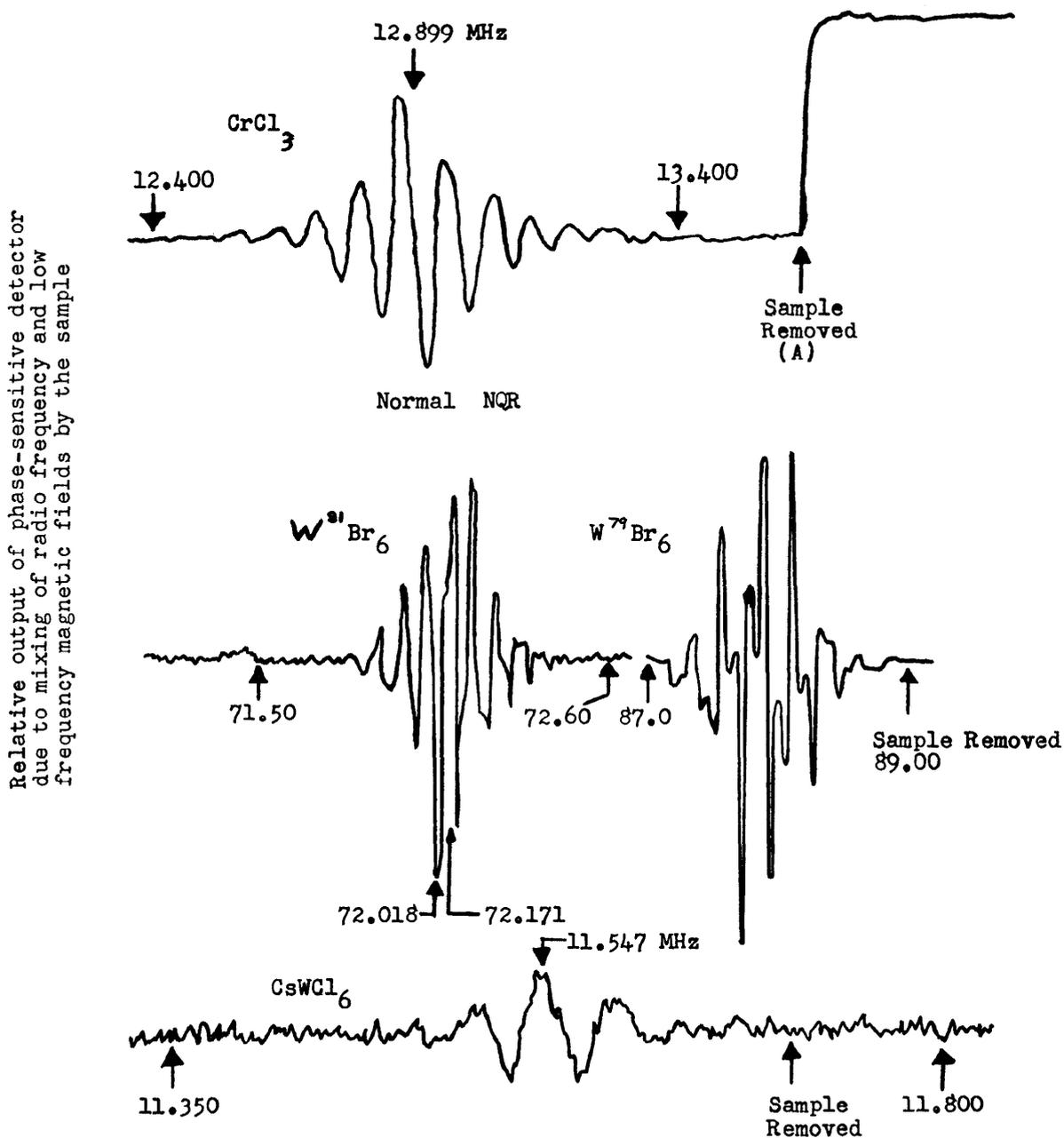


Figure 2. Examples of Recorder Output, including Magnetic Feedthrough Anomaly (CrCl_3).

Tuning was motorized to cover a 2:1 frequency ratio in about 10 hours. Considerable shielding was necessary to avoid reception of radio and TV signals, appearing as sound in the loudspeaker output, and as extraneous ripples in the chart recorder output. To aid in detection, a 100-Hz - 100-gauss magnetic field was placed at a 90° angle to the radio-frequency (RF) field.¹⁰

This "Zeeman" frequency did not appear in the SRO output unless mixed with the RF by

the sample. Mixing occurs only at the critical radio frequency by virtue of the fact that energy levels shift in the low frequency Zeeman field involved in the quadrupolar transition. The Zeeman field is merely used as a "gimmick" to facilitate detection. In the case of extremely strong NQR absorptions the Zeeman frequency (actually, the second harmonic, or 200 Hz) could be heard in the loudspeaker.

Sensitive quantitative results were obtained by passing the SRO output into an extremely

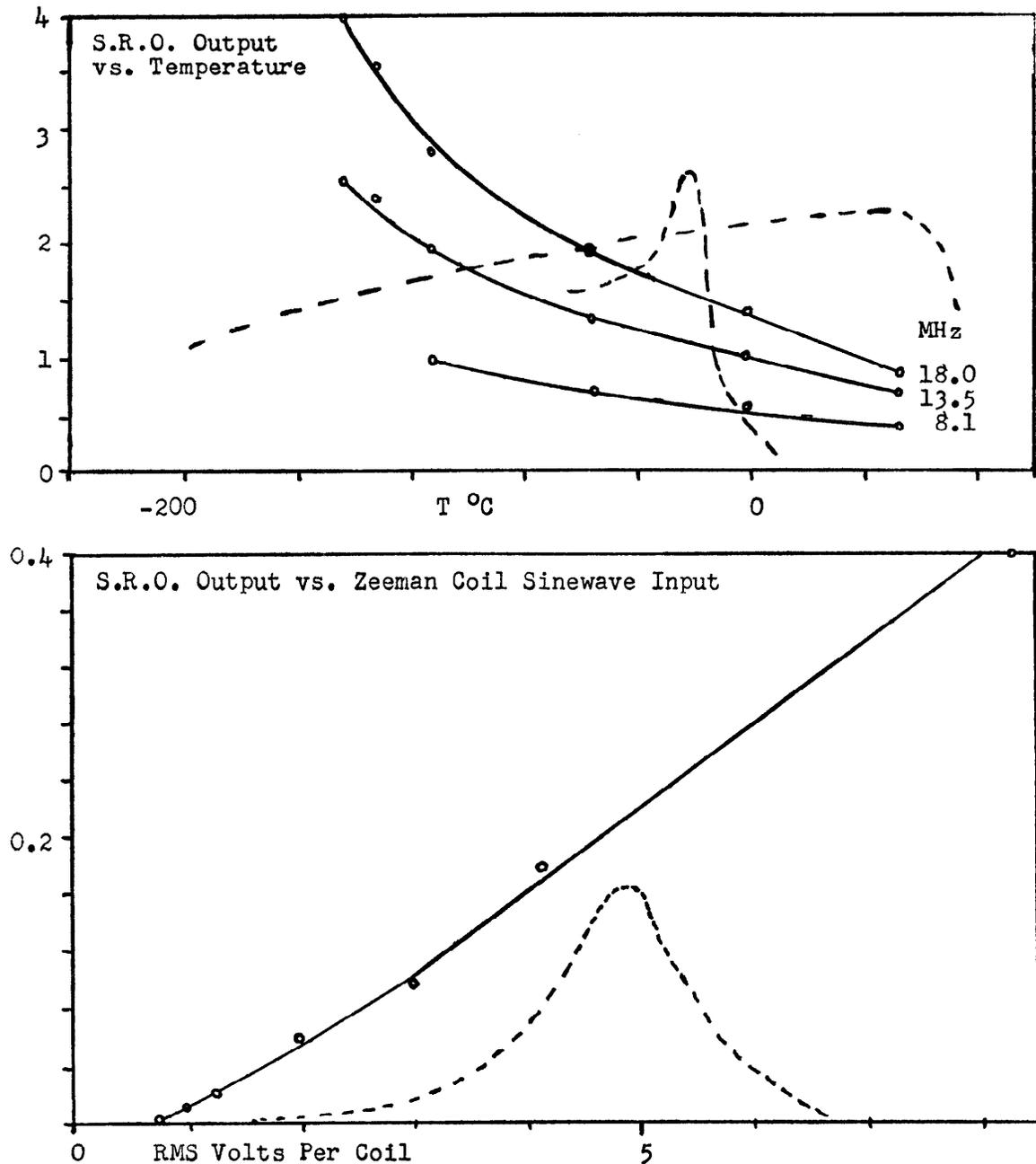


Figure 3. Magnetic Feedthrough in Chromium (III) Chloride.

stable and selective filter (a phase-sensitive detector, PSD) to discriminate against noise, then into a continuous chart recorder, yielding traces typified in Figure 2. A block diagram of the RF, Zeeman, scanning, thermostating, and monitoring systems involved is seen at the top of Figure 1. Each of the two Zeeman coils consisted of one pound of #16 enameled wire on an aluminum spool $\frac{1}{8}$ " thick, 1.3" wide, with minimum and maximum diameters of 1.6" and 4".

Field Mixing in CrCl_3

The anomaly treated in this paper is seen at the top of Figure 2 as a permanent shift in center (base) line, at the arrow (A), upon removal of the sample. The sample was removed shortly after the normal NQR resonance was scanned to underscore the effect. The x-axis position of sample removal is noted for two normal NQR scans; no base line offset is noted.

CrCl_3 is essentially unique in exhibiting this shift, which arises from mixing of the Zeeman and resonant RF fields beyond the normal NQR frequency, shown at the left of the offset. Were there no anomaly, the entire signal to the left of (A) would be shifted upward; no ledge would appear at (A).

The effect is independent of the angle between RF and Zeeman fields. It bears the intensity dependences on ambient temperature and Zeeman magnetic field intensity noted in Figure 3. For NQR, both dependences exhibit maxima; typical curves appear in dashed lines. The effect bears audio output equal in frequency, phase, and approximate amplitude to that seen in normal NQR. It is essentially uniform in intensity over the frequency range 8–100 MHz, and is seen in all samples of CrCl_3 of various sources and ages.

The quench frequency (hiss) in the SRO is essential for sensitivity in detecting NQR signals; it is unnecessary, and even of some hindrance in detecting the anomalous effect. A small sample placed inside the coil of a Millen Grid Dip Oscillator yields almost invariant output from 8–66 MHz, decreasing to 65% at 82 MHz and 5% at 118 MHz, uncorrected for circuit Q.

Over 100 compounds, ranging widely in magnetic characteristics, effective atomic number, oxidation state, coordination, bonding, history, and crystalline form, were investigated for this anomalous mixing of fields: many transition metal complexes, cuprous oxide (noted for an extremely strong NQR absorption), a few organic halides, inorganic chlorates, halides, phosphates, nitrites – to name some of the categories. Of these, only FeCl_3 seems to exhibit a similar effect. That is only 7% as intense as is CrCl_3 's; no NQR for FeCl_3 was obtained. At 80 MHz, feedthrough level for FeCl_3 is below that of ambient noise, or about 1% on the scale discussed.

The interaction is indeed one between the Zeeman magnetic field and the RF magnetic (H) rather than RF electrostatic (E) field. Although in space transmission, several wavelengths from an antenna, the two fields travel together orthogonally, they may be isolated from each other, practically, at the resonant circuit elements involved: CrCl_3 was placed between the plates of a small brass-molded capacitor carrying 15 MHz SRO tank energy; application of a strong Zeeman field failed to show mixing, eliminating E-field as a possible path. To rule out the possibility that supernatant gas might be the non-linear medium necessary and sufficient for the mixing of the two fields, evacuated and room-pressure systems were tried, with spaces above the samples placed in the crossed fields. Later, HCl adsorbed on silica gel also yielded no signal.

The interaction did occur in semiconducting junctions, Iron/Iron-Constantan thermocouples, and some casual electrical contacts, hence they were kept away from the fields during this investigation. Neither magnetic nor non-magnetic steels caused mixing; neither iron nor iron-constantan wires alone gave the effect. CrCl_3 residual feedthrough is, because of its stability and universality (over various heat treatments and origins of sample), used as a standard for our NQR equipment adjustments.

The Nature of the Effect

What is the mechanism operative in this interaction of fields? In NQR, mixing occurs (as in NMR) by virtue of a magnetically-induced shift in quantized energy levels, moving the absorbed RF out of the detector's tuning range. In the studied NQR system, this shift was accomplished in the Zeeman field 200 times per second; in most NMR systems higher frequencies are used. No such resonance is involved in the anomalous (CrCl_3) mixing: it occurs over a wide range of radio frequencies. Also, the Zeeman field acts, through the sample, upon the RF field independently of the polarity of the Zeeman field, i.e., the North and South poles are identical in their effects. The effect is independent of the thermal and preparative history of the sample and thus is different from sporadic crystalline effects, such as F-centers, or semiconducting nonstoichiometries in the CrCl_3 microcrystalline lattices.

To elucidate the mechanism, single crystal studies are needed, noting the plane orientation with respect to the two fields. Shaped pulse work should show whether the Zeeman field acts to degrade absorption of RF energy by the sample or to enhance it (as is suspected from the nearly linear relationship in Figure 3, bottom).

Reflections

At this point, no mechanism for the interaction can be proposed. Notably lacking are similarly behaving substances; hence only the data are presented, and suggestions for further investigation are made. The number and types of compounds studied for this effect serve to impress the author with the unique nature of CrCl_3 .

Because of uniformitarian dogma in the sciences, one's conditioned response would be to expect a series of related compounds to exhibit varying degrees of similar behavior. Paucity of success thus far does not, of course, preclude the existence of such a series.

However, this investigator is reminded of the many other examples where the "grey area" is thin: (a) ferromagnetic materials in nature; (b) facile long-chain formation in nature—practically exclusively the domain of carbon; (c) boron's cages; (d) the unique nature of water in its expansion below 4°C; (e) the bodies of

the universe in their orbits (very non-uniform/non-random; (f) and the most problematic: quantization of energy levels!

Scientists seem to gravitate toward the desire for continua—of fossils, of energy states, of behavior in naturally occurring compounds across the periodic table. Were one, though, without this emotional commitment or desire for a continuum (perhaps born of each man's need for a connection with the whole plan of things—for the time-based security of Linus' blanket) his thinking would be freed of uniformitarian bias.

Men of God in science are not so bound. Were they capable of objectivity in this area they would choose a creationist stand rather than that of the evolutionist, and would do so on scientific evidence alone. The faith required to fill

in vast gaps ("missing links") is staggering, not only in the realm of biological and geological evolution, but, as noted in this article, in the realm of materials behavior, at the microscopic and macroscopic levels.

Such faith is great in mass and fantastic in quality if one considers merely the scarcity of continua. By adding the questions of the origin of the first Energy-Mass and of design probability (even allowing for a generous supply of "natural selection"), the faith required becomes humorous. How much more logical to believe in the all-wise and all-powerful Creator who planned and shall consummate the four dimensions in which we move! But one cannot be logical or objective in this regard without a life regenerated by this Creator—and Savior.

References

- ¹Drago, R. S. 1965. Physical methods in inorganic chemistry. Reinhold Publishing Co.
- ²Lucken, E. A. C. 1969. Nuclear quadrupole coupling constants. Academic Press, N.Y.C.
- ³Kubo, M. and D. Nakamura. 1966. Nuclear quadrupole resonance and its application in inorganic chemistry (*in*) Advances in inorganic and radiochemistry, Vol. 8, Academic Press, N.Y.C.
- ⁴Brown, Theodore L., W. Gordon McDugle, Jr., and L. Gregory Kent. 1969. Vibrational and pure nuclear quadrupole resonance spectra of hexahalometallates, *Journal of the American Chemical Society*, 92:3645.
- ⁵Brown, Theodore L. and L. G. Kent. 1970. Temperature dependences of chlorine and bromine nuclear quadrupole resonances in hexahalometallates, *Journal of Physical Chemistry*, 74:3572.
- ⁶Kent, L. G. 1969. Halogen nuclear quadrupole resonance studies of metal halides systems. Ph.D. Thesis, University of Illinois.
- ⁷Pople, J. A., W. G. Schneider, and A. J. Bernstein. 1959. High resolution nuclear magnetic resonance. McGraw-Hill, N.Y.C.
- ⁸Lucken, *Op. cit.*
- ⁹Kubo and Nakamura, *Op. cit.*
- ¹⁰Pople, *Op. cit.*

HOW MANY ANIMALS IN THE ARK?*

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Biological arguments against a universal flood are answered through a comprehensive study of the relevant Biblical and scientific evidence. Biblical evidence bearing on the following points is studied: animal groups represented on the Ark, animals classed as clean, number of animals taken from each clean kind, and the gathering of the animals to the Ark. This is supplemented by a biological study of the number of kinds, the relative diversity of clean and unclean animals, and the problem of hibernation. It is concluded that biological arguments against a universal flood are invalid, and that the number of animals under Noah's care probably did not exceed 2,000.

I. Introduction

In the continuing debate over *The Genesis Flood*,¹ one particular group of criticisms has not been answered adequately. These criticisms are usually presented as a series of questions centering around the number of animals in the Ark:

(1) How was it possible to gather representatives of every type of animal?

(2) How could room for so many animals be found on the Ark?

(3) How could eight people feed and care for all these animals?

(4) If only a smaller number of creatures was involved—representatives of the main "kinds" or "orders" of animal life—then we have the evolution of thousands of new species in a far shorter time than the most ardent evolutionists have ever believed possible. Does belief in a universal Noachian Flood entail belief in extremely rapid evolution?

This article is an attempt to provide a comprehensive reply to these criticisms. The first

*This article is the third in a series dedicated to the memory of Dr. Jacobus Johannes Duyvené, de Wit (1909-1965), late Professor of Zoology, University of the Orange Free State, Bloemfontein, South Africa. The other two articles in this series are found in the *Creation Research Society Quarterly*, 9(1):53-57, June 1972; and 9(2):114-123, September, 1972.

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