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I. OBJECTIVE (U)

(U) The objective of this effort is to continue the work being conducted under contract MDA908-91-C-0037 by extending the analysis of the data and adopting approaches that were developed to conduct specific experiments.

II. APPROACH (U)

(U) For convenience, the section numbering matches that of the Statement of Work (SOW) from request for quote RSQ−4.

6. Specific Tasks (U)

(U) The specific tasks are modest extension of those that are currently being investigated. In most cases, they involve analysis of existing data or involve the implementation of experiments that were designed under the current effort.

6.1 Basic Research (U)

(U) Basic research of anomalous mental phenomena (AMP) is defined as that activity that is primarily designed to understand the parameters of and theoretical basis for AMP.

6.1.1 Biophysical Measurements (Follow-on to SOW 6.3.1*) (U)

6.1.1.1 Magnetoencephalograph / Electroencephalograph Correlation (U)

(U) The trend in some magnetoencephalograph (MEG) laboratories has been to collect magnetic and electrical data simultaneously. Thus, for some measurements, it may be possible to correlate the results from the two techniques. We propose to conduct a literature search for such studies and conduct a meta-analysis on the pertinent papers to determine the degree to which EEG may be substituted for MEG. In particular, we will examine experiments that do not involve precise source localizations within the brain.

6.1.1.2 Magnetoencephalograph Data Analysis (U)

(U) The magnetoencephalograph database consists of 11 blocks of data obtained from an earlier program and an additional 80 blocks obtained in the current program. Altogether there are brain-wave data for over 9,000 remote stimuli (i.e., stimuli that are sensorially and physically isolated from a receiver†), a similar amount for pseudo stimuli (i.e., randomly placed time markers generated during the experiment), and additional 9,000 stimuli of each type that were collected as a control (i.e., identical circumstances as in the experiment, but without a receiver being present). We propose to apply the following analysis techniques to this substantial database.

a. Efficient Phase-Shift Calculations (U)

(U) The primary purpose for the collection of magnetoencephalograph data is to determine the degree to which remote stimuli affects the phase of the primary alpha rhythm. There is a vast literature dating back to the 1930s suggesting that a relaxed brain, which is producing sustained alpha bursts, reacts to weak external stimuli with a phase shift of that alpha activity.

* All follow-on SOWs refer to the current contract PR330/012Z/91.

† Please refer to the Glossary (Section III) for a definitions of terms.

(U) To study alpha-phase shifts in an efficient way, it is important to present stimuli only when the subject is producing alpha; however, the effort under SOW 6.3.1 in PR 330/012Z/91 was an attempt to replicate a similar experiment conducted in 1988. The protocol for data collection was constrained to match that study, and therefore presented stimuli randomly.[1*]

(U) We propose to reevaluate the alpha-phase shifts for all the data collected under PR 330/012Z/91. In this new analysis we will compute the phase shifts for only those stimuli that happen to occur within an appropriate alpha burst. We will use pseudo stimuli that meet this constraint as within-run controls and generate Monte-Carlo stimuli only within alpha bursts during which no other stimuli occurred. Standard statistical methods will be used to compute effect sizes and evaluate the observed phase shifts.

b. Higher Order Spectral Processing (U)

(U) Fourier-based spectrum estimation techniques have proven valuable for the analysis of signals in the frequency domain. These techniques use only second-order statistical information; thus, they assume that the signals are Gaussian. In fact, most real-world signals are not Gaussian; hence, there is usually much more information in a stochastic non-Gaussian or deterministic signal than is conveyed by its autocorrelation or spectrum. Higher-order spectra are defined in terms of the higher order statistics of the signal; therefore they can proved non-linear information.[2,3] An additional benefit is realized because all Gaussian noise vanishes, and thus any non-linear signals are more easily detected.

(U) One such higher-order technique is the bi-spectrum. Preliminary application of the bi-spectrum of the MEG data has produced promising results. It appears that remote stimuli produce significantly different bi-spectra than those observed in non-stimulus intervals.

c. Wavelet Analysis (U)

(U) Recent work has produced techniques for representing signals in terms of a set of orthogonal basis functions with local support. While such a method was thought impossible for many years, recent research has shown that an infinite number of such basis function sets exist.[4,5] These basis functions consist of dilations and translations of a "mother wavelet" function which is zero outside of some range. Since they are an orthogonal and complete set, the wavelet transform is information preserving, that is, the original signal can be reconstructed from the wavelet coefficients without error.

(U) The wavelet coefficients are generated by correlating these functions with the signal at every position, with wavelets on every scale. In this way, features in the signal can be located in time with great precision; hence, these methods could prove highly effective in clearly indicating the discontinuity which is thought to occur at the time of the remote stimulus.

d. Time-Frequency Distributions (U)

(U) Time-frequency distributions describe how the spectral content of a signal changes over time. They consist of a set of methods which represent the energy or intensity of a signal simultaneously in time and frequency. The spectrogram, which used windowed short-term Fourier transforms to produce a local estimate of the spectrum, was an early method of this sort. It had a severe disadvantage: small windows provided good time localization put poor frequency resolution; large windows produced the opposite problem. The Wigner distribution was developed to alleviate this problem, but was found to introduce serious artifacts with certain signals.

* References may be found in Section IV.

(U) More recent methods showing better performance include the Wigner-Ville distribution[6] and the Choi-Williams distribution.[7] Both of these improve time and frequency resolution while suppressing unwanted artifacts. Since these distributions are complex, their transfer functions provide both gain and phase information.

e. Cyclostationarity (U)

(U) Most conventional signal processing methods treat random signals as if they were statistically stationary. If the parameters of the underlying signal-generating mechanisms are time varying, as they are in brain-wave data, then this assumption is invalid and other techniques must be used to extract important properties of the signal. For example, a signal whose autocorrelation function fluctuates periodically with time is said to exhibit second-order cyclostationarity. A number of signal processing methods can extract information from such signals.[8]

(U) By constructing time intervals that are symmetric around the remote or pseudo stimulus, we can produce pseudo periodic signals that are likely to exhibit properties that can be extracted by cyclostationary processing methods.

f. Conclusion (U)

(U) Since the underlying physical process which produces signals is poorly understood, it is impossible to predict which of these signal analysis techniques will yield the best results. However, a systematic program of applying these methods to the MEG data will greatly increase the probability that a genuine physiological response can be detected and measured with much higher confidence levels.

6.2 Data Patterns/Correlations (Follow-on to SOW 6.3.2) (U)

(U) The search for patterns or correlations within anomalous cognition (AC) is part of basic research.

6.2.1 Sender/No-Sender Analysis (U)

a. Sender/No-Sender in the Ganzfeld (U)

(U) Under the current contract, we initiated two investigations of whether the quality of AC depends upon a sender. We let a subcontract to Psychophysical Research Laboratories (PRL) to perform a meta-analysis of the pertinent literature to determine the appropriate parameters for a Ganzfeld study of the sender condition. The Ganzfeld is a protocol for conducting a type of AC experiment. PRL was also tasked to design an appropriate experiment using the results from the meta-analysis. Unfortunately, the number of previous Ganzfeld experiments was insufficient to determine heuristic parameters. Instead, PRL drew from its 20 years of Ganzfeld experience and designed an appropriate experiment.

(U) We propose to continue this effort by tasking PRL to conduct approximately 70 Ganzfeld trials with novice receivers (i.e., first-timers) as screening/selection for the multi-condition sender-environment experiment. One of the most important elements in any AC experiment is to identify individuals who can demonstrate high quality results. This is particularly important if, as in this case, the primary experiment is designed to examine the effect of an independent variable. Thus, this preliminary screening effort is critical to understanding the role of the sender in AC experiments.

(U) Besides the usual judging and analysis implied by the Ganzfeld protocol, the data from the screening/selection experiment will also be examined with regard to six facets of extroversion. Honorton et al. have shown that the degree of extroversion is important in quality AC, and, thus, this variable is important to the success of the main experiment.[9]

a. Sender/No-Sender with Static and Dynamic Targets (U)

(U) Using the AC database that was obtained under the existing contract, we will apply fuzzy set theory to search for target/receiver properties that yield higher quality AC. Under an earlier program, we applied fuzzy set theory to the analysis of AC. In particular, we developed fuzzy set representations of all the static targets used in the current study. They were encoded with 131 separate visual target elements; therefore, to capitalize on this earlier work, we will examine our AC result from this particular viewpoint.[10]

(U) Under the current program we have developed an "adaptive" fuzzy set algorithm that will be able to determine which, if any, of these 131 target elements were responsible for receivers' improved AC quality. In the adaptive method, fuzzy sets are modified in accedence with a receiver's historical performance, and the modified version is applied to new data. The historical record is then updated to account for the results of that additional analysis.

(U) We propose to apply these techniques to approximately 250 AC trials. This analysis will cover the four combinations of sender/no-sender and static/dynamic targets that were used in the current study.

6.2.2 MEG/EEG Parameter Search (U)

(U) During a previous program, we tasked Psi Sources of Information Center to place the literature of all English language parapsychological technical journals into a computerized database. From that time, Ms. Rhea White has maintained that database, which now includes abstracts of all technical articles dating back to the early 1900s. We propose to use this database to examine all relevant MEG/EEG data and worldwide AC research to identify key performance and target pattern parameters (e.g., physical, psychological, biophysical). If enough studies identify a specific parameter, we propose to conduct a formal meta-analysis of that parameter to determine its effect upon performance quantitatively.

6.3 Applied Research (Follow-on to SOW 6.2.3.3) (U)

(U) Applied research of AMP is defined as that activity that is primarily designed to improve the quality of experimental results.

6.3.1 Long Distance AC Experiment (U)

(U) Under the current contract, we developed a two-by-five error-correcting block code, which we applied to an AC experiment. The objective was to increase the reliability of detecting AC and to explore its potential for communications. In that effort, receivers were not monitored and target feedback was sometimes significantly delayed. In addition, the receivers were allowed to respond to an intended target at any time during a one-week interval.

(U) We propose to improve upon this protocol and apply the techniques to testbeds that are similar to potential applications. Specifically, each AC trial will be monitored at a site designated by the contracting office's technical representative, and each AC trial will be conducted in real time. Feedback and a portion of the analysis will be provided immediately.

(U) We plan to explore a number of analytical techniques to determine the optimal technique for potential applications. They will include "crisp" answers (i.e., either "yes" or "no" to a predefined set of questions) for the input to the two-by-five block code and "fuzzy" answers (i.e., receivers express the degree of confidence in their answers to each question) to the same questionnaire. In the latter case, we will use a rich set of standard fuzzy set mathematical techniques in the analysis.

6.4 Theoretical Issues (Follow-on to SOW 6.2.5) (U)

(U) As part of basic research, theoretical issues address potential underlying mechanisms for AMP.

6.4.1 Nuclear Mossbauer Effect (U)

(U) We propose to construct an anomalous perturbation (AP) experiment using the nuclear Mossbauer effect. Sometimes referred to as gamma raw resonance spectroscopy, using the Mossbauer effect is an extremely precise way of measuring the electromagnetic environment at the nuclear site within an atomic lattice and measuring the structure of the nucleus, itself. The nuclear environment is impervious to external factors. Experiments that use the Mossbauer effect are also exquisitely sensitive. Because it is inherently controlled, a Mossbauer set-up is ideal for the study of AP. An overview of the Mossbauer effect can be found in Section V, Mossbauer Background.

(U) In a Mossbauer AP experiment, an individual watches a dynamic display of gamma ray absorption as feedback. He or she is instructed to use mental strategies to affect the absorption, and thus the nuclear properties, in predetermined ways. For example, the instructions might suggest to increase or decrease or shift the location of the maximum absorption. Random control periods (i.e., no human effort to modify the absorption) are intermixed with effort periods. Statistical comparison is made between these periods and both are compared to long-term, stable measurements of the unattended apparatus.

(U) To our knowledge, no other AP experiment has exclusively attempted to modify nuclear properties; therefore, this exploratory experiment must be considered a pilot effort. Should we observe potential AP effects, we will recommend an extension to verify that the effects cannot be accounted for by known interactions.

6.4.2 Theoretical Models (U)

(U) We propose to explore at least two theoretical approaches toward understanding the physics of AC. The heuristic observables are the following:

(1) Information, albeit noisy, "propagates" from point A to point B regardless of the spatial or temporal separation.

(2) The quality of the reception appears to be proportional to target complexity.

(U) The first of these suggests that a four-dimensional, non-electromagnetic model is appropriate. The second implies a relationship to thermodynamic entropy, but at the present, there is no known propagation mechanism for "pure" information.

(U) All theoretical approaches to these two questions will be constrained toward testable hypotheses. We suspect that if a reasonable theoretical model can be developed, that it will entail physics implications that can be tested by traditional experimentation.

6.5 Research Methodology (Follow-on to SOW 6.4) (U)

6.5.1 Committees (U)

(U) As a continuation of the current program, we propose to the use the three existing committees, which are in place, as support and quality control for methodological and policy issues. These committees are:

(U) **The Scientific Oversight Committee (SOC).** The five voting members of the SOC are respected scientists from the following disciplines: physics, astronomy, statistics, neuroscience, and psychology. Since the time of the original proposal, we have added Professor of Neuroscience Steven A. Hillyard of the University of California at San Diego. His resume is include in Section IV.

(U) The SOC is tasked with three major responsibilities:

- Review and approve all experimental protocols prior the collection of data.
- Critically review all experimental final reports as if they were submissions to technical scientific journals. All remarks are in writing and are included in the technical final report to the sponsor.
- Suggest directions for further research.

(U) In addition to these three responsibilities, the SOC members are encouraged to exercise un-announced drop-in privileges to view experiments in progress.

(U) **Institutional Review Board (IRB).** The IRB's responsibility is to assure the safety of human subjects in experiments and to assure the sponsor that all research involving the use of human subjects is in compliance with all appropriate federal regulations. The IRB members represent the health, legal, and spiritual professions in accordance with government guidelines. The membership is as follows:

• Gary R. Fujimoto, M.D.	Occupational Medicine, Palo Alto Medical Foundation
• Byron Wm. Brown, Jr., Ph.D.	Biostatistics, Stanford University
• John Hanley, M.D.	Neuropsychiatry, University of California, Los Angeles
• Robert B. Livingston, M.D.	Neuroscience, University of California, San Diego
• Robin P. Michelson, M.D.	Otolaryngology, University of California, San Francisco
• Ronald Y. Nakasone, Ph.D.	Buddhist Studies, Institute of Buddhist Studies, Berkeley, CA
• Louis J. West, M.D.	Neuropsychiatry, University of California, Los Angeles
• Garrison Rapmund, M.D.	Air Force Science Advisory Board

(S/NF) **Policy Oversight Committee (POC).** The POC's responsibility is to advise SAIC and assure the Defence Intelligence Agency that the activity under this contract fulfills the requirements of the Intelligence Community (IC) and the Department of Defence (DOD). In addition, the POC recommends policy for the establishment of a long-term program for the application of anomalous mental phenomena to problems of interest to the DOD and the IC.

6.5.2 Management and Research Support (U)

(U) We will provide technical, management, and administrative support for all research activity.

SG1B

7. Quick Reaction Capability (QRC) (U)

(S/NF) We propose to reserve approximately five percent of the program effort in order to respond rapidly to the sponsor's request for briefings, conference attendence, or unanticipated experiment or application requirements.

III. GLOSSARY (U)

(U) Not all the terms defined below are germane to this report, but they are included here for completeness. In a typical anomalous mental phenomena (AMP) task, we define:

- AC—A form of information transfer in which all known sensorial stimuli are absent. That is, some individuals are able to gain access, by as yet an unknown process, to information that is not available to the known sensorial channels.
- Receiver—An individual who attempts to perceive and report information about a target.
- Agent—An individual who attempts to influence a target system.
- Target—An item that is the focus of an AMP task (e.g., person, place, thing, event).
- Target Designation—A method by which a specific target, against the backdrop of all other possible targets, is identified to the receiver (e.g., geographical coordinates).
- Sender/Beacon—An individual who, while receiving direct sensorial stimuli from an intended target, acts as a putative transmitter to the receiver.
- Monitor—An individual who monitors an AC session to facilitate data collection.
- Session—A time period during which AC data are collected.
- Protocol—A template for conducting a structured data collection session.
- Response—Material that is produced during an AC session in response to the intended target.
- Feedback—After a response has been secured, information about the intended target is displayed to the receiver.
- Analyst—An individual who provides a quantitative measure of AC.
- Speciality—A given receiver's ability to be particularly successful with a given class of targets (e.g., people as opposed to buildings).

IV. REFERENCES (U)

(U) All the following references are unclassified.

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V. MOSSBAUER BACKGROUND (U)

(U) This Section is entirely unclassified.

Gamma Ray and Gamma Ray Resonance Spectroscopy

by

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INTRODUCTION

Resonance phenomena are today a very direct part of our lives. They are used in radio, tuning in a station or selecting a TV channel, in microwave cooking and heating, store security and many other daily uses. It was Lord Rayleigh who, a century ago, first suggested that resonance scattering should occur in atomic systems.

Gamma ray Resonance Spectroscopy (GRS), also known as The Mossbauer Effect, was discovered by Rudolf L. Mossbauer in 1957, at the time a graduate student at the University of Heidelberg in Germany. Mossbauer was interested in the line shape (profile) of gamma radiation. It was a known fact that gamma rays, photon "particles", would give a recoil to the nucleus which emitted the gamma ray. The gamma ray would therefore have a lower energy. Similarly, if the gamma ray were to strike another nucleus its energy must be higher, in order to be absorbed and also to provide the absorber recoil energy. This energy can be provided by heating the gamma ray source, since this raises the average velocity of the atoms in the source and therefore the energy. Both positive and negative velocities will be present and thus the line shape of the gamma ray will be broadened. This line broadening is known as a Doppler broadening. The energy lost to recoil could now be compensated for by raising the temperature. Mossbauer's initial experiment was very straightforward, consisting of a gamma ray source, an absorber, and a counter to detect the gamma radiation. As the temperature of the source and absorber was raised, the count rate of unabsorbed gamma rays went down since the increase in thermal energy compensated for the energy lost in recoil. This is shown in figure 1. To obtain a reference count rate, Mossbauer cooled the source and absorber to liquid nitrogen temperature. There the count rate should have been the highest, but to his amazement, it was not. Mossbauer interpreted this effect as a recoil-free emission and absorption at lower temperatures. This obviously violates the principles of conservation of energy and momentum and was, at first, not well accepted. Mossbauer continued his work at the University of Munich, Germany, and his experiments were soon confirmed at other laboratories. R. L. Mossbauer was awarded the Nobel Prize in Physics in 1961. Within a decade (GRS) became a standard tool, with applications in Physics, Chemistry, Metallurgy, Mineralogy, Geology, and Biology.

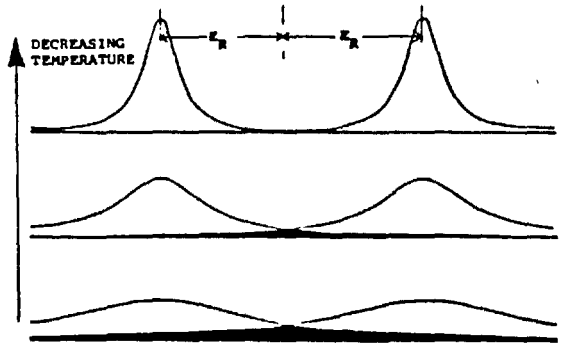


Figure 1. Increased overlap of source and absorber line profiles, moved apart as a result of recoil, due to Doppler broadening with temperature.

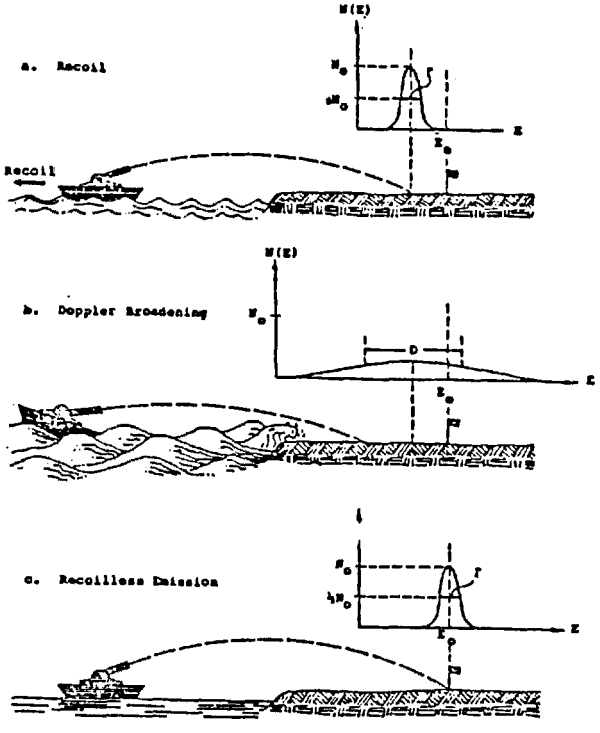


Figure 2. Classical analogy of a boat firing a cannon in a choppy lake, then "freezing the lake."

The Mossbauer Effect is a quantum phenomenon. However, some of its basic characteristics may be easily understood through a classical analogy. The analogy developed by Frauenfelder in Ref. 1 is particularly apt. He likens the gamma ray source to a cannon firing at a target. The statistical spread of the impacts is the natural line width. If the cannon is firing from a boat, it will recoil so that the center of the impact distribution is shifted to a shorter range (lower value of energy for the gamma ray), as in Fig. 2a.

Doppler broadening can be represented by placing the boat in a choppy sea. Since the aim is much less accurate, the distribution of impacts is broadened (Fig. 2b.). The Mossbauer Effect is made possible by "freezing the lake," so that recoil and Doppler broadening are eliminated (Fig. 2c). In the actual source and absorber, this is done by locking the atoms in a crystal lattice.

To observe the Resonance Effect, we must change the energy of the gamma ray by a small amount. We can use the Doppler shift to our advantage. Instead of Doppler broadening, we can use a coherent Doppler shift, or Doppler modulation, by giving the entire source a known velocity. The line width of the source and the line width of the absorber overlap by a differenct amount for each velocity.

If total transmission is plotted against velocity, the absorption curve will be observed to have a line width twice that of either source or absorber. (See Fig. 3).

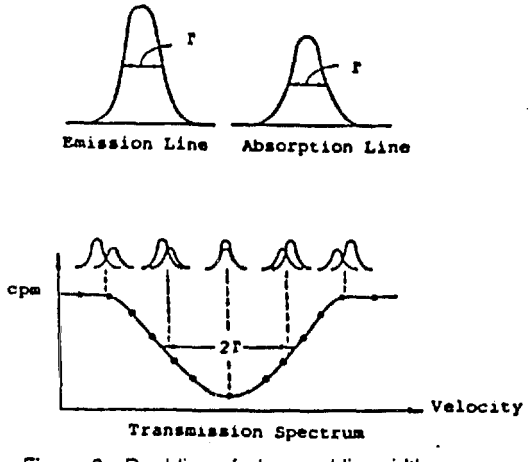


Figure 3. Doubling of observed linewidth

THEORY

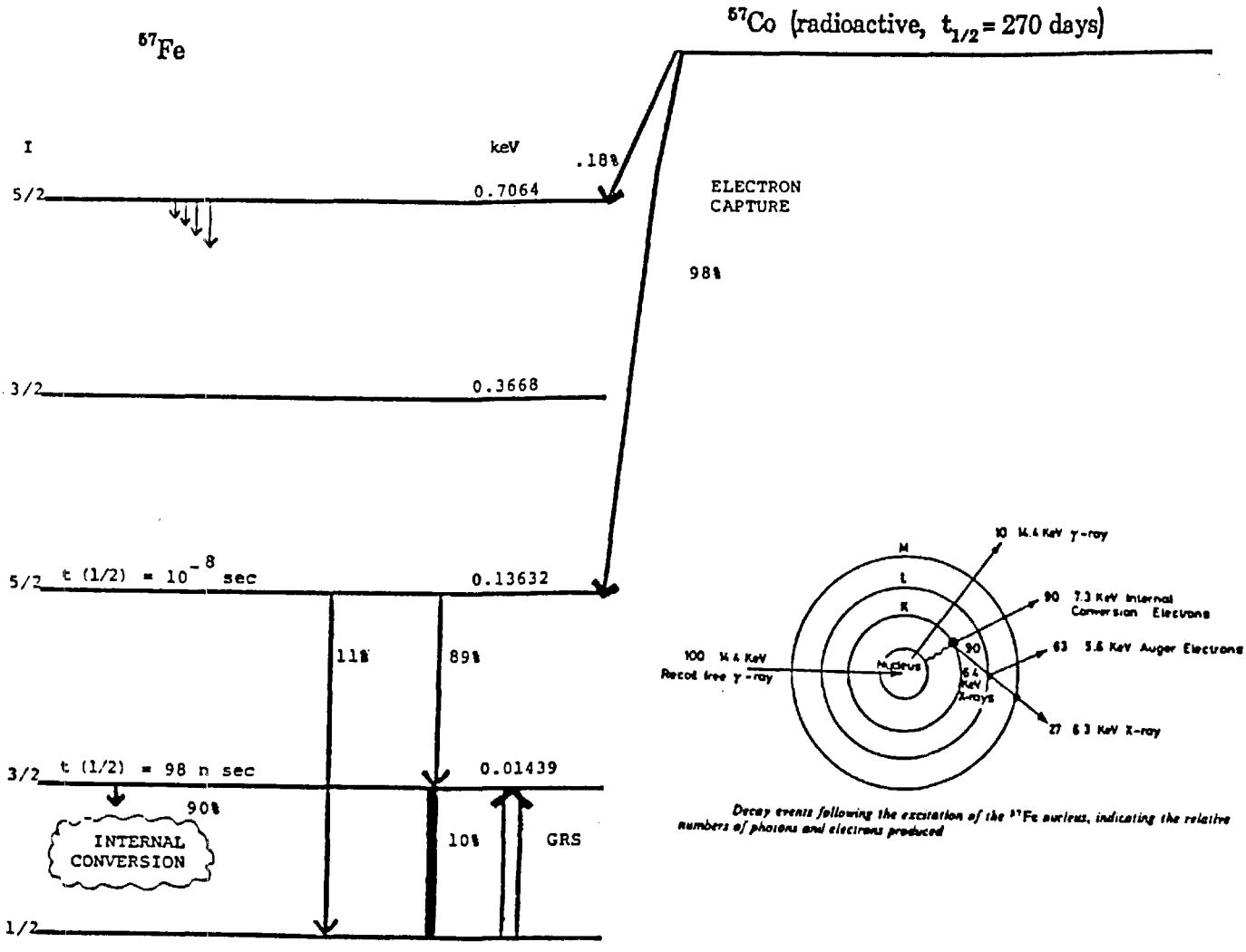
As was pointed out in the introduction, eliminating the recoil given to the nucleus by the emitted gamma ray is the first prerequisite for the Mossbauer Effect. If the nucleus is initially at rest, its momentum after emission is

$$p_n = -p_\gamma = E_\gamma / c.$$

The recoil energy imparted to the nucleus by the leaving gamma ray is then

$$E_R = p_n^2 / 2M = \frac{E_\gamma^2}{2Mc^2} \qquad [1]$$

Here M is the mass of the nucleus. For a gamma ray of 14.4 keV, this recoil energy is 2 X 10^{-3} eV. To explain the Resonance Effect, we must not use the mass of the nucleus in equation 1, but the mass of the crystal to which the nucleus is bound. This recoil free process is also demonstrated in X-rays by the Bragg reflection from a crystal. The recoil energy then becomes vanishingly small. The binding energy plays a very important role in the Mossbauer Effect. If the recoil energy E_R is larger than the binding energy, the recoil-free process will not take place. Thermal vibrations due to higher temperature can also destroy the recoil-free emission and absorption. Equation (1) therefore places limits on when the Mossbauer effect will take place. We must have a solid or very large molecule so that E_R becomes vanishingly small, and the gamma ray energy must be low so that E_R is LESS THAN THE BINDING ENERGY OF THE NUCLEUS. Many isotopes have shown the Mossbauer Effect, but Fe^{57} has the best properties for our purpose. The source used for Fe^{57} Resonance spectroscopy is Co^{57}, with the radio-active decay scheme and the corresponding radiation emitted by this source is shown in figure 3. Cobalt has a positive nuclear charge of 27. The nucleus captures an electron, to reduce the charge to 26, and balances the energy by emitting three gamma rays, 14.4 keV, 122 keV, and 136 keV. The electron capture leaves a hole in the elctron shell, which is promptly filled producing 6.3 keV and lower energy X-rays. The 14.4 keV gamma ray shown in the energy level diagram of figure 4 is used in



Decay events following the excitation of the ^{57}Fe nucleus, indicating the relative numbers of photons and electrons produced

Cobalt-57 Decay Scheme

the Mossbauer Effect. The 122 keV transition does not go to the ground state, and the 136 keV gamma ray is too energetic for a usable effect.

The line shape of the recoil free 14.4 keV radiation is a Lorentzian profile, or

$$L(x) = \frac{A}{1+x^2}; \quad x = \frac{E-E_o}{\Gamma} \qquad [2]$$

Where Eo is the gamma ray energy and Γ is the halfwidth. The halfwidth or line width can be calculated from the uncertainty principle, and the lifetime of the excited state. The uncertainty principle states that

$$\Delta E \cdot \Delta \tau = \hbar \qquad [3]$$

Where $\hbar$ is Planck's constant divided by 2 π. The lifetime of the 14.4 keV level can be determined by measuring the 1.4 X 10^{-7} second delay between the 122 keV and 14.4 keV radiation, because the lifetime of the 122 keV level is 50 times shorter than that of the 14.4 keV level. This corresponds to a line width of 4.670 X 10^{-9} eV. The resolution required to observe this line is E_o/Γ or about 10^{12}.

To distinguish this narrow band of recoil free radiation from non-recoil free radiation using a gamma detector is hopeless, since the detectors have at the best a 10% resolution. Gamma ray

spectrometers using a diffracting crystal can do a thousand times better, but this still leaves a factor of 10^8. However, we can use the source and absorber technique with the Doppler effect. This time we do not raise the temperature, but move either the source or the absorber at various velocities. The Doppler effect is given by

$$\nu = \nu_o\left(1+\frac{V}{C}\right) \qquad [4]$$

Where ν_o is the transition frequency of the stationary absorber and ν the frequency of the source moving at a velocity v.

Re-writing equation 4,

$$\nu = \nu_o + \nu_o\frac{V}{C} \quad \text{and} \quad \Delta\nu = \nu - \nu_o = \nu_o\frac{V}{C}$$

or

$$\frac{\Delta\nu}{\nu_o} \propto \frac{\Delta E}{E_o} = \frac{V}{C} \qquad [5]$$

Since $E = h\nu$. E_o is the basic transition energy, 14.4 keV. If we use the values for ^{57}Fe, the velocity required to shift the line by one line width is 0.19 mm/sec. Plotting the count rate as a function of velocity gives the familiar absorption pattern, as shown in figure 5.

The recoil-free emission and absorption was not the only surprise of this new effect. When an iron foil was used for an absorber, a six line absorption pattern as in figure 6 was observed and identified as a nuclear Zeeman effect brought about by the iron's internal magnetic field.

Iron compounds used for absorbers gave a variety of spectra, and the simple energy level diagram of figure 4 could no longer explain the observed results. There were other interactions (forces) present, previously completely obscured. With the ultra precise energy measuring capability of the Mossbauer Effect it was possible to determine the energy and derive the nature of these interactions. For this analysis we must first look at the nucleus and its electron cloud. There are three electron-nuclear (hyperfine) interactions:

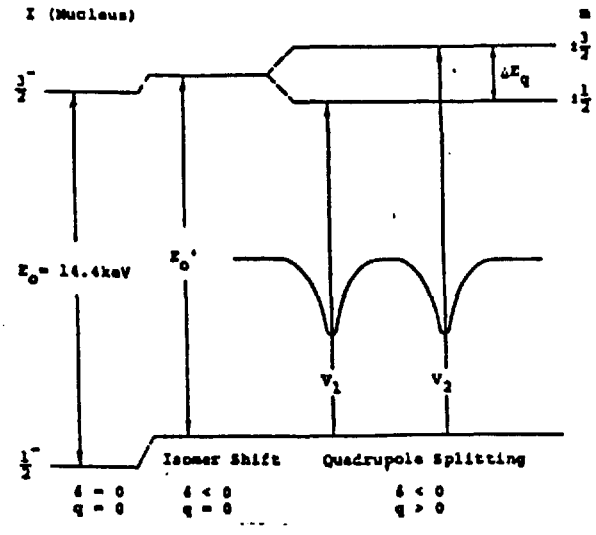


Figure 5. Electric Quadrupole Splitting

(a) Electric Monopole (EO) which results in the isomer shift (Fig. 5) and originates in the Coulomb potential between the nucleus and the surrounding electron cloud. Since the chemical valence is determined partially by the number of electrons associated with the iron, there is a strong relation between the isomer shift and valence state. See Experiment 1.

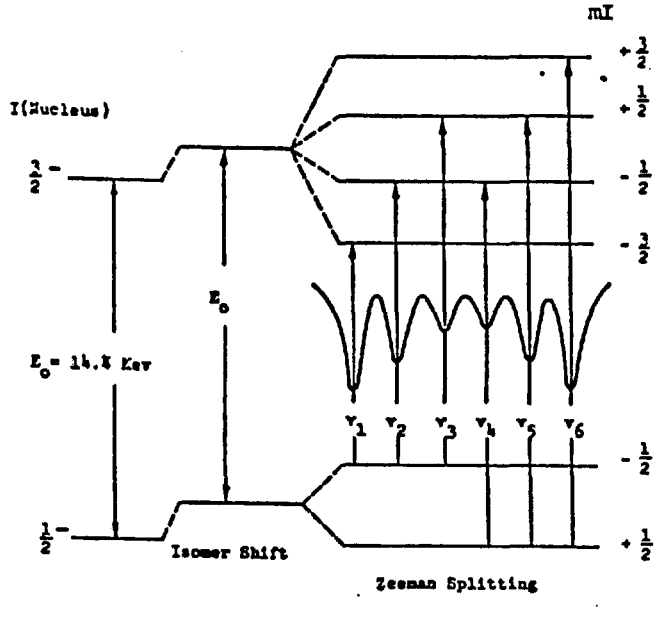


Figure 6. Magnetic splitting of nuclear levels. (Nuclear Zeeman Effect).

(b) Electric Quadrupole (E2) which generates the quadrupole splitting observed in iron spectra as a typical doublet line-pattern (Fig. 5). The asymmetry in the electron cloud forces the nucleus to align itself either with or across the electric field gradient, allowing two possible energy states. See Experiment 3.

(c) Magnetic dipole (M1) with the typical six line pattern of the nuclear Zeeman effect. For Fe^{57} the nuclear spin is 3/2 with the four possible energy states of ↑↑↑, ↑↑↓, ↑↓↓ and ↓↓↓ spin states of the excited state and ↑ or ↓ for the ground state, resulting in a possible six transitions. (Fig. 6) The magnitude of the magnetic field at the nucleus determines the separation of the six line pattern. For iron metal this corresponds to a magnetic field at the nucleus of 331.5 kGauss. See Experiment 4.

INSTRUMENTATION

The GR spectrometer is a computer based instrument. The computer collects the data, processes the data for storage on a diskette and display on the video screen. The data is analyzed by the computer using a least square fitting routine.

To understand the operation of the spectrometer, we will follow the gamma ray from its detection to the display of its presence on the monitor. When the γ ray enters the detector, the Krypton gas is ionized into electrons and positive ions, the number of ion pairs depends on the gamma ray. energy. The electrons move toward the positively charged wire in the center of the detector, and after gaining energy they ionize more atoms, and the cascade process produces a pulse of electrical charge at the wire, which is converted to a voltage pulse by a charge sensitive amplifier.

In this way electronic pulses whose voltages are proportional to gamma ray energy are produced. Gamma rays of a certain energy are detected, and those of higher and lower energy ignored, by comparing the voltage pulses to an upper voltage level and lower voltage level in a circuit known as a discriminator. Those pulses that cross the lower level (LLD) but not the upper level (ULD) are registered.

In order to measure the gama ray energy spectrum, the discriminator window defined by LLD and ULD is swept over a range, in a process known as pulse height analysis (PHA). In practice, the window is repetitively incremented through 1024 positions. Each of these 1024 positions has a counter, known as a channel, which counts the gamma rays that pass the discriminator while the window is in that position. Thus, as the discriminator window is swept over a range of energies, an energy spectrum is accumulated. It is transferred to the computer, where it is stored and displayed graphically. The energy calibration of the spectrometer is then achieved from the channel peak positions of known energies.

To measure the gamma ray resonance spectrum, we need to obtain count rate as a function of doppler velocity. In order to improve signal to noise ratio in the spectrum, the discriminator is no longer swept, but set to recognize only the 14.4 KeV gamma rays. The velocity is cyclically swept, and each of the 1024 channels counts those gamma rays emitted at a certain velocity. Over time a spectrum is accumulated, as the statistical fluctuations due to the random nature of radioactive decay average out, and the count rates corresponding to different velocities become more accurate.

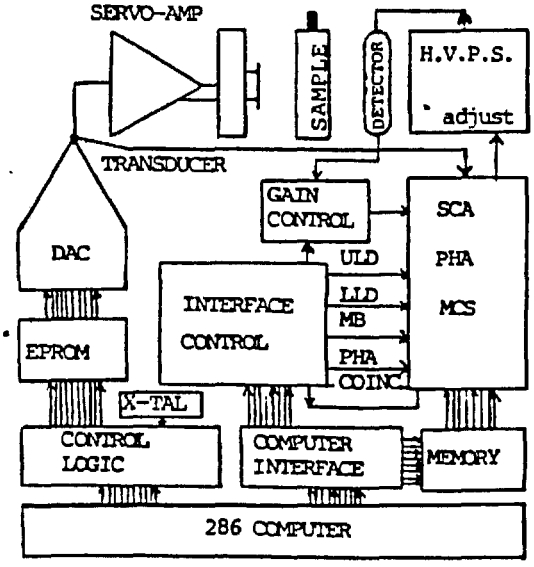


Figure 7. Block diagram of spectrometer

A block diagram of the spectrometer is shown in figure 7. The data from the memory in the MS-1500 is transferred to the computer via DMA (direct memory access). The interface control translates the computer key board functions to adjust the High Voltage power supply (HVPS), the gain of the proportional counter pulse amplifier, the upper and lower discriminator, the Doppler velocity amplitude, and the selection of GRS or GS and PHA or PHS. The interface control also has additional ports for temperature control and frequency generator for the advanced experiments.

Experimental Techniques

The absorbers supplied with the spectrometer are encapsulated in plastic.

Optimum thickness is a function of three factors: the atomic absorption, the number of Mossbauer nuclei per unit area, and the production of scattered radiation by the absorber. The attenuation of the absorber can be expressed as

$$I/I_o = e^{(-\mu/\rho)(\rho x)} \qquad [6]$$

where μ/ρ is the mass absorption coefficient in cm^2/g, and ρx is the absorber thickness in g/cm^2. The attenuation coefficient for 14.4 KeV gamma rays is given in Fig. 8.

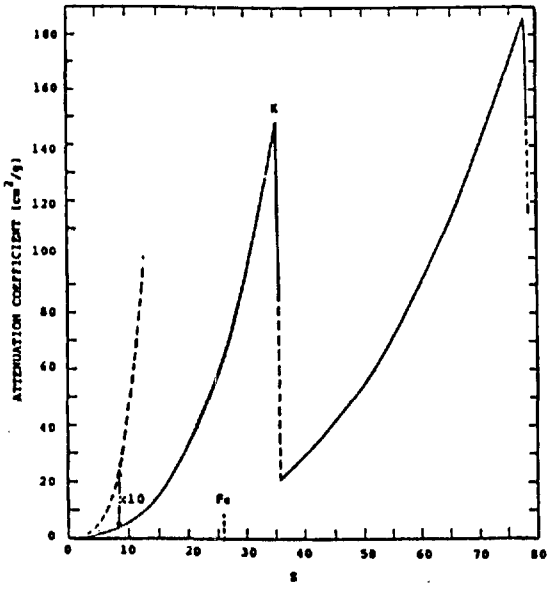


Figure 8. Attenuation coefficient for 14.4keV gamma radiation as a function of element.

Generally, 30% transmission should be used for an initial trial, as judged from the pulse height spectrum. This should also give a good measure of the Compton scattering which is hard to calculate for different absorbers. The 14.4 KeV peak should be at least 20% above the background, in the pulse height spectrum. Too thick an absorber will cause line broadening, as shown in Experiment 1 (Ref. 2, pp. 32-33).

Position of the absorber is not critical, although if the Comption scattering is large, the absorber should be placed closer to the source to minimize inverse-square-law distortions.

Many materials are suitable for mounting absorbers. Plexiglass and polyethylene are most suitable, if their iron content is low. Clear plastic tape is convenient for quickly mounting a powder sample - simply sprinkle the powder onto the sticky surface. Samples in solution may be allowed to dry on filter paper. Samples may be mixed with epoxy and cast between two glass plates which have been previously coated with silicon release compound. In all cases, a mount without the sample should also be prepared, to measure its attenuation.

Foils, thin films, and paper samples may be mounted in standard 2 X 2 inch cardboard slide mounts for convenience in handling.

EXPERIMENTS

1. Uncertainty Principle Measurement of $\hbar$

Heisenberg's Uncertainty Principle states that any measurement to determine the energy of system requires at least a time

$$\Delta E \cdot \tau = \hbar \qquad [7]$$

or the finite life time of the excited state means a given line width Γ of the emitted radiation, or

$$\tau \Gamma = \hbar \qquad [8]$$

The lifetime of the excited state has been measured at 98 n sec. We now can calculate

from a careful measurement of the line width Γ of the resonant line, and make corrections for the experimental conditions;

a. Line Broadening

Increasing the thickness of the iron absorber not only reduces the intensity of transmitted gamma rays by

$$I = I_0 e^{-\alpha t}$$

but broadens the transmitted linewidth. It can be shown that the effective thickness of the absorber becomes:

$$T = f_a n a \sigma_0 t, \qquad [9]$$

where f_a = fraction of recoil free γ rays in absorber

n = number of atoms per unit area (cm^2) in the path

σ_0 = absorption cross section (15×10^{-19} cm^2 for iron)

a = natural abundance (.0217 for iron)

t = thickness (cm)

The fraction of effect then becomes:

$$\epsilon = \frac{N_\infty - N_0}{N_\infty - B} = f_s \left[1 - e^{T/2}\right] \qquad [10]$$

where N_∞ = transmission intensity off resonance

N_0 = transmission intensity for absorption

B = non-Mossbauer transmission intensity (background)

f_s = fraction of recoil free γ rays from source

Background in this case should be meaured with the source and all absorbers in place as when taking the spectrum, but with the aperture in the Proportional Counter tube's lead shield covered with a piece of 1/8 inch aluminum or 1/4 inch plexiglass.

The amount of line broadening is then given by

$$\Gamma_t = (2 + 0.27T)\,\Gamma_{natural} \qquad [11]$$

To obtain Γ natural, plot the line width of the 4 single line absorbers against the T of these absorbers containing various concentrations of iron. Use $f_a = .9$ for the source and $f_a = 0.6$ for the absorber.

b. The Cosine Effect

Since the Doppler shift is defined by

$$\upsilon = \upsilon_0 \left(1 + \frac{\vec{V} \cdot \vec{c}}{c^2}\right),$$

$$\frac{\Delta E}{E} = \frac{v}{c} \cos\theta \qquad [12]$$

Calculate the maximum error in the line width measurement from the geometry of one experiment.

2. Debye Temperature

The Mossbauer Effect may be explained by means of the uncertainty principle. The wave function of an atom in a crystal is limited to a region of space ΔX. It has an uncertainty in momentum of $\hbar/\Delta X$. If $\hbar/\Delta X$ of the atom is larger than the momentum $\hbar K$ of the γ-ray, there is a possibility of absorbing the recoil without changing the state of the atom. The condition for a large fraction of recoilless emission is $\kappa \Delta X < 1$. The probability of finding the lattice in the same state after emission is

$$\left| \langle G | \exp\left[-\frac{\vec{}}{i\kappa} \cdot \vec{x}\right] | G \rangle \right|^2 \qquad [13]$$

where G> is the wave function of the lattice, $\vec{\kappa}$ the wave vector of the gamma-ray and $\vec{x}$ the position of the emitting atom. If the initial states are occupied with probability, gG in thermal equilibrium, then the fraction of recoilless emission is

$$f(t) = \sum_G g_G \left| \langle G | \exp\left[-\frac{\vec{}}{i\kappa} \cdot \vec{x}\right] | G \rangle \right|^2 \qquad [14]$$

For a harmonic solid the probability of recoilless emission or absorption is given by exp [- $\kappa^2 < x^2 > T$], where κ is the wave vector of the gamma-ray, and $< x^2 > T$ is the mean square displacement $< > T$ denoting thermal average. If the Debye model is used to describe the solid, then

$$\kappa^2 < x^2 > T = 3\frac{E_R}{\kappa_B \theta_D}\left[1/4 + \left(\frac{T}{\theta_D}\right)^2 \int_0^{\theta_D/T} \frac{x\,dx}{e^x - 1}\right] \qquad [15]$$

where θ_D is called the Debye temperature. Thus, if the nuclear transition is of low energy and if the Debye temperature of the crystal is high, then the probability for recoilless emission or absorption is high.

The recoil free fraction,

$$f = e^{-<x^2>/\lambda^2} \quad \text{and} \quad \frac{1}{\lambda^2} = \left(\frac{E}{\hbar c}\right)^2$$

$$f = e^{-\frac{E_r}{\kappa \theta_D}\left\{\frac{3}{2} + \frac{\pi^2 T^2}{\theta_D^2}\right\}} \qquad [16]$$

Calculate the Debye temperature for the absorber used in experiment 1.

3. Electric Quadrupole Splitting

The absorber furnished for this experiment gives a well resolved doublet. Measure the quadrupole splitting, isomer shift and line width.

4. MAGNETIC DIPOLE SPLITTING: NUCLEAR ZEEMAN EFFECT IN IRON

Fe^{57} foil, because of its high intrinsic magnetic field, is the most convenient sample for observing the Nuclear Zeeman Effect. Run a Mossbauer Spectrum with sufficient velocities (± 8 mm/sec) to observe all six absorption lines. (See Fig. 6)

The ground state in Fe^{57} foil, with total spin I_g = 1/2, is split into two levels of $m_g = \pm 1/2$ by the magnetic field H. The excited state, with I_e = 3/2, is split into four levels of $m_e = \pm 1/2, \pm 3/2$. The displacement of each sublevel is given by $\Delta E = -\mu Hm/I$, where μ = nuclear magnetic moment, and H = internal magnetic field at the nucleus.

The transitions between these levels are then given by

$$E = E_o\left(1 + \frac{v}{c}\right) = E_o - H\left(\frac{\mu_e m_e}{I_e} - \frac{\mu_g m_g}{I_g}\right) \qquad [17]$$

with the limitation of the selection rule that $\Delta m = 0, \pm 1$. E'_o takes into account the isomer shift, since the six line spectrum does not center on zero velocity. The nuclear magnetic moments of the ground state and excited state are μ_g and μ_e, respectively.

Of the four variables μ_e, μ_g, H, and the velocity calibration of the apparatus, two can be determined if the other two are known. In particular, if μ_g and velocity calibration are known, H and μ_e can be calculated. H is given by the equation above. μ_e is calculated from the sublevel displacement,

$$\Delta E = E_o \frac{v}{c} = -\mu Hm/I .$$

Taking $\Delta V_1 = V_6 - V_5$ as the difference in velocity between the last two absorption lines and substituting I = 3/2, and m = 3/2, 1/2, we find

$$E_o \frac{\Delta v_1}{c} = 2/3\,\mu_e H$$ For the lower level,

$\Delta v_2 = v_5 - v_3$ both originating from the $m = \pm 1/2$ upper level). Then

$$E_o = \frac{\Delta v_2}{c} 2\mu_g H . \qquad [18]$$

Eliminating E_o, H, and c between the two equations, then

$$\mu_e = 3\mu_g \frac{\Delta v_1}{\Delta v_2} . \qquad [19]$$

μ_g has been measured to be 0.0903 ± .0007 nuclear magnetons.

Velocity calibration of the apparatus may be achieved by measuring the separation of the outermost two lines. The intrinsic magnetic field of Fe^{57} at the nucleus is 331.5 Kilogauss.

From the Zeeman splitting, calculated the following:

a. magnetic moment of the excited state
b. calibration of the spectrometer

c. line width and amplitude of the resonant lines

5. Antiferromagnetism

Test the sample provided with a bar magnet, and notice that the material is not magnetic. Set the velocity range to ± 8 mm/sec, and take a spectrum.

a. Explain the presence of a magnetic dipole spectrum
b. Measure the magnetic field, quadrupole splitting and isomer shift.

6. The Iron Phosphide Paradox

Again, test the sample provided with a bar magnet, and use a velocity range of ± 8 mm/sec.

a. explain the spectrum
b. analyze the data
c. What could be done to change the spectrum?

7. Polarization of γ-rays

The Mossbauer spectrum of iron, seen in experiment 4, changes when the iron sample is magnetized- - that is, when all the magnetic moments are polarized in one direction. The two samples provided are magnetically polarized parallel and perpendicular to the beam. From the theory given in experiment 4,

a. Calculate the line intensities for a parallel and perpendicular magnetic field.
b. Add the intensities of a, and give the resulting spectrum.

8. Oxidation States

The classical question of the iron's valence state in Fe_3O_4 is given a decisive answer by GRS. the observed absorption curve shows two superimposed iron spectra, one with an isomer shift corresponding to a valence of +2, the other corresponding to a valence of +3. The Fe^{+3} spectrum has twice the magnitude of the other, thus showing that two of the iron atoms have valences of +3, and one has a valence of +2. Record the spectrum, and analyze the data, using Mossfit, for
a. Magnetic, quadrupole and isomer shift for each valence state.
b. Assign these parameters to the Fe^{+2} and Fe^{+3} sites.

If you have a problem with the interpretation or assigning the resonance lines, use the $NiFe_2O_4$ absorber, the resonance lines, use here the Fe^{+2} lines are missing.

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SLIDES

1. PROPORTIONAL COUNTER DESIGN AND CHARACTERISTICS CURVE
2. CO^{57} ENERGY LEVEL DIAGRAM AND INTERNAL CONVERSION
4. X-RAY ABSORPTION AND ABSORPTION EDGES
5. X-RAY FLUORESCENCE
6. COMPTON EFFECT THEORY AND COMPTON SPECTRUM
7. DOPPLER EFFECT AND GRS
8. BLOCK DIAGRAM OF GAMMA RESONANCE SPECTROMETER
9. RECOIL FREE EMISSION AND ABSORPTION, OVERLAP INTEGRALS, CURVE FITTING
10. LINE BROADENING THEORY
11. UNCERTAINTY PRINCIPLE
12. THE DEBYE TEMPERATURE
13. THE GRS PARAMETERS
14. MAGNETIC SPLITTING, CLEBSCH-GORDON COEFF.AND SELECTION RULES
15. MAGNETIC POLARIZATION
16. MAGNETIC MATERIALS; FERROMAGNETIC, ANTIFERROMAGNETIC, RELAXATION
17. CURIE AND NEEL TEMPERATURES
18. FM MODULATION OF GAMMA RAYS
19. CONVERSION ELECTRON GRS
20. REFRACTIVE INDEX OF PLASTIC MEASURED BY GRS

VI. RESUMES (U)

(U) This section includes only those resumes that were not included in the original proposal.

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EDUCATION:

University of Minnesota Major: Mathematics	B.A.	1952
University of Minnesota Major: Statistics	M.A.	1955
University of Minnesota Major: Biostatistics Minor: Mathematics	Ph.D.	1959

ACADEMIC APPOINTMENTS:

Assistant Professor, Biometry Division University of Minnesota	1959-1961
Associate Professor, Biometry Division University of Minnesota	1961-1965
Professor and Head, Biometry Division Director of Graduate Study in Biometry University of Minnesota	1965-1968
Professor and Head, Division of Biostatistics Stanford University, California	1968-
Acting Chairman, Department of Family, Community and Preventive Medicine Stanford University	1975-1976, 1984
Chairman, Department of Health Research and Policy Stanford University	1988-

RECOGNITION AND HONORS:

B.A. magna cum laude, Univ. of Minnesota
Phi Beta Kappa; Sigma Xi
Fellow, American Statistical Association
Fellow, Arteriosclerosis, American Heart Association
Fellow, American Association for the Advancement of Science
Who's Who in America; Dictionary of International Biography
Statistics Section Award, American Public Health Assn., 1983
International Institute of Statistics
Institute of Medicine, National Academy of Sciences

PROFESSIONAL SOCIETY MEMBERSHIPS:

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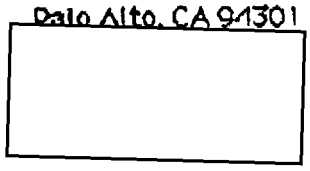

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Date of Birth:

PRESENT POSITION:

04/88 - present — Medical Director, Occupational Medicine Department, Health Care Division, Palo Alto Medical Foundation
Medical Director - Travel Medicine Clinic, Palo Alto Medical Foundation, Palo Alto, CA

ACADEMIC APPOINTMENTS:

1991 - present — Assistant Clinical Professor of Medicine, Department of Medicine Stanford University Medical Center, Stanford, CA

1987 - present — Assistant Clinical Professor of Medicine, Department of Medicine, School of Medicine, University of California, San Francisco, CA

1987 - 1989 — Clinical Instructor in Medicine, Department of Medicine Stanford University Medical Center, Stanford, CA

1986 - 1988 — Associate Chief, Division of Occupational Medicine and Employee Health Services, Santa Clara Valley Medical Center, San Jose, CA

1985 - 1987 — Assistant Clinical Professor of Medicine, Department of Medicine, University of California Medical Center, San Diego, CA

1983 - 1985 — Clinical Instructor of Medicine, Department of Medicine, University of California Medical Center, San Diego, CA

1983 - 1985 — Post-Doctoral Scholar, Division of Pulmonary Medicine, Department of Medicine, University of California Medical Center, San Diego, CA

LICENSING AND CERTIFICATION:

1980 G43075 — Medical License, State of California

1980 AF9486867 — DEA Registration number

1983 089100 — Board certified, American Board of Internal Medicine

1990 22406 — Board certified, American Board of Preventive Medicine (Occupational Medicine)

EDUCATION:

1982 - 1983	**Medical Chief Resident:** General Internal Medicine, Department of Medicine, University of California Medical Center, San Diego, CA
1980 - 1982	**Medical Resident:** Department of Medicine, University of California Medical Center, San Diego, CA
1979 - 1980	**Medical Intern:** Department of Medicine, University of California Medical Center, San Diego, CA
1975 - 1979	**Medical School:** M.D.: Albert Einstein College of Medicine, Bronx, N.Y.
1971 - 1975	**College:** B.A.: Oberlin College, Oberlin, OH

HONORS:

1979	Ira Rubin Memorial Award in Pulmonary Medicine, Albert Einstein College of Medicine
1975	Honors at graduation, Oberlin College

CONSULTANT FOR:

Raychem Corporation, Stanford University, Stanford University Medical Center, Alza Corporation, SyStemix Corporation, DNAX Corporation, Failure Analysis Stanford Research Insititute, California Biotechnology, City of Palo Alto, Menlo Park Fire Protection District, City of Sunnyvale Fire Department-Hazardous Materials Teams, City of Mountain View Fire Department-Hazardous Materials Teams

RELATED ACTIVITIES:

1989	Medical Advisor, Santa Clara County Infectious Waste Task Force
1988	Medical Advisor - HIV/Hepatitis B Exposures Among Health Care Workers, Santa Clara Valley Medical Center - Infection Control Subcommittee
1987 - present	Member, Environmental and Public Health Advisory Committee, Santa Clara County Medical Society, San Jose, CA
1987 - 1988	Member, Specialty Consultant Panel, Central-Coast Counties Regional Poison Center, San Jose, CA
1987 - 1988	Consultant, Subcommittee on the Health Effects of Refuse-Derived Energy, American Lung Association of San Diego and Imperial Counties

RELATED ACTIVITIES (continued)

1986	Chairman, Subcommittee on the Health Effects of Refuse-Derived Energy, American Lung Association of San Diego and Imperial Counties
1984 - 1986	Medical Director, County Medical Services Program, University of California, San Diego Medical Center
1983 - 1986	Occupational and Internal Medicine Consultant and Attending Physician, Beach Area Community Health Center, San Diego, CA
1982 - 1986	Occupational Medicine Consultant, American Lung Association of San Diego and Imperial Counties

SOCIETIES AND PROFESSIONAL ASSOCIATIONS:

Western Occupational Medicine Association
American Occupational Medical Association
Santa Clara County Medical Society
American College of Physicians
American Public Health Association, Occupational Health Section
American Lung Association of San Diego and Imperial Counties, Occupational and Environmental Health Committee
California Medical Association

RESEARCH ACTIVITIES:

1982 - Present	Acute and chronic effects of fire fighting among San Diego fire fighters. (Principal investigator)
1983 - 1985	Clinical research on new antihypertensive medications - MK 286 (a uricosuric diuretic) and tiapamil (a calcium channel blocker). A double blind clinical investigation. Paul Jagger, M.D. (Principal investigator)
05/78	Participation in a study of the Michigan population exposed to polybrominated biphenyls (PBB's). Mount Sinai School of Medicine, Environmental Services Laboratory. Irving J. Selikoff, M.D.
06-08/78	Research on the chemical hazards in the pharmaceutical industry. Albert Einstein College of Medicine, Department of Community Medicine, and the Oil, Chemical and Atomic Worker's Union

RESEARCH ACTIVITIES (continued)

06-08/75	Study of asbestos-related disease of the gastrointestinal tracts and lungs of individuals from Duluth, Minnesota, Mount Sinai, School of Medicine, Environmental Sciences Laboratory. Irving J. Selikoff, M.D.
1974 - 1975	Senior Honors Thesis (Oberlin College) on the biological effects of asbestos fiber (gross and electromicroscopic pathology) on the gastrointestinal tracts of mice. Oberlin College,. Department of Biology. Dr. Anna R. Brummett, Chairman, Department of Biology
06-08/74	Effects of heat and chemical exposures among workers in the rubber tire industry. Harvard School of Public Health. John M. Peters, M.D.
06-08/73	Study of pulmonary disease associated with asbestos exposure (electromicroscopic pathology). Mount Sinai School of Medicine, Environmental Sciences Laboratory. Irving J. Selikoff, M.D.
06-08/72	Occupational hazards in the newspaper industry. International Printing Pressmen's and Assistants' Union

PUBLICATIONS:

Edited Chapter by Graef, J.W. and Lovejoy, F.M., Jr.: Heavy Metal Poisoning, in Harrison's Principles of Internal Medicine, 11th Ed. 1986.

Fujimoto, G.R., McQuade, S.F., and Ramsdell, J.W., Eds.: Drug Pricing Manual. UCSD Publications 1983.

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10/91

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1961-62	Loma Linda University Rotating Internship White Memorial Hospital	Los Angeles, Calif.	
1963-66	University of California at Los Angeles Psychiatric Residency		

PROFESSIONAL TRAINING AND EXPERIENCE:

1956-57	Research Assistant Massachusetts General Hospital Harvard Medical School	Boston, Mass.
1962-63	General Practice Kaiser Permanente (Compton Clinic)	Los Angeles, Calif.
1963-66	Member, Neuroendocrine Clinic and Diabetic Retinopathy Clinic, UCLA	
1965-66	Postdoctoral Fellowship Award USPHS MH-6415 Brain Research Institute, UCLA	
1966-present	Member, Brain Research Institute, UCLA	
1966-71	Assistant Professor in Residence, Dept. of Psychiatry, School of Medicine, UCLA; Assistant Research Psychiatrist, BRI, UCLA	
1972	Associate Professor in Residence, Dept. of Psychiatry, School of Medicine, UCLA	
1973-77	Joint Appointment: Associate Professor in Residence, Computer Science Dept., School of Engineering, UCLA	
1977-present	Joint Appointments: Professor in Residence, Dept. of Psychiatry, School of Medicine and Computer Science Dept., School of Engineering, UCLA	
1978-present	Joint Appointment: Professor in Residence, Dept. of Anesthesiology, School of Medicine, UCLA	

UNIVERSITY COMMITTEE SERVICE:

Data Processing Laboratory Advisory Committee

Telemetry Consultant to Brain Research Institute Mountain Campus Committee

Representative for the Dept. of Psychiatry on Mental Health Training Program Committee

Mental Health Training Program Subcommittees on Budget and Education

Brain Research Institute Committee on Future of Brain Research Institute

The Next Ten Years Brain Research Institute Committee for BRI 10th Anniversary

Hospital Intensive Care Committee

Appointment and Promotion Committee, Dept. of Psychiatry (two years), Ad Hoc Committees

CONSULTATION SERVICES:

a. Consultant to Dept. of Urology, University of Rochester, School of Medicine, for hyperbaric research
b. EEG Consultant to NASA for Biosatellite III Program, 1967 to present
c. Consultant to AMPEX Corporation, Redwood City, California, for advanced EEG research
d. Consultant to Alza Corporation, Stanford, California, on computer analysis of EEG data
e. Consultant to Committee on Space Research (COSPAR), on space terminology
f. Consultant to Jet Propulsion Laboratory Biomedical Group on the use of ultrasonics
g. Consultant to the Behavioral Research Foundation, St. Kitts, British West Indies, on animal telemetry systems
h. Consultant to the Behavioral Science Foundation
i. Consultant to the Sleep Laboratory at the Southern California Neuropsychiatric Institute, La Jolla, California
j. Consultant to Assessment Systems, Incorporated, Houston, Texas
k. Consultant to the Sleep Disorders Clinic (John Andrews, M.D.), Provo, Utah
l. Consultation service to the N.I.H. Neurology Study Section (sleep)

HONORS:

1957-61	Leopold Schepp Foundation Scholar (in medical school)
1957-58	Johnson Wax Foundation Scholar

STEVEN A. HILLYARD

Curriculum Vitae

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PERSONAL DATA

EDUCATION

B.S., California Institute of Technology, 1964. (Biology)
Ph.D. Yale University, 1968. (Psychology)

POSITIONS

Professor of Neurosciences, Department of Neurosciences, University of California, San Diego (U.C.S.D.) 1980 - present

Lecturer through Associate Professor, Department of Neurosciences, U.C.S.D. 1968-1980

USPHS Traineeship at Yale University in Physiological Psychology with Robert Galambos. 1964-1968

Research Assistant at Caltech in Psychobiology with C.R. Hamilton and R.W. Sperry. 1963-1964

TEACHING AREAS

Basic Medical Neurology
Sensory Processes: Neurophysiology of Vision and Audition
Human Information Processing: Attention and Perception
Psychophysiology
Neuropsychology

HONORS and AWARDS

Fellow of the American Association for the Advancement of Science
MERIT Award from National Institute of Mental Health
UCSD Neurosciences Department Outstanding Teacher Award

ADVISORY AND REVIEW PANELS

NIMH Study Section: Mental Health Small Grant Committee, 1976-1980.
NIMH Study Section: Neurosciences Research Review Committee, 1986-1990.

Advisory Council: International Association for the Study of Attention and Performance 1978-1983; 1985-present.

Advisory Panel to NIMH Neurosciences Research Branch. 1982-1983.

EDITORIAL BOARDS

Electroencephalography and Clinical Neurophysiology, 1977-present.

Journal of Cognitive Neuroscience, 1988-present.

Journal of Experimental Psychology: Human Perception and Performance, 1974-1979; 1985-1988.

Consciousness and Cognition, 1990-present.

SOCIETY MEMBERSHIPS

American Association for the Advancement of Science.
Society for Neuroscience

GRANTS AND CONTRACTS

Principal Investigator: NIMH 2 R01 MH 25594. "Electrophysiological Studies of Selective Perception." 1974-1995.

Principal Investigator: Sloan Foundation Grant B1980-35. "Event-Related Brain Potentials and Semantic Processing". 1980-1982.

Co-Principal Investigator (with M. Kutas): NSF BNS 80-05525. "Semantic Processing and Event-Related Brain Waves." 1980-1986.

Principal Investigator: NINCDS 1P01 NS17778. "Event-Related Potentials and Cognition: Program in Cognitive Neuroscience" Cornell Medical School (M.S. Gazzaniga, Program Head) 1982-1994.

Principal Investigator: Office of Naval Research Contract, N00014-86-K-0291. "Electrophysiological Studies of Visual Attention and Resource Allocation." 1986-1992.

Brief Curriculum Vitae, 1991 Robert B. Livingston,M.D.

Education: **Stanford University** (AB, 1940); **Stanford University School of Medicine** (MD, 1944); (Residency, Internal Medicine [under Professor **Arthur L. Bloomfield**], **Stanford University Hospitals,** 1943-1945).

Academic Appointments: **Stanford University** (Instructor in Pathology [under **Alvin Cox**], 1943-44); **Yale University School of Medicine** (Instructor to Assistant Professor of Physiology [under **John F. Fulton**], 1946-52); (concurrently) **Harvard Medical School** (Assistant Professor of Psychiatry [under **Harry Solomon**], 1946-47); **UCLA School of Medicine** (Associate Professor to Professor of Anatomy and Physiology [under **H. W. Magoun** and **John Field**], 1952-57); Adjunct Professor, Mid-Career Course, **U.S. State Department,** 1957-1964; Founding Chair, **UCSD School of Medicine**, Department of Neurosciences (Professor of Neurosciences, 1964-1989 [with **Theodore H. Bullock, Robert Galambos, Reginald Bickford, John O'Brien, Marjorie Seybold, Fred Gage, Robert Terry,** and **Robert Katzman**]; Guest Professor of Neurosciences, at the *Hirnforschungsinstitut* **der Universität Zürich** [under **Konrad Akert**], 1971-72). Science Consultant. [under **His Holiness, the Dalai Lama**], 1991--).

[Aim of this academic career has been to investigate combinations of nervous and mental functions, using a variety of neuroanatomical, neurophysiological, behavioral and clinical techniques and disciplines.]

Advanced Training: **Université de Génève** (National Research Council Senior Fellow in Neurology, [under **Oscar Wyss**],1948-49); **Universität Zürich** (ditto [under **Walter Rudolph Hess**], 1949); **Collége de France** (Wilhelm B. Gruber Fellow in Neurology, [under **Alfred Fessard**], 1949-50); **Oxford University** (ditto [under **F.S.C. Little** and **Paul Glees**], 1950); **Universitet Göteborg** (US Public Health Service Senior Fellow in Neurology, [with **Bo Gernandt** and **Holger Hydén**], 1956); **Massachusetts Institute of Technology** (Research Associate, Neurosciences Research Program, [under **Francis O. Schmitt**], 1961-1973).

National Service: **US Navy Medical Corps (Reserve), World War II:** [Established and directed the hospital for wounded Okinawans and Japanese POWs throughout the battle of Okinawa, (awarded U.S. Navy Bronze Star for this contribution), 1945]; [**"Interpreter"** for surrender of Japanese Army in North China, (U.S. Marine Corps needed people with even modest Chinese and Japanese language training), 1945]; [Chief, Medical Battalion Laboratory, **2nd Marine Division**, Tiensin and Peking, throughout "Cease-Fire" between Kuomintang and Chinese Communists, 1945-46]; U.S. Public Health Service representative -- **First Life Sciences Committee, NASA**, advisory for life support systems, safety, communication, selection of Astronauts, etc., 1958-63].

International Diplomatic Contributions: International Physicians for the Prevention of Nuclear War (IPPNW), winner of 1985 Nobel Prize for Peace, IPPNW Emissary [with **Lars Engstedt**] to Egypt, Jordan, Syria, Kuwait, Bahrian, and Saudi Arabia, to persuade Arab physicians to contribute internationally to prevention of nuclear war; IPPNW Ambassador, to Tibetan Government-in-Exile, Dharamsala, India. Contributed to three successive tutorials 1987, 1989, 1990 on Mind and Life [under **Tenzin Gyatso, His Holiness, The Dalai Lama**, winner of the 1989 Nobel Peace Prize],). Participant, two international diplomatic missions conducted by the Center for the Study of the Person [under **Carl Rogers**] in Rust, Austria, [with **Gay Swensen** after Roger's death] in San José, Costa Rica, [under **President Arias**], to establish dialogue between governments of Nicaragua and United States.

Research Contributions: Neocortical representations of visceral functions in monkey and chimpanzee [with **Ernest Sachs, Jr.**, **Sam Brendler**, and **José Delgado**]; Human frontal and cingulate cortical representations of visceral functions [with **William P. Chapman, William H. Sweet,** and **Kenneth E. Livingston**]; Plasticity of muscle synergy in humans [with **Alfred Fessard, Jean Paillard,** and **Auguste Tourney**]; Eye movements controlled by frontal eye fields and occipital visual fields in monkey; Frontal motor representations in deep sulci of cats [with **José Delgado];** Localization of frontal eye fields in cats; Head turning and eye deviation elicited by stimulation of frontal cortex in freely moving cats [under **Walter Rudolf Hess,** with **Donald A.**

MacDonald]; Explosive decompression at high altitude [with **Samuel Gelfan** and **Leslie Nims**]; Use of biological potentials to warn of anoxic anoxia [with **Harold S. Burr**]; Segregation, origin and destination of first-order sensory dorsal column axons [under **Paul Glees**]; Central control of ascending sensory pathways [with **Raúl Hernández-Peón** and **Harald Scherrer**]; Cortical influences on brain stem conduction systems, and on brain stem arousal mechanisms [with **John D. French, Raúl Hernández Peón, W. Ross Adey** and **José Segundo**]; Cerebrospinal fluid equilibria; Somatic functions of the nervous system [with **Raúl Hernández-Peón**]; Differential seizure susceptibility in monkey cortex [with **John D. French**]; Prevention of seizures in monkeys by intravenous procaine injections [with **John D. French, Bruce Konigsmark,** and **Ken Richland**]; Vestibulo-spinal motor projections [with **Bo Gernandt, Sid Gilman**, and **Magdolna Iranyi**]; Brain mechanisms and behavior; Neurophysiology of brain stem reticular formation [with **Frederic G. Worden**]; Neurophysiological contributions to internal medicine [with **Frederic G. Worden**]; Longitudinal spinal and brainstem reflex systems relayed through the bulbar reticular formation [with **Muneo Shimamura**]; Dynamics of acoustic pathways under control of middle-ear muscles [with **Arnold Starr** and **Peter Carmel**; What makes the sloth so slothful? [with **T.H. Bullock, Donald B. Lindsley**, and **Robert Galambos**]; Central control of receptors and sensory transmission systems; Role of central nervous mechanisms relating to reinforcement; Ultrastructure of myelin glial-axonal junctions, and functional dynamics of synaptic boutons [under **Konrad Akert**]; Cinemorphology of whole human brain serial surfaces, in registration, exposed at microscopically thin intervals throughout the entire brain in 68 "normal" human brains [with **Roy Mills** and **Thornton Egge**]; Three-dimensional reconstruction of one whole human brain, using interactive computer graphics [with **Kent Wilson, Bill Atkinson**, and **Bud Tribble, III**]. A film on this subject [produced under **Sy Wexler**] won sweepstakes awards at all major international documentary film festivals in 1976/7 and has been shown repeatedly on NOVA, National Geographic Society, BBC, OMNIMAX, and many other television programs, worldwide, since then. Undernourishment affecting human brain development in the U.S. [under **Doris H. Calloway,** with **Helen Ross,** and **Elisabeth Stern**]. Expeditions include: Ship's Physician and Chief Diver, Scripps Institution of Oceanography Expedition CAPRICORN [under **Roger Revelle** and **Walter Munk**], 1951-1952; Alpha

Helix Expedition to the Amazon [with **Theodore H. Bullock** and **Donald B. Lindsley**], 1968; Expedition to Panama [with **Theodore H. Bullock** and **Robert Galambos**] 1970.

Research Publications: Some 200 research publications including a few research monographs. Chapters on Neurophysiology in a textbook for psychologists; Chapters on Neurophysiology in a textbook for psychiatrists--these latter were republished as a separate monograph, *Sensory Processing, Perception, and Behavior,* 1978, Section on Neurophysiology consisting of a dozen chapters in *Best and Taylor's Physiological Basis of Medical Practice,* 11th Edition,1985, and 12th Edition, 1990.

Lectureships: AAAS Holiday Science Lecturer, for State-wide honor high school students: Florida, 1958, Oregon, 1959; National Sigma Xi Lecturer, 1960 and 1961; Queen Kamehameha Lecturer, University of Hawaii School of Medicine, 1965; AAAS Chautauqua Lectureship [shared with **Elisabeth Stern**], 1978 and 1979; Sachs Memorial Lecturer, Dartmouth Medical School, 1981.

Extra-Curricular Activities: Co-Incorporator [with **John F. Fulton**], the Journal of the History of Medicine, 1951. Participated closely with **Leo Szilard** in founding the Council for Abolishing War, which became the Council for a Livable World, 1962. Co-Incorporator [with **Richard J. Barnet, Marcus Raskin**, and **Christopher Jencks**], of the Institute for Policy Studies, 1962. Co-Incorporator [with **Fritjof Capra**] of the Elmwood Institute, 1979. Active [under **Bernard Lown**] in International Physicians for the Prevention of Nuclear War, as Emissary and Ambassador; Deputy Council representative for U.S. Physicians for Social Responsibility; House of Delegates, 1986-88, U.S. national Physicians for Social Responsibility, President-Elect 1991, [to serve as President, 1992, Past-President 1993; Co-President, San Diego Chapter, 1989-91.

Robert B. Livingston, M.D.
Professor of Neurosciences Emeritus
University of California San Diego
Address: 7818 Camino Noguera, San Diego, California 92122-2027.
Telephone: (619) 455-0306; Telefax: (619) 455-1874.

CURRICULUM VITAE

NAME: **ROBIN P. MICHELSON, M.D.**

BORN: [redacted]

SGFOIA3

EDUCATION:

1932-1934	University of California Berkeley, Calfiornia	
1934-1936	Stanford University Stanford, California	B.S
1936-1940	Stanford University School of Medicine Stanford, California	M.D.

POSTGRADUATE TRAINING:

1940-1941	Assistant Resident, Pathology San Francisco General Hospital
1946-1948	Otolaryngology Resident Veterans Administration, San Francisco

MILITARY SERVICE:

1941-1946	Captain, U. S. Army (MC)

LICENSURE AND CERTIFICATION:

1940	California
1950	American Board of Otolaryngology

HOSPITAL AFFILIATIONS:

1945-1956	St. Luke's Hospital, San Francisco
1946-1956	St. Mary's Hospital, San Francisco
1968-Present	University of California Hospitals
1958-Present	Sequoia Hospital, Redwood City, California
	University of California Hospitals, San Francisco

POSITIONS HELD:
UNIVERSITY OF CALIFORNIA, SAN FRANCISCO

Department of Otolaryngology

1968-1974	Associate Clinical Professor
1974-Present	Clinical Professor

OUTSIDE THE UNIVERSITY OF CALIFORNIA:

1948-1952	Clincal Instructor, Stanford University School of Medicine
1952-Present	Assistant Clinical Professor, Stanford University School of Medicine
1955-1958	Chief, Stanford ENT Service, San Francisco General Hospital
1960-1963	Chief of ENT Service San Mateo County Hospital
1940-1980	Private Practice, Redwood City, California

MEMBERSHIP IN SCIENTIFIC SOCIETIES AND THEIR COMMITTEES:

1945	American Medical Association
1945	California Medical Association

GARRISON RAPMUND

SGFOIA3

EDUCATION:

- A.B. Harvard, 1949
- M.D. Columbia, 1953
- George Washington University School of Government and Business, 1973-1974
- Army War College, 1976

MEDICAL LICENSE:

- New York #77729
- California #G-4697
- Certified, American Board of Pediatrics, 1961

EXPERTISE:

- Health and Performance Research
- Technology Transfer
- Epidemiology and Infectious Disease
- Senior Executive Management

PRESENT POSITION Consultant to Systems Engineering and Management Associates, Falls Church, Virginia

Responsible for facilitating commercialization of Strategic Defense Initiative technologies to the health care industry and the life sciences research community.

PAST EMPLOYMENT

1987-1990 Chief Scientist (Biomedical Operations)
Flow General Inc., McLean, Virginia

Advised the CEO on health-related activities of the six subsidiary companies world-wide. Also served as Director, Biomedical and Veterinary Services Division, Flow Laboratories, Inc., owned by Flow General, Inc. (Left company when health-related activities were sold.)

1957-1986 Active duty, U.S. Army 1957-1986

Continuously involved in research and development (R&D) throughout Army service; retired 1 September 1986 in the grade of Major General as Assistant Surgeon General (R&D) and Commander, U.S. Army Medical R&D Command.

GARRISON RAPMUND

SGFOIA3

EDUCATION:

- A.B. Harvard, 1949
- M.D. Columbia, 1953
- George Washington University School of Government and Business, 1973-1974
- Army War College, 1976

MEDICAL LICENSE:

- New York #77729
- California #G-4697
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EXPERTISE:

- Health and Performance Research
- Technology Transfer
- Epidemiology and Infectious Disease
- Senior Executive Management

PRESENT POSITION Consultant to Systems Engineering and Management Associates, Falls Church, Virginia

Responsible for facilitating commercialization of Strategic Defense Initiative technologies to the health care industry and the life sciences research community.

PAST EMPLOYMENT

1987-1990 Chief Scientist (Biomedical Operations)
Flow General Inc., McLean, Virginia

Advised the CEO on health-related activities of the six subsidiary companies world-wide. Also served as Director, Biomedical and Veterinary Services Division, Flow Laboratories, Inc., owned by Flow General, Inc. (Left company when health-related activities were sold.)

1957-1986 Active duty, U.S. Army 1957-1986

Continuously involved in research and development (R&D) throughout Army service; retired 1 September 1986 in the grade of Major General as Assistant Surgeon General (R&D) and Commander, U.S. Army Medical R&D Command.

CURRICULUM VITAE

Garrison Rapmund, M.D.
Major General (Retired), United States Army

SGFOIA3

DATE OF BIRTH

CITIZENSHIP

MARITAL STATUS

HOME ADDRESS

PRESENT POSITION

Consultant to Systems Engineering and Management Associates, Falls Church, Virginia

Responsible for facilitating commercialization of Strategic Defense Initiative technologies to the health care industry and the life sciences research community.

Approved For Release 2003/04/18 : CIA-RDP96-00789R003100170001-9

RESUME

Philip D. Wasserman

EDUCATION

Study leading to Ph.D.in Computer Science and Engineering
MS Electrical Engineering and Computer Science, Santa Clara University
BS Mathematics, Summa Cum Laude, College of Notre Dame

PROFILE OF EXPERIENCE

Over 25 years experience in the field of artificial neural networks. Author of two books and several papers on theory and applications. Successfully applied artificial neural networks to solve a wide range of real world problems.

More than 30 years diversified experience as an Electronics Engineer, heavily involved in the detailed design of electronic instruments, analog and digital circuits, computer software, computer hardware and computer systems. Extensive project management and technical supervision experience.

Founder of two profitable electronics manufacturing firms. Served as Chief Executive Officer for eight years. Designed all of the firm's instrumentation products.

MAJOR ACCOMPLISHMENTS, 1979-1991

Developed artificial neural network architectures and training algorithms. Applied these to various problems in pattern recognition, optimization, and control. Published technical papers and presented technical seminars on artificial neural networks for a number of organizations.

Wrote two books, Neural Computing and NeuralSource, on artificial neural networks. Published by Van Nostrand Reinhold in 1989.

Developed analog and digital circuits and sub-systems for an automatic instrument used in semiconductor manufacturing, including signal acquisition and conditioning, electromechanical servo controllers, and software written in C for control and processing of data.

Designed an autofocus system for a diffraction limited microscope. Included inventing an algorithm, (patent pending) designing a digital signal processing board, and developing the software system to operate in a multi-processor environment.

Designed a solid-state high resolution video camera for use in a semiconductor inspection system, including video frequency, low level analog signal processing circuits.

Designed a high speed video signal conditioning and image digitizer board with interface to a 40 Megabyte/sec parallel digital bus, including a/d, d/a, and analog signal processing.

Performed architectural design of high speed digital signal processing circuit intended for CMOS integration. Supervised a group which designed and constructed TTL prototype to evaluate the architecture, and implemented digital signal processing algorithms for V22bis modem.

Developed the architecture, circuit, and system design of a high speed modem utilizing a multiprocessor configuration. Produced a custom assembler, wrote programming instructions and assisted algorithm developers in its use. Designed active filters and implemented sample and hold, a/d, and d/a circuits. Designed power supply including thermal design of package. Supervised printed circuit layout, mechanical packaging, and conducted tests verifying performance to specification.

Designed three new nuclear radiation measuring instruments and supervised their packaging and production engineering.

Conceived, designed circuits, and supervised hybrid circuit packaging of a wrist worn digital heart rate monitor. This involved the design of two semi-custom integrated circuits, one bipolar and the other CMOS, and coordination with the integrated circuit producers. Supervised mechanical design and performed production engineering leading to a successful product.

Designed hardware and algorithms for a 160 MBPS, parallel-pipelined image processing system. This included software simulation of processing algorithms, digital and analog circuit design, and integration with optical and mechanical systems.

Participated in the establishment of a Computer Science Major at the College of Notre Dame. Recommended courses, evaluated instructors, and taught many of the courses. Selected software and installed a new administrative computing system for the College of Notre Dame. Upgraded hardware, established procedures, trained personnel, and wrote programs to integrate system for Finance, Admissions, Registration, and Graduate Office.

MAJOR RECENT PROFESSIONAL EMPLOYMENT

Science Applications International Corporation

1990 to Present
Position: Director, Neural Network Applications
Duties:

Identify applications for artifical neural networks, develop solutions, and implement them.

Anza Research Inc.

1975 to Present:
Position: President
Duties:

Designed artificial neural network architectures and algorithms for pattern recognition, optimization, and control. Completed challenging, detailed, hardware and software design projects. This included both analog and digital circuits and systems. Designed software systems and algorithms, from concept to coding and test. Managed development projects, solved technical problems in manufacturing, developed and evaluated new product proposals, performed technical and marketing studies.

College Of Notre Dame Belmont CA
1983 to 1989 (part time)
Position: Program Director and Assistant Professor, Computer Science.
Duties: Teach Computer Science courses, participate in curriculum development, staffing, scheduling. Provide academic advising for students.

Chapman College Sunnyvale CA
1987 to Present (Part Time)
Present Position: Lead Instructor, Computer Science
Duties: Teach Computer Science courses, evaluate instructors, assist in course planning.

College Of Notre Dame Belmont CA
1985 to 1986
Position: Director of Administrative Computing
Duties:
Establish and maintain the central computerized administrative computing system, supervise support personnel, provide training and documentation for the various offices.

PATENTS

The following U.S. patents have been issued in my name:

# 4,924,098	Nuclear Radiation Level Detector
# 4,293,917	Non-Linear Function Generator
# 4,476,348	Carbon Microphone Linearization
# 4,491,733	Radiation Flux Measuring System
# 3,893,105	Integrating Type Analog-Digital Converter
# 3,273,143	Digital-To-Analog Converter
# 3,149,282	Digital Voltmeter
# 3,368,149	Dual-Slope Digital Voltmeter
# 4,945,220	Autofocusing System for Microscope

Two additional patent applications have been filed and are pending in the U.S. Patent Office

RECENT PUBLICATIONS

Neural Network On-Line Machine Condition Monitoring Systems, Proceeding of the Conference on Artificial Neural Networks in Engineering. University of Missouri-Rolla, Engineering Management Department, 1991.

On-Line Machine Condition Monitoring Using Neural Networks, Journal of the Acoustical Society of America, Vol. 90, No. 4, Pt.2, October 1991.

Neural Network On-Line Machine Condition Monitoring Systems, Society of Manufacturing Engineers, 1990, Detroit MI.

Vibration Signature Analysis Using Artificial Neural Networks, EPRI 4th Incipient Failure Detection Conference, 1990, Philadelphia PA.(With Sam Haddad and Aynur Unal).

Using Artificial Neural Networks For Vibration Signature Analysis, Proceedings of the Acoustical Society of America, Fall 1990

Vibration Signature Analysis using Artificial Neural Networks, Proceedings of the Second Workshop on Neural Networks: Academic/Industrial/NASA Defense, Auburn AL, February 11-13, 1991.

Neural Computing, Theory and Practice, Book published by Van Nostrand Reinhold, Spring 1989

Neural Source Annotated Bibliography, Book published by Van Nostrand Reinhold, Fall 1989

Experiments with a Combined Backpropagation/Cauchy Machine, Journal of Neural Net Computing.

Neural Networks, Part 1, IEEE Expert, Winter 1987 (With T. Schwartz)

Neural Networks, Part 2, IEEE Expert, Spring 1988 (With T. Schwartz)

Experiments in Translating Chinese Characters Using Backpropagation, Proc. IEEE Computer Society International Conference, San Francisco, Feb. 1987
Experiments with a Combined Backpropagation/Cauchy Machine, International Neural Network Society Conference, Boston, 1988

LECTURES PRESENTED
Artificial Neural Networks in Engineering Conference, St Louis,MO 1991 (Invited Paper)
Acoustic Society of America, Dallas TX, 1991(Invited Paper)
SDIO Parallel Programming Group Meeting, Malibu CA, 1991
American Nuclear Society Conference, Jackson Hole Wyoming, 1991
Defense Nuclear Agency, Washington DC.
Avionics Laboratory, Wright Patterson AFB, Dayton Ohio.
CIA/ORD, Washington DC.
Joint National Intelligence Development Service, Washington DC.
Electrical Power Research Institute, Palo Alto CA.
National Institutes of Health, Bethesda MD.
Federal Bureau of Investigation, Washington DC.
Military Sealift Command, U.S. Navy, Washington DC.
Santa Clara University, Santa Clara, CA.
University of California, Santa Cruz CA.
A.I. Forum, Palo Alto, CA.
A.I. SIG, Santa Clara, CA.
Special Interest Group, Machine Learining, Palo Alto, CA.

Also, seminars were presented to a number of industrial firms.

PROFESSIONAL SOCIETIES
Senior Member, IEEE
Member, IEEE Computer Society
Member, ACM
Member, International Neural Network Society
Referee for the IEEE Computer Society Press

REFERENCES Upon Request

PERSONAL INFORMATION

SGFOIA3

UNIVERSITY OF CALIFORNIA, LOS ANGELES

UCLA

BERKELEY · DAVIS · IRVINE · LOS ANGELES · RIVERSIDE · SAN DIEGO · SAN FRANCISCO

SANTA BARBARA · SANTA CRUZ

DEPARTMENT OF PSYCHIATRY AND
BIOBEHAVIORAL SCIENCES
UCLA SCHOOL OF MEDICINE
760 WESTWOOD PLAZA
LOS ANGELES, CALIFORNIA 90024-1759

(January, 1991)

LOUIS JOLYON WEST, M.D.

CURRICULUM VITAE

SGFOIA3

PERSONAL

EDUCATION

Marquette School, Madison, Wisconsin	1929-1934
Harvey School, Madison, Wisconsin	1934-1935
East High School, Madison, Wisconsin	1935-1941
University of Wisconsin, Madison, Wisconsin	1941-1942
State University of Iowa, Iowa City, Iowa (Army Specialized Training Program)	1943-1944
University of Minnesota School of Medicine, Minneapolis, Minnesota	1945-1948

DEGREES

B.S.	University of Minnesota	1946
M.B.	University of Minnesota	1948
M.D.	University of Minnesota	1949

POSTGRADUATE TRAINING

Internship (Straight Medicine): University of Minnesota Hospitals, Minneapolis	1948-1949
Residency in Psychiatry: Payne Whitney Clinic of the New York Hospital (Cornell Medical Center), New York	1949-1952

OTHER EDUCATIONAL EXPERIENCE

Personal psychoanalysis (candidate, Topeka Psychoanalytic Institute) 1958-1962
Group relations training programs (Tavistock/A.K. Rice Institute) 1965-1975
Fellow, Center for Advanced Study in the Behavioral Sciences, Stanford, California 1966-1967

MILITARY SERVICE

Army of the United States (enlisted): 301st Infantry Regiment, 94th Division; other assignments 1942-1946
United States Air Force Medical Corps (Lieutenant to Major) 1948-1956

MEDICAL LICENSURES AND SPECIALTY CERTIFICATION

Licensed: Minnesota, 1948; New York, 1950; California, 1951; Oklahoma, 1956
Diplomate: National Board of Medical Examiners, 1949
American Board of Psychiatry and Neurology (Psychiatry), May 1954

UNIVERSITY APPOINTMENTS

Assistant in Psychiatry, Cornell University Medical College, New York 1950-1952
Professor and Head, Department of Psychiatry, Neurology and Behavioral Sciences, University of Oklahoma School of Medicine, Oklahoma City 1954-1969
Professor of Psychiatry, UCLA School of Medicine 1969--
Chairman, Department of Psychiatry and Biobehavioral Sciences, UCLA School of Medicine, Los Angeles 1969-1989
Director, UCLA Neuropsychiatric Institute 1969-1989

HOSPITAL APPOINTMENTS

Chief, Psychiatry Service, 3700th USAF Hospital, Lackland Air Force Base, San Antonio, Texas 1952-1956
Psychiatrist-in-Chief, University of Oklahoma Hospitals 1954-1969
Consultant in Psychiatry, Oklahoma City Veterans Administration Hospital 1956-1969

HOSPITAL APPOINTMENTS (continued)

Chief, Mental Health Section, Oklahoma Medical Research Foundation, Oklahoma City	1956-1969
Consultant in Psychiatry, United States Air Force Hospital, Force Base, Oklahoma	1956-1966
Consultant in Psychiatry, Palo Alto Veterans Administration Hospital	1966-1967
Psychiatrist-in-Chief, UCLA Medical Center	1969-1989
Attending Staff, UCLA Medical Center and UCLA Neuro-psychiatric Institute	1969--
Consultant in Psychiatry, Veterans Administration Center for Psycho-social Medicine at Brentwood, Los Angeles	1969--
Consultant in Psychiatry, Veterans Administration Hospital, Sepulveda, California	1969--
Attending Staff, Harbor General Hospital, Torrance, California	1971--
Medical Staff, Saint John's Hospital and Medical Center, Santa Monica, California	1979--

HONORS

Alpha Omega Alpha - Honor Medical Society
Oklahoma Nominee, "Ten Most Outstanding Young Men in America," United States Junior Chamber of Commerce (1959)
Medical Ambassador of Good Will, Pan American Medical Association (1963)
Commencement Speaker, University of Oklahoma School of Nursing (1963)
Leadership Award, Association of the University of Oklahoma Medical Faculty (1966)
Sommer Memorial Lecturer, Portland, Oregon (1968)
Certificate of Appreciation, Oklahoma City Council (1969)
Abreu Memorial Address, National Medical Student Research Forum, Student AMA (1969)
Distinguished Professional Service Citation, Oklahoma State Psychological Association (1969)
Certificate of Appreciation, Department of Health, Education and Welfare, United States Public Health Service (1969)
Benjamin Rush Gold Medal Award, American Psychiatric Association (1973)
Certificate of Appreciation "For Outstanding Service," University of Nebraska, School of Alcohol Studies (1973)
Commendation for Exceptional Service, United States Veterans Administration (1974)
First Annual Dr. Gustav Bychowski Memorial Lecture, Mt. Sinai School of Medicine, New York City (1974)
Knight of Mark Twain (1974)

HONORS (continued)

"Louis Jolyon West House" (Facility for Oklahoma Center for Alcohol-Related Studies, University of Oklahoma Medical Center, Oklahoma City, dedicated 1974)
Certificate of Commendation, American Psychiatric Association (1976)
L.I.F.E. Group Award for Outstanding Dedication to Humanity (1977)
Karolinska Institute Medal, Stockholm, Sweden (1978)
The H.B. Williams Memorial Travelling Professor of the Royal Australian and New Zealand College of Psychiatrists (1979)
Consultant Emeritus in Psychiatry, United States Army Medical Research and Development Command (1979)
Honorary Fellow, American Association of Psychoanalytic Physicians, Inc. (1980)
Walter C. Alvarez Memorial Award, The American Medical Writers Association (1982)
Annual Award for Distinguished Professional Service in the Field of Mental Health, The Group Psychotherapy Association of Southern California (1983)
Special Award, Society for Clinical and Experimental Hypnosis, "For Advancing the Role of Hypnosis in Psychiatry and Medicine" (1986)
Vestermark Award, The American Psychiatric Association and the National Institute of Mental Health (1987)
Outstanding Achievement Award, Southern California Psychiatric Society (1988)
Marshal, Hippocratic Oath Ceremony and Medical School Graduation, UCLA (1989)
First Annual Thomas H. Holmes Memorial Lecture, University of Washington (1989)
Philip R.A. May Award, Howard R. Davis Society for Knowledge Utilization and Planned Change (1989)
Leo J. Ryan Award, National Cult Awareness Network (1989)
Founder's Award, Center for Research on Alcohol and Drug Abuse, University of Oklahoma School of Medicine (1989)
Doctor of Humane Letters (hon. caus.), Hebrew Union College (1990)

NATIONAL AND INTERNATIONAL APPOINTMENTS

American Board of Psychiatry and Neurology (Examiner)	1955-1975
Advisory Council, Behavioral Sciences Division, United States Air Force Office of Scientific Research	1956-1958
National Consultant in Psychiatry to the Surgeon General, United States Air Force	1957-1962
Board of Directors, The Institute for Research in Hypnosis	1958-1966
Committee on Hypnosis, Council on Mental Health of the American Medical Association	1959-1962
Professional Advisory Council, National Association for Mental Health	1959-1964

NATIONAL AND INTERNATIONAL APPOINTMENTS (continued)

Consultant, United States Information Agency	1960-1961
Executive Council, Committee on Behavioral Research (Advisory on Disaster Research to the Office of Emergency Planning), National Academy of Sciences - National Research Council	1961-1963
Consultant, United States Air Force Aero-Space Medical Center	1961-1966
Consultant, Peace Corps	1962-1963
Consultant, Bureau of Social Research, Inc.	1965-1968
National Advisory Mental Health Council, United States Public Health Service (National Institute of Mental Health)	1965-1969
Board of Scientific Advisors, Morton Prince Clinic for Hypnotherapy, The Institute for Research in Hypnosis, New York City	1965-1966
White House Conference on Civil Rights: "To Fulfill These Rights," Washington, D.C.	June, 1966
National Advisory Committee on Alcoholism to the Secretary, Department of Health, Education, and Welfare	1966-1968
National Advisory Committee on Psychiatry, Neurology, and Psychology, United States Veterans Administration	1968-1973
Professional Services Subcommittee, 1968-1972 Chairman, 1970-1972	
Anglo-American Conference on Drug-taking in the Younger Generation, Ditchley Foundation, Oxfordshire, England	Spring, 1968
Member, First Public Policy Conference on Psychiatry, Brookings Institution	1970
National Committee for Effective Drug Abuse Legislation	1970-1972
Special Medical Advisory Group, United States Veterans Administration	1970-1974
Review Committee for Drug Abuse Training, National Institute of Mental Health	1972-1973
International Board of Directors, Kittay Scientific Foundation	1972-1977
American Professional Advisory Committee, Jerusalem Mental Health Center, Jerusalem, Israel	1971-1989
American Advisory Board, Jerusalem Mental Health Center, Israel	1972-1989
Residency Review Committee for Psychiatry and Neurology (Council on Medical Education, American Medical Association)	1973-1978
Ad Hoc Committee to Assess Conflicts of Interest Between Organizational Responsibilities of Physicians in Institutional Settings and Their Concern for Welfare of Individual Patients (National Academy of Sciences - National Institute of Medicine)	1973-1989
Israeli Center for Psychobiology, International Advisory Board	1974-1989

NATIONAL AND INTERNATIONAL APPOINTMENTS (continued)

Consultant to the Surgeon General, United States Army Medical Research and Development Command	1974-1977
Member, United States Army Medical Research and Development Advisory Panel	1974-1979
Consultant, V.A. Health Care Committee, National Research Council, Division of Medical Sciences, Assembly of Life Sciences	1975-1976
Member, U.S. Honorary Board, International Association of Medicine and Biology	1979-1989
Member, Academic Psychiatry Consortium, Center for Advanced Study in the Behavioral Sciences	1982-1990
Medical Advisory Committee, The John Douglas French Foundation for Alzheimer's Disease	1983--
Committee on Polar Biomedical Research	1983--
Board of Advisors, American Family Foundation	1982--
Board of Scientific Advisors, Institute of Experimental Psychiatry	1985--
Advisory Board, National Depressive and Manic Depressive Association	1987--
Board of Directors, Caring for Children	1987--

EDITORIAL BOARDS

Advisory Editor, The International Journal of Clinical and Experimental Hypnosis	1958-1966
Advisory Editorial Board, Journal of Nervous and Mental Disease	1961-1966
Consulting Editor, Medical Aspects of Human Sexuality	1967-1984
Editorial Board, Journal of Existential Psychiatry	1970-1971
Editorial Board of Advisors, Psychiatric Annals	1971-1977
Editorial Board, Directions in Psychiatry	1976--
Advisory Editorial Board, Medical Update	1978--
Editorial Board, Psychiatric Books	1979--
Editorial Board, A Critical Guide to Psychiatric Literature	1979--
Advisory Board, Salk Letter to Parents	1982--
Editorial Board, Cultic Studies Journal	1984--
Editorial Board, Violence, Aggression, Terrorism	1985--

REGIONAL AND LOCAL APPOINTMENTS

Dean's Committee, Oklahoma City Veterans Administration Hospital	1954-1969
Research Coordinator, Oklahoma Alcoholism Association	1956-1966
Executive Committee, Mayor's Committee on Human Relations, Oklahoma City	1961-1962

REGIONAL AND LOCAL APPOINTMENTS (continued)

Oklahoma Mental Health Planning Council	1963-1965
Consultant, Oklahoma City Human Relations Council	1963-1969
Board of Directors, Oklahoma City Council on Alcoholism	1964-1969
Governor's Committee on Alcoholism, State of Oklahoma	1964-1966
Professional Advisory Council, Central State Community Mental Health Center, Norman, Oklahoma	1966-1969
Board of Directors, Northeast Oklahoma City Community Mental Health Center	1966-1969
Dean's Committee, Wadsworth Veterans Administration Medical Center	1969-1989
Dean's Committee, Brentwood V.A. Medical Center (Chairman)	1969-1989
Board of Consultants, Rush Research Foundation	1969-1989
Dean's Committee, Sepulveda Veterans Administration Medical Center	1970-1989
Committee of Psychiatry Consultants, Charles R. Drew Postgraduate Medical School, Los Angeles	1970-1989
Advisory Committee, National Center for Drug Information, Research and Education, Mills College, Oakland, California	1970-1974
Mental Health Development Commission, Welfare Planning Council, Los Angeles	1971-1989
Research Advisory Committee, Gateways Hospital, Los Angeles	1971-1989
Professional Advisory Committee, Reiss-Davis Child Study Center	1973-1976
Board of Trustees, UCLA Foundation	1975--
Member, Finance and Administration Committee	1976-1980
Board of Directors, Alcoholism Council of California/NCA	1978--
Member, Central City Public Inebriate Advisory Commission	1979--
Member, Development Panel, California Self-Help Center	1984--
Member, Ad Hoc Committee, California State Support of Psychiatric Research, West Coast College of Biological Psychiatry	1986--
Member, Board of Trustees, Imagination Workshop, Inc.	1986--
Member, Mental Health Committee, Commission on Cults and Missionaries, Jewish Federation Council of Greater Los Angeles	1989--

UCLA COMMITTEES

Board of Directors, University Hospital Chaplaincy Service, Inc. Vice President, 1972	1970-1989
Advisory Committee, Brain Research Institute	1975-1989
Endowment Committee, Brain Research Institute	1976-1989

UCLA COMMITTEES (continued)

Committee to Endow Great Teaching, School of Medicine	1977-1989
University Extension Committee, Academic Senate	1977-1978
Committee for a Public Medical Forum, School of Medicine	1979-1989
School of Medicine Faculty Development Committee	1981-1989
Representative to Intercampus Faculty Advisory Committee for the Hutchins Center for the Study of Democratic Institutions	1981-1989
Advisory Board, UCLA Archive of American Folk Medicine	1984--
Student Affairs Committee, School of Medicine Subcommittee on Substance Abuse	1990--

NATIONAL AND INTERNATIONAL SOCIETY MEMBERSHIPS

Aerospace Medical Association*
Alpha Omega Alpha
American Academy of Clinical Psychiatrists*
American Academy of Political and Social Science*
American Academy of Psychiatry and the Law
American Academy of Psychoanalysis (Scientific Associate)
- Committee on Education and Research, 1960-1965
- Research Committee, 1970-1975

American Association for the Advancement of Science (Fellow)
American Association of Chairmen of Departments of Psychiatry*
- Councilor, 1969
- Secretary-Treasurer, 1970
- Committee on Liaison with the Veterans Administration, 1976
- Ad Hoc Committee to Maintain Liaison with the ABPN, Inc., 1976

American College of Neuropsychopharmacology (Charter Fellow)*
- Credentials Committee, 1973-1976

American College of Psychiatrists (Fellow)*
- Chairman, Program Committee, San Diego, 1970
- Bowis Award Committee, 1982

American Federation for Clinical Research*
American Medical Association
American Orthopsychiatric Association*
American Polar Society*
American Psychiatric Association (Life Fellow)
- Committee on Research, 1957-1960
- Committee on Program, 1962-1968
- Task Force on Drug Abuse in Youth, 1967-1969
- Board of Trustees, 1968-1971
- Council on Research and Development, 1972-1977
  - Chairman, 1975-1977
- Reference Committee, 1975-1977
- Foundations Fund Prize Board of Research, 1981-1985
- Task Force on Quality of Psychiatry Residency Training, 1983--
- Task Force on Treatment of Psychiatric Disorders, 1986--

NATIONAL AND INTERNATIONAL SOCIETY MEMBERSHIPS (continued)

American Psychiatric Association (continued)
Task Force on Terrorism, Chairman, 1987-1988
American Psychological Association
American Psychopathological Association
American Psychosomatic Society
American Public Health Association
American Sociological Association*
Antarctican Society*
Association for Academic Psychiatry*
Association for the Psychophysiological Study of Sleep*
Member, Organizing Committee, First International Conference, Bruges, Belgium, June, 1971
Association of American Medical Colleges*
Association for Research in Nervous and Mental Diseases
National Academy of Religion and Mental Health (Founding Member)*
National Committee Against Mental Illness (Sponsoring Member)
International Society for Advancement of Humanistic Studies in Gynecology (Honorary Member)
New York Academy of Sciences
Pan American Medical Association*
President, Section on Clinical Hypnosis, 1962-1964
Council Member and Diplomate, Section on Psychiatry, 1962
Board of Advisory Vice Presidents, 1962
North American Co-Chairman, Section on Clinical Hypnosis, 1966-1968
Pavlovian Society
Second Vice President, 1973
First Vice President, 1974
President, 1975
Sigma Xi
Society of Behavioral Medicine (Fellow)
Society of Biological Psychiatry (Senior Member)
Public Relations Committee, 1975
Society for Clinical and Experimental Hypnosis*
Society for General Systems Research*
Society of Medical Consultants to the Armed Forces*
Society for Psychophysiological Research*
Southern Professors of Psychiatry*
President, 1963
World Medical Association*

*Inactive or prior member

REGIONAL AND LOCAL SOCIETY MEMBERSHIPS

Central Neuropsychiatric Association	1959-1969
Dallas Southern Clinical Society (Honorary Member)	1962
Mid-Continent Psychiatric Association	1956-1969
Councilor, 1960-1962	
North Pacific Society of Neurology and Psychiatry	
(Honorary Fellow)	1962
Oklahoma City Clinical Society	1956-1969
Oklahoma County Medical Society	1956-1969
Medical Center Liaison Committee, 1959-1962	
Oklahoma District Branch, American Psychiatric Association	
(Fellow)	1956-1969
Committee on Medical Education, 1964-1969	
Oklahoma Psychiatric Association	1956-1969
Oklahoma State Medical Association	1956-1969
Safety Committee, 1962-1964	
Mental Health Committee, 1964-1966	
Southern California District Branch, American Psychiatric Association (Fellow)	1969--
Southern California Society for Adolescent Psychiatry	
(Honorary Member)	1970
California State Medical Association	1971--
Los Angeles County Medical Society	1971--
Southern California Psychiatric Society	1974--
California Society for the Treatment of Alcoholism and other	
Drug Dependencies	1974--
Mental Health Association of Los Angeles County	1976--
Southern California Society for Clinical Hypnosis	
(Honorary Member)	1986--

BIOGRAPHICAL LISTINGS

American Men and Women of Science
Biographical Directory, American Psychiatric Association
Dictionary of International Biography
Directory of Medical Specialists
Who's Who in America
Who's Who in American Science
World Leaders in Science
World Who's Who in Science
Who's Who in the West
Who's Who in Frontiers of Science and Technology

RONALD YUKIO NAKASONE
Graduate Theological Union
Institute of Buddhist Studies
1900 Addison Street
Berkeley, CA 94704

PROFESSIONAL EXPERIENCE:

Core Doctoral Faculty, Graduate Theological Union/Institute of Buddhist Studies, Berkeley, CA, July 1987 to present

Responsibilities: teaching Mahayana, Chinese and Japanese Buddhist philosophy, Buddhist ethics, Buddhist and Japanese aesthetics, homiletics, practical ministry; research and publications; thesis advising

Dean for Student Affairs, Institute of Buddhist Studies, 1987-present

Responsibilities: Student advising and counselling, Buddhist services and ritual, planning special programs and lectures; curator of art exhibits

Minister, San Jose Buddhist Church, May 1983 to August 1986

Responsibilities: ritual, sermons, temple administration, counselling; visitations etc.

Japanese Analyst with the U.S. Army Publication Review Unit, Silver Spring, MD, June 1981 - April 1983.

Reviewed, translated and analyzed political, technical and economic publications

Lecturer, Dept. of East Asian Languages, University of Hawaii, Jan. 1980 - June 1981

Responsibilities: teach first and second year Japanese (Jordan I and II); teach calligraphy on a non-credit basis

Instructor, Japanese Conversation, Adult Education, Pearl City High School (part-time), Sept. 1979 - Dec. 1979).

Translator/Interpreter, Oscar Mayer Co., Madison, WI, 1977 (intermittently). Interpreting and translating of Japanese to English and English to Japanese.

Teaching English as a Second Language, Kyoto, Japan, 1969-75.

Graphic Artist, Planning Dept., City & County of Honolulu, Hawaii, 1968-69.

Prepared visual aids for public hearings; designed and coordinated the publication of government publications; researched and requisitioned visual aid equipment, etc.

Illustrator, University of Hawaii, Honolulu, Hawaii, 1967-68.

Developed visual aid materials for Japanese language textbook.

CURRENT RESEARCH

Ethics: "Decisionmaking in context of Buddhist notions of interdependence and karma, and its application in Japanese medicine," part of an attempt to develop a theory of Buddhist approach to bioethics

"Illness and Holiness: A Study of AIDS in an American Zen Community." To be presented at the Medicine and Its Stories Conference, May 1992

Buddhist Studies:

An interpretative study of the Awakening of Faith based on Chinese and Japanese sources

EDUCATION

University of Wisconsin-Madison, Ph.D., Buddhist Studies, 1980 (Ph.D. Minor in Philosophy)
Ryukoku University, Kyoto, Japan, M.A., Buddhist Studies, 1975
University of Hawaii-Manoa, M.A., Oriental Art History, 1967
University of Hawaii-Manoa, B.A., Philosophy, 1965

Ordained Jodoshinshu Honganji Sect Buddhist Priest in 1983

PROFESSIONAL COMMITTEES

Scholarship Committee, Graduate Theological Union, 1991-92
Internal Review Board, Science Application International Cooperation, Menlo Park, CA. Internal review of cognitive science research projects funded by U.S. Government involving human subjects. 1991-present.
UC-Berkeley Committee for the Protection of Human Subjects, 1988-1991; internal review of research protocols involving human subjects
Steering Committee for the Northern California Interfaith Network, 1989-present; sponsor programs of common concern

ACADEMIC AWARDS:

Luce Grant, Graduate Theological Union, 1991-92.
Visiting Professor, Ryukoku University, 1990.
Visiting Scholar, Center for the Study of World Religions, Harvard University, 1986-87.
Fulbright-Hays Doctoral Dissertation Research Abroad Fellowship, 1978-79.
Visiting Scholar, Institute of Buddhist Culture, Ryukoku University, Kyoto, Japan, 1978-79.
Hawaii Tendai Fellowship, 1976 and 1977 academic years.

PERSONAL DATA:

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