AN OCCUPATIONAL INDEX FOR THE NUCLEAR ENERGY FIELD

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CHAPTER I

INTRODUCTION

Statement of the Problem

The only consistent characteristic of national manpower planning is change. Effective planning and management of programs in the private and public sectors and industries and educational institutions, however, require continuous information upon which to base decisions. The accuracy, reliability, and acceptability of this information will afford a basis for decision making. The emphasis placed on national manpower planning in the atomic energy field fluctuates but the need for the information obtained from these efforts remains constant for educational, industrial, and governmental planners. In order to fill the void created by the lack of information during periods of delinquent information and to serve as a check during periods of adequate information, an indicator of manpower requirements for the nuclear energy field is necessary. This indicator must be easily developed and maintained and independent of approvals, surveys, and politics.

Need for the Study

In 1944, an elite group of scientists and engineers working in top secrecy at several locations across the country, each a specialist in his own area, combined their efforts, knowledge, and capabilities in a project which was to affect the world in a manner which was to be with humanity for all time. On August 6, 1945, the sum total of this effort mushroomed above the Japanese city of Hiroshima; thus, the Nuclear Age exploded upon us.

In its 28 years of existence, the U. S. Atomic Energy Commission's (AEC) research and development efforts have brought the peaceful uses of atomic energy to all our lives. Peaceful uses of atomic energy have developed into a multi-billion dollar business which is still in its infancy.

As in all emerging industries dependent on new technologies, the development of competent manpower is essential to the progress of that industry. In the atomic energy field, however, competent manpower is even more essential because of the unique safety considerations in all aspects of nuclear energy. The atomic energy field tends to utilize all aspects of scientific, engineering, and technician manpower. Manpower in this field, however, require a core of nuclear knowledge, to a greater or lesser degree, in order to perform their duties. Until 1965 all cross training in the nuclear area was done "in-house" by the AEC, its contractors, or private industry involved in atomic energy activities. It is estimated that through 1965, all nuclear engineers in the world were crosstrained at the AEC's Oak Ridge National Laboratory at Oak Ridge, Tennessee, or Argonne National Laboratory at Argonne, Illinois.

In 1965, a decision was made in the AEC to transfer the responsibility of education and training from the Commission mission to colleges and universities. This was the mission of the Division of

Nuclear Education and Training (DNET) established March 1, 1962. The legal basis for this was an interpretation of the Atomic Energy Act of 1954 to the effect that a viable nuclear industry necessitated adequately trained manpower. In order to transfer the technical expertise of the Commission's laboratory training to colleges and universities, several mechanisms were utilized: faculty institutes were established to train instructors; equipment and material loans and grants were utilized to aid educational institutions in setting up programs unique to nuclear efforts; fellowships and traineeships were established to encourage students into nuclear programs at the graduate level, and to assist the educational institution in the financial burden of expensive special-purpose programs. The main areas of emphasis were nuclear engineering and radiation protection (health physics). Traditional engineering programs with a core of nuclear subjects, commonly called nuclear options, were also supported.

Education and training was a line item in the AEC budget requiring congressional approval and the release of the allocated funds by the Office of Management and Budget (OMB). Each year the budget for the Division of Nuclear Education and Training went before Congress. Two questions were generally asked: What are the results of the money that has been spent on programs, and what are the needs now and in the future for education and training in the atomic energy field? These were the very questions that the Division of Nuclear Education and Training was asking itself.

In January 1967, a task force of the Joint Committee on Atomic Energy stated that the statistical data furnished by the Division of

Labor Relations, AEC, were not adequate to plan educational programs. Subsequently, the responsibility for manpower data were removed from that Division and placed in DNET along with all training activities of LABR except the responsibility of craft level training. In 1967, the Manpower and Appraisal Branch of the Division of Nuclear Education and Training was established to analyze primary and secondary sources of manpower data and to develop and implement appraisal techniques for the Division's education and training programs.

It was found that most secondary sources of data were either too outdated for planning purposes and/or not in the detail necessary; for example, they did not specify nuclear areas.

The primary objective of the Manpower and Appraisal Branch, DNET, in the data area was to construct continuing supply and demand information for scientific, engineering and technician manpower by utilizing secondary information when available and applicable, and by developing primary information gathering systems when necessary. It was found that many schools which had received support to train nuclear engineers and health physicists were not reported in graduate data collected by the Department of Health, Education, and Welfare. In these instances it was found that the universities were not granting a unique degree in these areas but offering nuclear or health physics related options in traditional degree programs.

Two surveys were initiated to eliminate this data gap: the Nuclear Engineering Enrollment and Degree Survey (WASH 1228) and the Radiation Protection Enrollment and Degree Survey (WASH 1229). The first survey considered all schools either offering a degree in nuclear engineering or a nuclear option in a traditional degree program. The latter survey solicited enrollment and degree information on programs which would, upon completion, enable the graduate to function as a health physicist.

By 1972, there was a growing formal interest in the technician area. It was decided that a nationwide technician supply and demand information system would be initiated to monitor this situation--the format of which was developed by a joint effort of the Southern Interstate Nuclear Board (SINB), Oklahoma State University, and the Division of Nuclear Education and Training, AEC. A five-year OMB approval was granted for this survey. The limited staff and resources of the Manpower and Appraisal Branch dictated the implementation of a four-year plan to accomplish the complete technician information system. A recycle of the survey in the Southern Interstate Nuclear Board region was slated for early 1973. Concurrent with this effort the Western Interstate Nuclear Board (WINB) was to develop, under contract to the AEC, the survey universe for their region. In 1974, a Cycle I surveying effort would begin in the WINB region concurrent with the Cycle III SINB effort, the survey universe for the region served by the Midwest Nuclear Compact would be developed and, if funds permitted, the survey universe for the northeastern region of the United States would commence. These efforts would have permitted a total national technician information system by 1976.

A survey of employment in the atomic energy field was conducted on an annual basis for the AEC by the Bureau of Labor Statistics (BLS) in the Department of Labor, under supervision of the Division of Labor Relations, AEC. This survey thoroughly covered the spectrum of scientific engineering and technician occupations. The basis for the survey universe was the Nuclear Buyers Guide published by the American Nuclear Society. This source is perhaps the best single source of industrial participants in the atomic energy field; however, in 1973 several radioisotope manufacturers were found not to be included and, in 1975 the survey respondents in the WINB and SINB regions were used to augment this source. The AEC/BLS survey did not cover academic, health care, federal, state and local governments. The survey asked the organizations contacted to report those individuals they reported which required a nuclear background in order to perform their duties. A brief surveying effort by the Manpower Assessment Branch (MAB) concluded that approximately 50% of those reported would require a specific nuclear background. This survey was used by DNET as a basis for survey projections until that time when a more comprehensive technique could be developed and utilized.

On June 30, 1973, the Division of Nuclear Education and Training was abolished and its function assigned to other divisions within the AEC. The determination of manpower supply and demand information was reassigned to the Division of Labor Relations which had previously demonstrated its ability to manage the development of meaningful manpower information. The appraisal function for educational programs went with their respective programs. The concept of a timely manpower information system was not adopted by the Division of Labor Relations. The SINB technician survey results were released in January 1975, two years after the survey was initiated. The WINB survey was initiated January 1975, one year after it was planned. No effort was made to recycle the SINB technician regional survey or to develop a survey universe for the other regions of the country. As of March 1975, there were no plans in LABR to continue the nuclear related technician survey effort. The Nuclear Engineering Enrollment and Degree Survey, and the Radiation Protection Enrollment and Degree Survey were recycled in 1974--the results of which were released in May 1975, which caused the value of the data to be greatly diminished.

The Energy Reorganization Act of 1974 created the Energy Research and Development Administration, with the AEC forming the nucleus of the staff. In August 1975, the Office of University and Manpower Development Programs was established which assumed the responsibility for the assessment of manpower needs as mandated by Congress in the 1974 Act. The Manpower Assessment Office was formally established early in 1976 upon the hiring of a branch chief. The strong pressure for manpower information in all energy areas and the political contest in the nuclear area mandated attention be directed toward the nonnuclear area. With the appointment of a division director in July 1976, the division was retitled Office of University Programs; however, this did not affect the efforts of the Manpower Assessment Office. The nuclear manpower assessment efforts are limited to the continuation of previous efforts with no new efforts planned, thus leaving a void in required planning information still in existence.

The future of timely nuclear related manpower information is doubtful. The need for this detailed information is increasing as our Nation's efforts are directed toward energy. The Carter Administration's position on nuclear energy will not help when specialized energy manpower needs studies are initiated. Experts agree that nuclear energy will play a major role in this Nation's goal of energy self-sufficiency. If policy dictates a continuing nuclear Manpower Information System(s), it would take at least three to five years to recreate the systems now being abandoned. The critical need now and in the future will be for information in greater detail. This information is critical for government, industry, and educational planning and policy decisions. Although the political climate for information systems in this area fluctuates, the need for the information provided by these systems continuously increases. It is clear that at least an indicator is necessary that is independent of politics, that could assist planners during periods of delinquent information, and that could serve as a check during periods of adequate information.

Purpose of the Study

The overall purpose of this study is to develop an occupational index for the atomic energy field which will provide a measure of the intensity of employer's need through the spectrum of technical employment--professionals, subprofessionals, crafts and trades--which is easily reproducible with a minimum of time and resources.

Hypotheses

The value of an occupational index for the nuclear energy field will be investigated as it relates to total employment and to discrete occupational employment by testing the following null hypotheses:

1. H_o = An aggregate occupational index does not correlate with actual total employment in the nuclear energy field.
2. H_o = A disaggregated occupational index (1 - n) does not correlate with actual employment by occupation (1 - n) in the nuclear energy field.

Constraints of the Study

The occupational index to be developed in this study is dependent on employers in the atomic energy field advertising in printed media for employees. If the employers' degree of advertisement in the printed media does not correlate with their needs, then the index will not reflect their degree of need--resulting in an inaccurate indicator.

This study will attempt to stratify the Occupational Index by occupational category and by occupation. In order to do this, advertisements must be grouped by occupation. If employers are not homogeneous in their labeling of needs, the occupational data would tend not to represent the occupations. An error in assignment of an advertisement to an occupation would also lead to a faulty indicator. If employers tend not to advertise in the printed media, the value of the index would be limited.

CHAPTER II

REVIEW OF THE LITERATURE

The acquisition and application of knowledge has continually elevated the status of man's existence. The rate of increase continues at an astonishing pace. This has contributed to a condition of "overchoice" which will lead to Future Shock according to Alvin Toffler (17).

Few would deny the rapid accumulation of knowledge by man. I hold however, that knowledge in the area of prediction has not increased as rapidly as in other areas of knowledge even though prediction has always been of the utmost interest to man. The results of our most complex prediction techniques are not distinctly superior to those of the ancient soothsayer; whereas the results of the modern chemist are vastly superior to those of the alchemist.

Our ability to predict greatly limits our performance, whether our endeavors be investing in the stock market or manpower planning. The importance of developing methods of predicting is imperative.

This review of the literature investigates prediction techniques which are atypical when compared to traditional manpower planning techniques which utilize manpower utilization data and project future needs (extrapolation of trends, modeling, employer's best estimates of needs, etc.).

Need for the Study

In "Economics of Information," George J. Stigler (16) of the University of Chicago explores the benefit (value) of information from the point of view of both buyer and seller of economic goods. Information (specifically price) about a product may be considered a good in itself in that its cost and benefits are definable in economic terms. It is held that regardless of the commonality of a specific product (good), its price at any given point in time will be distributed through a range of prices from low to high because of a lack of knowledge (information) on the part of the seller and buyer as to which each is willing to agree. In order for either the buyer or seller to determine the most favorable price, it is necessary for each to survey their respective markets. Therefore, price dispersion (the same goods selling for different prices) is a result of a lack of adequate information.

Analyses by this researcher of Dr. Stigler's price dispersion characteristics for anthracite coal, new cars, used cars, and products with limited markets (e.g., extremely expensive cars and diamond studded platinum toothpicks in solid gold presentation cases) concluded:

1. The larger the fraction of the buyer's expenditures on the commodity, the greater the savings from search and hence the greater the amount of search.

2. The larger the fraction of repetitive (experienced) buyers in the market the greater the effective amount of search (with positive correlation of successive prices).

3. The larger the fraction of repetitive sellers, the higher the correlation between successive prices, and hence, by condition 2, above, the larger the amount of accummulated search.

4. The cost of search will be larger, the larger the geographical size of the market.

These conclusions were statistically and theoretically supported by the author.

It was suggested that advertising provides the most advantageous source of information to the buyers by first identifying sources of the desired product, and secondly by furnishing price information in many instances. The nature of advertising limits the seller to providing brief descriptive information of interest to the buyer because of the cost of advertising, itself, and affords an acceptably priced source of information to the buyer. Advertising prices, therefore, tend to (1) provide a large search of information, and (2) reduce the price dispersion in most products.

It should be noted that all analyses were based on the assumption of equal products; discounting quality factors, which are difficult for the economists to quantify.

Stigler (16, p. 216) concludes that knowledge or information on products and their markets are essential in the decision-making process for both buyer and seller. The gathering (or search) of this information can be accurately determined as to cost and benefit of the effort, but not precisely. The area of product knowledge and information has been slighted by economists. The author equates this with ignorance but wisely states, "Ignorance is like subzero weather: by a sufficient expenditure its effects upon people can be kept within tolerable or even comfortable bounds, but it would be wholly uneconomic entirely to eliminate all its efforts" (16, p. 224).

Albert Rees (14) identified two basic information networks which provide non-labor statistical information about the labor market in "Labor Economics: Effects of More Knowledge Information Networks in Labor Markets." The formal networks consist of (1) state employment services, (2) private fee-sharing employment agencies, (3) newspaper advertisements, (4) union hiring halls, and (5) school or college placement bureaus. Informal information networks consist of (1) referrals from employees and other employers, (2) walk-ins (open or hiring at the gate), and (3) miscellaneous sources.

According to a limited labor market study in the Chicago area, approximately 50% of all white collar occupations and 80% of all blue collar occupations hired are the result of information sources. The author submits that the traditional views held by economics about the labor market, although complex, are inaccurate and simplistic in that they neglect important parameters of the labor market--mainly those associated with personal value judgments and the necessity for the employer to narrow the number of prospective employees before extensive screening processes are initiated. In addition to this, employers have been dissatisfied with the formal information networks (state employment agencies) because of their tendency to refer individuals on the basis of financial need rather than ability, and the incompleteness of an operational national network. When formal networks were utilized, private-for-profit employment agencies led public employment services by a margin 10-to-1 as measured by the satisfaction of users according to studies of Illinois and Indiana users.

In summary, Rees concludes that informal labor market information networks have been neglected and are far more important than is currently recognized. The crucial characteristic of an information network is not its size, but the accuracy and reliability of its information. In this regard, the experienced employment counselors are a good judge of potential employees and their records are indispensable.

George Stigler (15) emphasizes the magnitude of labor market information as he notes that the labor market is an entity of enormous dimension and, in most instances, escapes the limits of one's comprehension. For the young, unskilled and semi-skilled individuals entering the labor market, the number of potential employers is in the millions. The young Ph.D. economist may select employment from a field of several thousand employers; with age and experience, the number of potential employers seldom falls below a thousand.

The task of identifying even a small fraction of the universe of potential employers, all of the characteristics and factors of each particular job in every given organization (such as wage rates, stability of employment, etc.), much less keeping this information up-to-date is an impossible task for an individual. It is, nevertheless, critical for one's decision in selecting an employer. For illustration, the article expands on one factor: wage rates.

Wage rates vary from a particular job across the range of potential employers because of imperfect knowledge about the labor market. This is known as "pure" dispersion of wages. The coefficient of variation of occupations other than engineers is conservatively estimated to range from 5-10%. Dispersion is also generated by differences in quality of workers and different rates of increases in wages and supply and demand of a particular skill. It is, therefore, advantageous for an individual to search the labor market for information before accepting employment. The extent of the search equals the expected return, and this directly corresponds to the cost of the search. Gains from a search are larger, the longer the perspective period of employment.

It was noted that the coefficient of variation increases with age for engineers. The reasons are as follow:

1. The dispersion of earnings of engineers increases with age because younger engineers make more extensive search than older engineers.

2. The difference in ability of engineers becomes better known as they become older (and have worked longer for a given employer).

3. The older engineers have made different amounts of on-the-job investment in training, which serve to increase their dispersion of abilities (15, p. 100).

The problems employers encounter when searching for employees are even more massive than when individuals are seeking information of potential employers. For instance, in addition to identification of potential employees, there are personnel processing, initial hiring, and training costs to consider. Moreover, "when an employer has numerous employees, the probability that a given employer needs additional workers is much greater than the probability that a given worker will accept a job offer" (15, p. 102).

In summary, labor market information is essential, but little has been done in this area. It, therefore, offers a prime area for future research.

These two authors have clearly identified the magnitude of obtaining labor market information, the value of this information, and the feasibility of this information over traditional manpower planning techniques. The first chapter of this study traced the manpower planning efforts of the U. S. Atomic Energy Commission and succeeding agencies for manpower in the nuclear energy field. It also questioned the practicality of a comprehensive manpower information system for this area because of politics, attitudes, and changing management policies and emphases.

Indicators as Predictors

With the feasibility of a comprehensive manpower information system for the nuclear energy field in question and with the sheer magnitude of the acquisition of this labor market information known, alternative techniques for manpower planning are considered.

Max Gunther (8) reports eight methods that have been employed for forecasting the stock market. These methods are : (1) the hemline indicator, (2) the heel hypothesis, (3) the drinking-couple count, (4) the sunspot theory, (5) the aspirin formula, (6) the yellowness rule, (7) the great lake watch, and (8) the best-guess theorem.

The "hemline indicator" was established in 1967 by Ralph Rotnem when he discovered that when the Dow-Jones industrial average for a 70-year period was superimposed on a plot of the height of the hemline of women's skirts for the same 70-year period that the correlation was near perfect. Rotnem (cited in 8, p. 116) claims that, "It's the only forecasting tool that's right 100 percent of the time."

Similar in nature to the previous indicator is "the heel hypothesis," developed by a Wall Street banker which employs the fashionable height of the shoe heel as an indicator of the market (cited in 8, p. 116). This has also been an accurate indicator of the stock market.

Based on analysis of behavior by a psychiatry professor,

> People enjoy sex more and want it more when they're feeling happy. In generally buoyant, optimistic times, women tend to dress in more revealing or exaggerated styles to catch the male eye. In gloomier times, they may dress in a more utilitarian manner. So these indexes of women's clothing styles might not be utter nonsense. Many women are highly sensitive to the emotional ambience around them. If their changing dress styles show they are feeling more buoyant, that may be a clue to emotional factors that will affect the stock market (cited in 8, p. 117).

The "drinking-couple count" notes the number of drinking couples in cocktail lounges. The theory states: "In times of general discontent, men tend to drink alone or with other men. When optimism is rising, they grow sexier, partly because women are inviting such conduct" (cited in 8, p. 118). The theory has not been supported, perhaps because of a lack of sufficient observations and corresponding market activity to date.

David Williams (cited in 8, p. 118), founder of the "sunspot theory," holds that the fluctuations in the sun's radiation affect electrical impulses which control the human brain and nervous system resulting in an unusually high quota of judgment errors. The fluctuation in the sun's radiation may be measured by a complex technique of noting sunspots. The theory's validity is based upon Mr. Williams' own success in the stock market from 1958 until 1973 during which time he made 279 purchases; 275 produced gains totaling $169,953 and 4 produced losses totaling $312.

The "aspirin formula" holds that the volume of aspirin sales is an indicator of the following year business climate. The yearly trend (up or down) of aspirin sales is simply noted. Aspirin sales accurately predicted the viability of the stock market (as measured by the

Standard & Poor's Index) every year from 1965 until 1972 except 1967 or 87.5% of the time (cited in 8, p. 118).

The "yellowness rule" was developed by Faber Berren, a New York color consultant, who noted that the popularity of yellow increases just prior to a major rise in the market. Yellow is often a favorite color of people in mental institutions. It is associated with violent, raving lunacy. "It is believed to signal wild speculation in the stock market" (cited in 8, p. 118). Its validity is not well documented to date.

The "great lake watch theory" contends that rising lake levels indicate that ample rainfall means good harvest for farmers. It takes four years for agricultural effects to influence industry and to be reflected in the stock market. The Great Lakes were low in 1925, 1935, and 1964. The market was, in fact, in trouble in 1929, 1939, and 1969 as was predicted by this indicator.

The "best-guess theorem" is the product of investors' intelligence in Larchmont, New York. According to the theory, whatever forecasting technique is used it is wrong most of the time. Therefore, do the opposite. Indications are that the theory is more correct than could be expected by chance.

The aforementioned indicators, as noted by Gunther (8, p. 116), "have little or no basis in common sense. All that can be said about them is that they seem to work."

Help-Wanted Indexes as Manpower Indicators

"The Help-Wanted Index: Technical Description and Behavioral Trends" by Noreen L. Preston (12), indicates that the volume of help-wanted advertising has been used as a measure of labor/market activity and economic conditions since its conception in the 1920's by William A. Berridge, an economist with Metropolitan Life Insurance Company. In the early 1960's the Conference Board assumed responsibility for this index and has concurrently developed a similar index. Methodologies of both indexes were merged to capture the best attributes of both indexes in 1964 and "to improve the accuracy and usefulness of the index as an economic indicator, and in particular as a measure of the supply-demand conditions in the labor market" (12, p. 2).

The Help-Wanted Index is constructed as follows: Fifty-one (51) individual indexes are constructed for cities from the Conference Board's monthly survey. Data for each city are adjusted by separate standard-day factors (which account for the number of weekdays and Sundays in each particular month) and individual seasonal factors for the cities (to reflect the usual seasonal variations in hiring and advertising within each city). The fully adjusted data, divided by the adjusted number of ads for the 1967 base year, yield the individual city indexes. The indexes are then multiplied by appropriate weights which reflect the nonagricultural employment in the respective cities. Based on the employment data, each city has a particular weight within its region, as well as within the Nation as a whole. The regional and national indexes are calculated by summing the weighted city indexes.

"Technical Paper Number 16, National Industrial Conference Board," notes several finer points about the index (9). The index draws only from the ads appearing in the classified section of selected newspapers. The index is based on the numeration of ads placed, not on the number of jobs advertised, and is not weighted for the effect of multi-job ads listed in a single ad. As a supply-demand indicator, it is plotted against Department of Labor unemployment statistics rather than actual employment levels. It traditionally leads maximums of low unemployment but does not lead peaks of high unemployment, although the direction of the advertising index does forewarn of the coming high unemployment condition. Its major advantage is its early availability of information as compared with other labor statistics used to gauge economic and employment conditions.

Deutch, Shea, and Evans (5), an advertising firm in New York City, publishes a monthly "Scientists and Engineers Index." This index notes the magnitude of advertising for these occupations. It is constructed by noting the number of ads for these occupations in selected periodic publications and weighting them according to their size which reflects cost to the purchaser of the ad.

It was believed by some at the 1975 Engineering Manpower Conference that this index was a leading indicator of actual hiring of individuals in these occupations (6). Telephone interviews with Betty Vetter (18), Director of Scientific Manpower Commission, John Alden (1), Director of Engineering Manpower Commission, and Frank Coss (5) of Deutch, Shea, and Evans (who is responsible for the index) indicate that the index only measures the amount of advertisement for these occupations. However, a lot of people seem to attach other values to it. Mr. Alden implied that the index reflects the volume of defense spending, especially for aerospace, but had no documentation to support this premise.

Dr. Derek De Sola Price (13), History of Science Department, Yale University, has been analyzing the Deutch, Shea, and Evans' index.

Although analysis is not complete, preliminary findings indicate that the index leads actual hiring by about one to one and a half months. Dr. Price and this researcher have agreed to collaborate on our individual efforts.

In summary, advertising indexes have been developed for the total employment effort (Conference Board Help-Wanted Index) and for occupational areas (Deutch, Shea & Evans' Scientists and Engineers Index) but have not been developed for specific occupations. Indicators of this nature do tend to lead actual hiring and may serve as indicators of coming unemployment. To date, indicators of this nature have not been gauged against actual employment levels. Analysis of help-wanted advertising indexes has been limited thus far to logical deduction explaining the patterns as they have developed. Dr. Price has gone well beyond this in his analysis, but his findings are not yet complete.

CHAPTER III

METHODOLOGY

Introduction

The purpose of this chapter is to describe the design of the study methods used in collecting and analyzing the data. This information is set forth in the following sections.

Definitions

The development of an occupational index for the nuclear energy field necessitates an understanding of the parameters within which it is developed. The following definitions clarify the broad-gauge parameters for the purposes of this study.

The nuclear energy field refers to those activities defined to be nuclear in nature according to criteria set for the survey of employment in Nuclear Energy Related Activities conducted by the Bureau of Labor Statistics, U.S. Department of Labor for the Manpower Assessment Office, U.S. Department of Energy. A list of these activities appear in Appendix A.

An Occupational Index is a help-wanted index structured in such a manner as to enable identification of the volume of ads for an occupational area within the total volume of ads covered by the particular index.

An Occupational Index for the Nuclear Energy Field is a help-wanted index which measures the volume of ads for occupations in the nuclear energy field in such a manner that discrete occupations may be disaggregated from the total volume of advertisement for employment in the nuclear energy area.

Occupations in this study refer only to scientific, engineering, and technical occupations in the nuclear energy field as identified in the survey of Employment in Nuclear Energy Related Activities. A listing of these occupations appears in Appendix B.

Assumptions

A survey of employment in the nuclear energy field has been conducted annually for the U. S. Department of Energy and its preceding agencies since 1960 by the Bureau of Labor Statistics, U. S. Department of Labor. Total employment for each survey conducted is available from 1960 to present; however, detailed, discrete occupational employment data is available only from 1968 through 1975. It is assumed that advertisement practices during this period do not differ significantly from other periods.

The data from the aforementioned survey indicates that approximately fifty percent of the employment in the nuclear energy field is in Government-Owned-Contracted-Operated (GOCO) facilities. It is assumed that their advertisement practices for employee recruitment will not differ significantly from the non-GOCO employers in the field because of the close working relationship, exchange of personnel, and regulatory relationships that the U. S. Atomic Energy Commission and the nuclear industry had during the development of the United States' nuclear capabilities.

The survey of employment in the nuclear energy field does not cover federal employees, state employees, or university employees. It is assumed that fluctuation in advertising practices and hiring among these establishments will not affect the general trend of the employment data or overall hiring practices.

Want-ads from periodic publications will be used to construct the occupational index. It is assumed that these industry specific publication want-ads will be representative of the volume of ads for the specified occupations, although newspaper advertising is used extensively for regional focus according to Robert Franklin (7), Division of Personnel, DOE.

Selection of the Subjects

Approximately 50 percent of the scientists, engineers, and technicians employed in the nuclear energy field have been employed in GOCO facilities. These facilities are under the direct management of Department of Energy Field Offices. There are eight Department of Energy Field Offices which report to the Office of the Assistant Administrator for Field Operation, Department of Energy Headquarters in Washington, D.C. Close regulatory arrangements, contractural agreements, and exchange of personnel (both administrative and technical) which has accompanied the development of the nuclear energy industry in the United States indicate a high probability of agreement between recruitment experiences in the national laboratories and the rest of the nuclear industry.

Mr. David Israel, Assistant Administrator for Field Operations DOE, assisted in the selection of eight national laboratories which have been historically involved in nuclear development. These national laboratories were selected because of their strong role in the nuclear industry and the personal endorsement of the information survey request by the Assistant Administrator for Field Operations. This endorsement enhances the probability of high return rates and quality information.

Collection of the Data

Two types of data were collected from the eight national laboratories: information as to advertising practices at the national laboratories, and a listing of all journals, magazines, and newspapers in which these laboratories advertised for scientists, engineers and technicians. Advertising practices were requested to gain insight on the "value" placed on advertising by employers when recruiting scientific, engineering, and technical personnel. The higher the actual or perceived value of a particular recruitment technique, the more reflective the quantification of that technique should be as an indicator of manpower demand. The listing of journals and magazines was necessary so that their advertisements for employment (help-wanted ads) could be noted. Although newspaper advertisement is not a concern in this study, Robert Franklin (7), Division of Personnel, DOE, and Ms. June Chewning (4), Manpower Assessment Office, DOE, encouraged its inclusion because of the absence of this information.

A questionnaire was developed to obtain the above information. The questionnaire was reviewed by Mr. David Israel, Mr. Robert Franklin, and Ms. June Chewning of the Department of Energy, and by Mr. Lawrence Smith, Director of Personnel, MITRE Corporation. Mr. Israel requested that Mr. Smith review the questionnaire in order to obtain an opinion outside the Department of Energy. The resulting survey instrument, incorporating recommendations from aforementioned reviewers, appears in Appendix C. A cover letter signed by Mr. Israel (Appendix D), accompanied by a request for endorsement by the author (Appendix E), and a copy of the survey instrument was sent to the Directors of the eight selected national laboratories. The response rate was 100 percent.

Analysis of the Data

Publications noted by the national laboratories were classified according to frequency of use among the laboratories. This was done for both journals and magazines, as well as for newspapers, and appears in Appendices F and G, respectively. The geographical distribution of newspapers noted by the national laboratories is shown in Figure 1. The 18 most frequently used journals and magazines for the years 1966 through 1977 were acquired through the DOE Headquarters library with the assistance of Robert F. Kimberlin, III, Chief, 20 Massachusetts Avenue, N.W., Washington, D. C. The overwhelming volume of material, the nonavailability of several of the identified journals, and the library policy to keep only the most popular journals for a three-year period and to microfilm only the most sought after journals in conjunction with the microfilming practice of some contractors to only

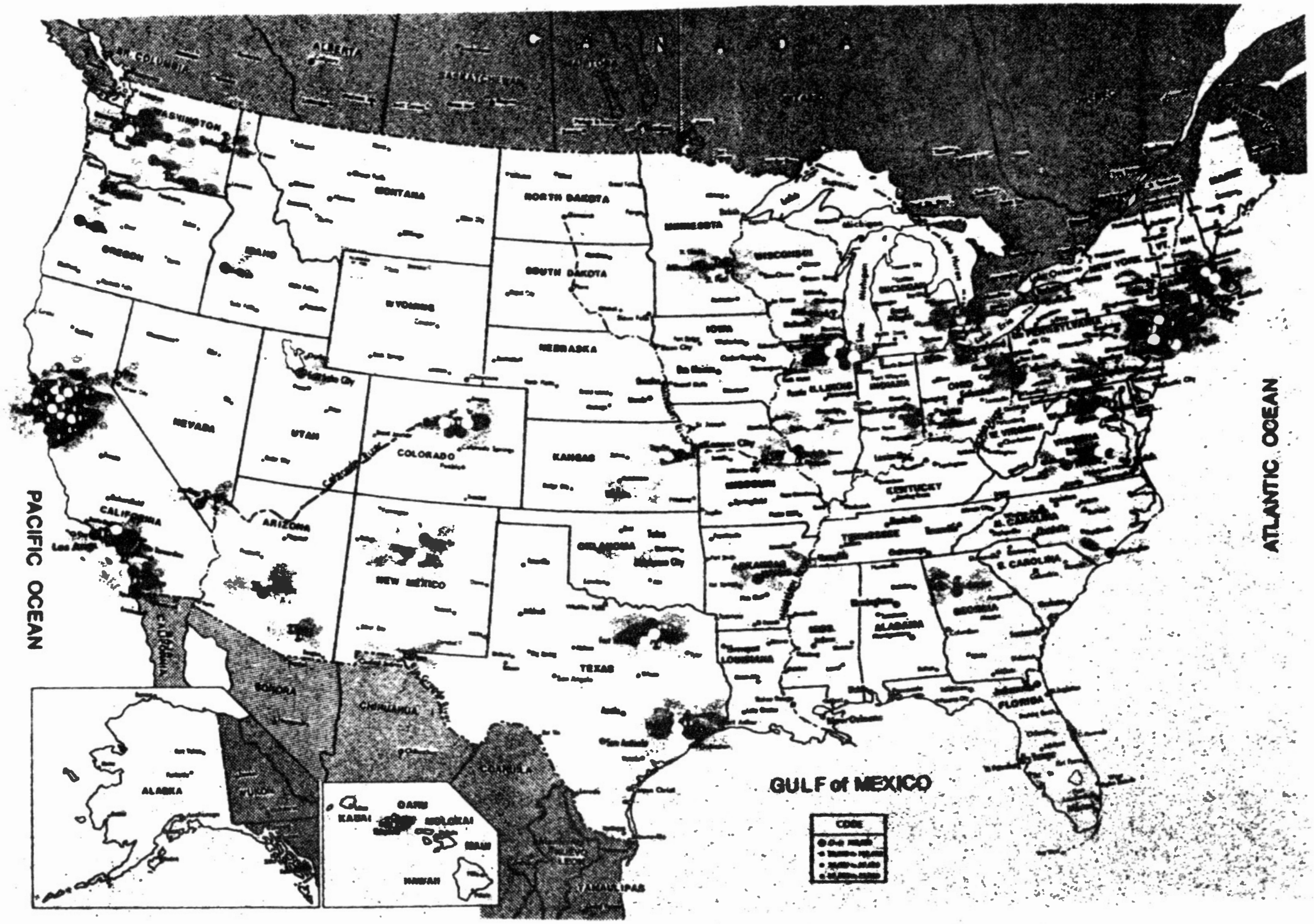

Figure 1. Geographic Location of Newspapers in Which Reporting National Laboratories Advertise for Scientific, Engineering and Technical Employees

microfilm the bulk of the articles, thus omitting much of the advertisement, lead to the decision of the author to limit the scope of the research project to one occupation in the nuclear energy field by selecting the most appropriate journal(s) associated with this occupation. Physicists and chemists are two occupations which have contributed considerably to the nuclear energy field. An occupational help-wanted index exists for chemists and is maintained by the American Chemical Society. The development of a help-wanted index for physicists was considered by the author to be more productive than redeveloping the American Chemical Society's help-wanted index for chemists. The completeness and availability of the journal, Physics Today (11)*, for the period 1966 through 1977, aided the decision to develop an advertisement index for physicists based on help-wanted advertisement appearing in Physics Today. This journal is also the referee journal of the American Physics Society. Narrowing the scope of research from 18 journals and 26 occupations to one journal and one occupation allowed for a structuring of a more detailed disaggregation of the "Help-Wanted Index" constructed in this research effort. This disaggregation allows for a more accurate representation of the type of advertisement in Physics Today. The categories identified were (1) universities advertising for staff, (2) post doctoral positions available, (3) graduate funding available to students, (4) foreign employment opportunities, (5) industrial employment, (6) private nuclear industrial employment, (7) GOCO employment, (8) Peace Corps

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*For the purpose of this study, Physics Today refers to all issues of the journal for an eleven-year period. Since Physics Today plays a key role and is noted frequently in this paper, no further citations will be given.

advertisement, (9) individuals advertising for positions wanted, (10) placement service, and (11) placement services strictly for nuclear and nuclear related employment.

The development of an advertisement index for physicists requires a definite method for measuring the volume of advertisement. The methods utilized in existing advertisement indexes were reviewed for appropriateness in this study. The Conference Board counts the number of ads appearing in newspapers. Deutch, Shea, and Evans (5) counts the number of pages of advertisement appearing in a select number of scientific and engineering journals in order to construct their Scientists and Engineers Index. Each of these techniques is a measure of quantity of advertisement. The actual area each ad occupies also constitutes a volume. In this study three measures of ad volume were noted: the actual number of ads appearing, the number of pages ads appeared on, and the total area help-wanted ads occupied. Each help-wanted ad appearing was measured (length and width), recorded in the appropriate category, and its area calculated in square centimeters. Total area of ads appearing monthly were calculated by summing the individual ad area. The possibility of inaccurate area measurements exists but is considered constant over the approximately 4,000 individual measurements made. A consistent error will not affect the performance of the overall resulting index.

The help-wanted advertisement index developed in this research will be referred to as the Physicists Index. The disaggregation structured into its development actually provides for a minimum of twelve discrete indexes--an overall volume of advertisement in addition to an index for each of the discrete categories. Correlations were run between and among each of these in order to establish possible relationships for the period January 1966 through December 1977. In order to establish relationships between the Physicist Index, unemployment and employment, the index was correlated with quarterly employment, unemployment, and labor force data from the Current Population Survey (CPS). The quarterly physicists data from the CPS were made available by the special efforts of Joel Berries (2), Science Resources Studies, National Science Foundation (NSF). The data is considered weak and suspect in that the figures for physicists are derived from an extremely small sample. Quarterly data for employment, unemployment and labor force for physicists were obtained only for the years 1972 through 1977 due to the difficulty in obtaining the data from the Department of Labor and the manipulation of the data required in order to place it in a usable format. Data was acquired for both physicists and physics teachers. Various combinations of disaggregation were correlated with combinations of employment, unemployment, and labor force data for both physicists and physics teachers quarterly CPS data in order to find the best fit. Techniques of lagging and leading the CPS data with the Physicist Index and its various disaggregated components were attempted in order to further increase the closeness of fit between the two sets of data. Nonlinear functions were also attempted (log, sine, log sine) to determine cyclical trends and to further closeness of fit.

The disaggregated portion of the Physicists Index for private nuclear industry, GOCO employment, and placement services strictly for nuclear related employment were manipulated through various combinations and regressed against private nuclear industry employment, GOCO employment, and total employment for the years 1967 through 1977.

Lagging and leading, and nonlinear functions were also attempted to establish relationships and determine trends and establish closeness of fit.

CHAPTER IV

PRESENTATION OF RESULTS

The results of this study gravitate toward a triadic form and are, therefore, presented in three distinct sections. These sections are (1) the personnel recruitment information request, (2) the help-wanted index for physicists, and (3) a measure of labor market tightness for physicists.

Personnel Recruitment Information Request

The personnel recruitment information request was designed to collect data which, when evaluated, would provide insight on the "value" of select recruitment techniques from the perspective of the employer. Employers' insights were obtained from eight DOE national laboratories which represent a major portion of total employment in the nuclear energy field. Three measures of recruitment technique values were collected: (1) a ranking of recruitment techniques by the employer according to "effectiveness" in recruiting high quality scientific, engineering, and technical personnel; (2) a ranking of recruitment techniques by the employer according to "cost-effectiveness" in recruiting high quality scientific, engineering, and technical personnel; and (3) an estimate by each employer of the expenditure by their organization for each of the recruitment techniques, by year, from 1967 through 1977. All eight national laboratories responded to the information request

Evaluation of Question on Ranking Recruitment Techniques for Effectiveness in Acquiring Quality Nuclear and Nuclear-Related Scientific, Engineering, and Technical Personnel

Each employer ranked (1-8, one being the most effective and eight the least effective) the recruitment techniques for their "effectiveness." Table I lists the recruitment techniques along with their respective means and standard deviations (SD). The means indicate that "recommendations from the present staff" is perceived clearly as the most effective way for an organization to acquire quality scientific, engineering, and technical personnel. "Help-wanted ads in journals and professional magazines," "campus recruitment," and "help-wanted ads in newspapers" also rank favorably. The SD associated with each mean prohibits a clear ordering of the recruitment techniques for "effectiveness." In order to gain insight as to the significance of each mean associated with its recruitment technique, t values were calculated for each possible combination of recruitment techniques taken two at a time. The results of this exercise appear in Table II. It is not necessary to complete all cells in this matrix. The cells not completed in Table II are merely a mirror image of the calculated t values shown. This may further be explained by the equation for the combinations of eight items taken two at a time $8^{C}2 = \frac{8}{(8-2)\ 2!} = 28$. Twenty-eight cells of the matrix contain appropriate calculated

TABLE I

STANDARD DEVIATION AND MEAN OF RECUITMENT TECHNIQUES
RANKED FOR COST-EFFECTIVENESS

Standard Deviation	Mean	Recruitment Technique
2.45	3.3	Campus recruitment
1.51	4.0	Help-wanted ads in newspapers
1.12	3.1	Help-wanted ads in journals and professional magazines
0.83	7.1	Employment service (State)
1.12	7.1	Employment service (Private)
1.03	1.7	Recommendations from present professional staff
1.64	5.1	Professional meeting recruitment
2.96	5.2	Other (specify)

TABLE II

CALCULATED t VALUES FOR MEANS OF RECRUITMENT TECHNIQUES RANKED FOR EFFECTIVENESS

	Campus Recruitment	Help-Wanted Ads Newspapers	Help-Wanted Ads Journals	Employment Service State	Employment Service Private	Recommendations Prof. Staff	Professional Meeting Recr.	Other
Campus Recruitment	"							
Help-Wanted Ads Newspapers	0.32	"						
Help-Wanted Ads Journals	-0.12	-0.69	"					
Employment Service State	2.26	2.77	4.14	"				
Employment Service Private	2.29	2.38	3.57	0	"			
Recommendations Prof. Staff	-0.98	-1.80	-1.26	-5.79	-4.98	"		
Professional Meeting Recr.	0.90	0.70	1.48	-1.70	-1.46	2.78	"	
Other	0.72	0.59	1.15	-1.59	-1.01	2.00	0.06	"

t values. The matrix of calculated t values allows for the testing of $H_o = u_i = u_j$, where i is the discrete recruitment techniques along the y-axis of Table II, and j is the discrete recruitment techniques along the x-axis of Table II. Rejection of the null hypothesis for a pair indicates a significant difference between the two recruitment techniques under consideration. Comparisons of the t values in Table II with the table value for t = 2.365 yields a rejection of the null hypothesis in five of the 28 pairs: employment service state--help-wanted ads newspapers; employment service private--help-wanted ads newspapers; employment service state--help-wanted ads journals; employment service private--help-wanted ads journals; and professional meeting recruitment-recommendations from professional staff. This indicates that (1) employers place more confidence in help-wanted ads in journals than in employment service state or employment service private, (2) employers place more confidence in help-wanted ads in newspapers than in employment service state or employment service private, and (3) employers place more confidence in recommendations from professional staff than professional meeting recruitment.

Evaluation of Question on Ranking Recruitment Techniques for Cost-Effectiveness in Acquiring Quality Nuclear and Nuclear Related Scientific, Engineering, and Technical Personnel

Table III shows the means and standard deviations derived from information provided from eight national laboratories as to the cost-effectiveness of select recruitment techniques in acquiring quality nuclear and nuclear related scientific, engineering, and technical

TABLE III

STANDARD DEVIATION AND MEAN OF RECRUITMENT TECHNIQUES
RANKED FOR COST-EFFECTIVENESS

Standard Deviation	Mean	Recruitment Technique
1.98	3.75	Campus recruitment
1.24	4.12	Help-wanted ads in newspapers
0.71	3.75	Help-wanted ads in professional magazines and journals
0.83	7.12	Employment service (State)
1.16	7.25	Employment service (Private)
0.00	1.00	Recommendations from present professional staff
2.14	5.00	Professional meeting recruitment
3.09	5.12	Other (specify)

personnel. Recommendations from present staff is perceived by employers as the most cost-effective technique for recruiting quality personnel. Help-wanted ads in professional magazines and journals, campus recruitment, and help-wanted ads in newspapers also rank high when evaluating employers' perceptions of cost-effective recruitment techniques by comparisons of means. Table IV presents the results of a calculated t-test for each pair of discrete recruitment techniques means. The table t value for this set of data is 2.365 at the .05 level of significance. Testing the null hypothesis, $H_o = u_i = u_j$, for each discrete combination of recruitment techniques results in the rejection of the null hypothesis in four cases. This indicates employers perceive that (1) help-wanted ads in newspapers are more cost-effective than employment service private and employment service state, and (2) help-wanted ads in journals are more cost-effective than employment service state and employment service private.

Evaluation of the Question of Estimating Expenditures on Recruitment Techniques

Reported estimated expenditures on recruitment were combined and means calculated for each recruitment technique in order to assure confidentiality of each employer providing financial information. Table V provides the standard deviation and means of reported estimated expenditures for each recruitment technique. The mean value indicates the relative expenditure for its respective recruitment technique. Table VI presents the calculated t value for all unique combinations of recruitment techniques. The table t value for this set of data is 2.228 at the .05 level of significance. Testing the null hypothesis

TABLE IV

CALCULATED t VALUES FOR MEANS OF RECRUITMENT TECHNIQUES RANKED FOR COST-EFFECTIVENESS

	Campus Recruitment	Help-Wanted Ads Newspapers	Help-Wanted Ads Journals	Employment Service State	Employment Service Private	Recommendations Prof. Staff	Professional Meeting Recr.	Other
Campus Recruitment	"							
Help-Wanted Ads Newspapers	-0.66	"						
Help-Wanted Ads Journals	0	0.39	"					
Employment Service State	-2.62	-2.96	-4.39	"				
Employment Service Private	-2.31	-2.61	-3.86	-0.13	"			
Recommendations Prof. Staff	UD	UD	UD	UD	UD	"		
Professional Meeting Recr.	-0.61	-0.54	-0.32	1.34	1.42	UD	"	
Other	-0.55	-0.51	-0.92	1.24	1.12	UD	.05	"

TABLE V

STANDARD DEVIATION AND MEAN OF ESTIMATED EXPENDITURES FOR RECRUITMENT TECHNIQUES

Standard Deviation	Mean	Recruitment Technique
58.0	166.8	Campus recruitment
71.8	97.5	Help-wanted ads in newspapers
63.7	77.1	Help-wanted ads in journals and professional magazines
0.75	0.85	Employment service (State)
14.2	15.3	Employment service (Private)
11.5	44.2	Recommendations from present professional staff
6.06	17.0	Professional meeting recruitment
12.5	40.7	Other (specify)

TABLE VI

CALCULATED t VALUES FOR MEANS OF REPORTED ESTIMATED EXPENDITURES FOR RECRUITMENT TECHNIQUES

	Campus Recruitment	Help-Wanted Ads Newspapers	Help-Wanted Ads Journals	Employment Service State	Employment Service Private	Recommendations Prof. Staff	Professional Meeting Recr.	Other
Campus Recruitment	"							
Help-Wanted Ads Newspapers	-1.06	"						
Help-Wanted Ads Journals	-1.48	- 0.30	"					
Employment Service State	-2.16	-13.17*	-11.03*	"				
Employment Service Private	-5.28*	- 2.57*	- 2.05	4.43*	"			
Recommendations Prof. Staff	-4.75*	- 1.85	- 1.22	14.76*	2.26*	"		
Professional Meeting Recr.	-7.96*	- 3.85*	- 3.05*	7.55*	0.18	-3.24*	"	
Other	-4.68*	- 1.90	- 1.29	13.01*	1.91	-0.29	2.71*	"

for the means of each discrete pair of (combinations) recruitment techniques yields a rejection of the null hypothesis in 16 of the 28 possible combinations. These are noted in Table VI by an asterisk (*) in the cells in which this occurs.

The Help-Wanted Index for Physicists

Three measures of help-wanted advertisement were noted for each help-wanted ad appearing in Physics Today for the period 1966 through 1977. The total volume of ads (as measured by the product of the length and width of each ad in centimeters) appearing in Physics Today for each month in the period January 1966 through December 1977 is shown graphically in Figure 2. Actual data for volume, number of ads and number of pages which ads appear for total volume of advertisement appears in Appendix H. This total volume of advertisement was disaggregated and its component parts identified. These component parts are (1) university, (2) post doctorate, (3) graduate students, (4) foreign, (5) industry, (6) Peace Corps, (7) positions wanted, and (8) employment service. Figure 3 illustrates this aggregation by month for the year 1975. Complete monthly detailed data for the 11-year period appears in Appendices I through P.

From the industry category, ads were noted and extracted for the nuclear industry. Nuclear industry ads were further divided into two categories: (1) government-owned-contractor-operated facilities, and (2) private industry. The ad volume, as measured by area of ads and the total number of ads for each month, from January 1966 through December 1977, appears in Appendix Q.

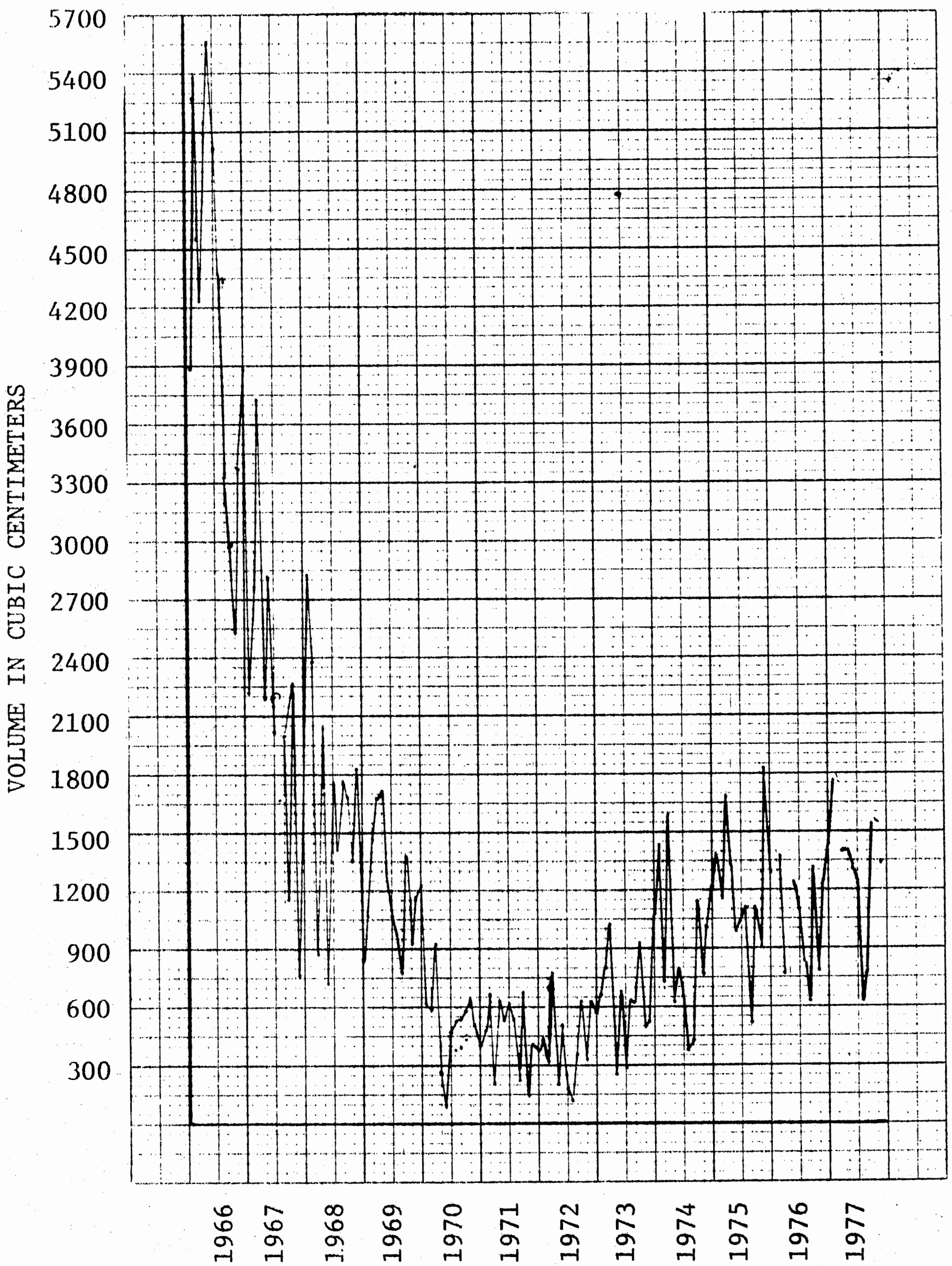
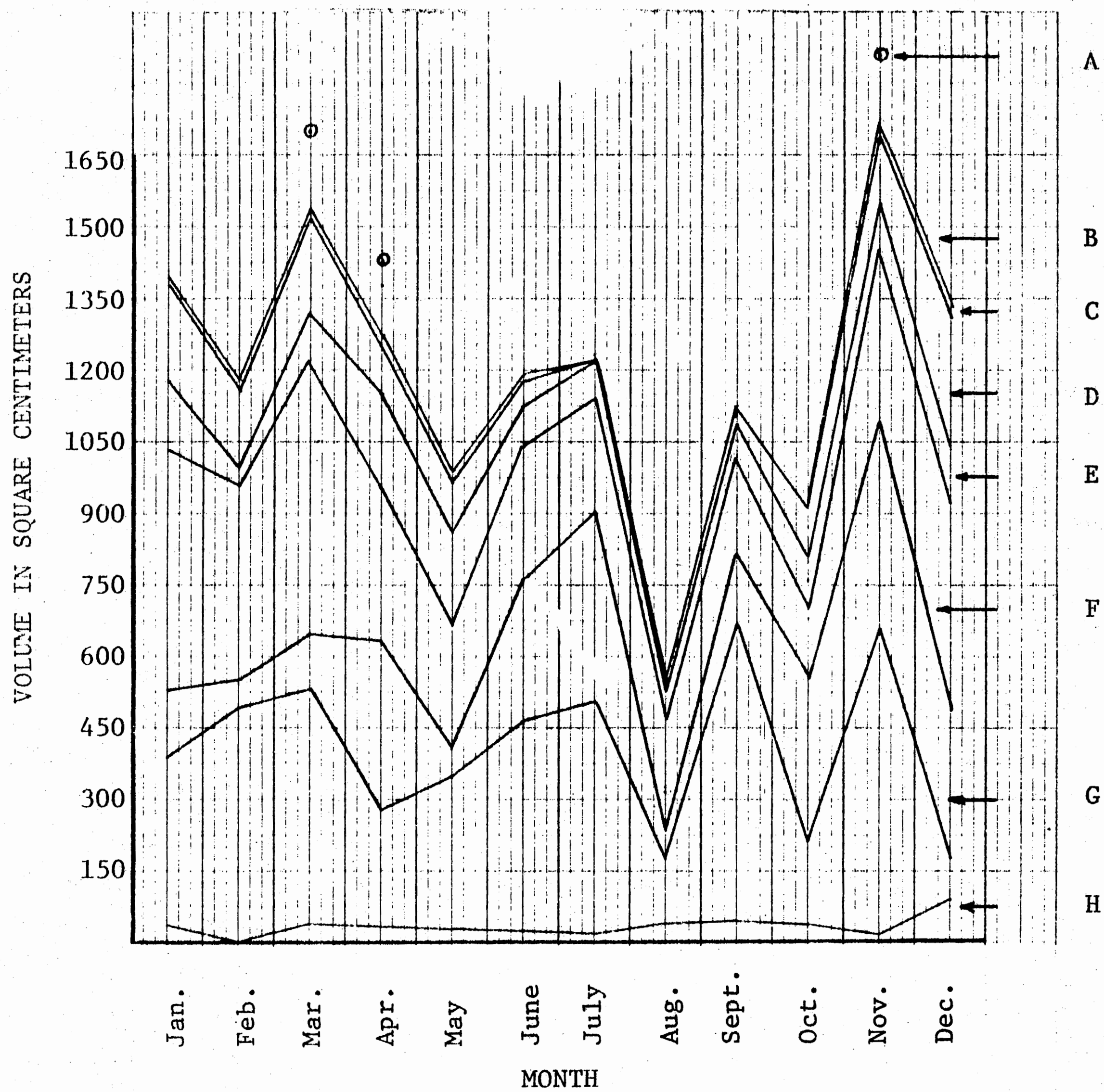


Figure 2. Total Volume Of Advertisement Appearing In Physics Today, 1966-1977



Curve Identification: A. Employment Service
B. Peace Corps
C. Graduate
D. Post Doctorate
E. University
F. Foreign
G. Industry
H. Positions Wanted

Figure 3. Disaggregation Of Advertisement Appearing In <u>Physics Today</u>, 1975

To determine if relationships existed between and among the component categories of advertisement, each advertisement category was regressed on each of the other advertisement categories. The results of these calculations appear in Table VII.

In order to determine if these correlations were significant, the null hypothesis $H_o: B_1 = 0$ was tested by use of the t-test for each regression which determined each correlation. Table VIII lists the calculated t values for each combination of advertisement categories. The table t value for 65 degrees of freedom at the 0.05 level of significance is 1.998. The following statements result from the above computations:

1. Peace Corps Ad Volume is positively related to Total Ad Volume. The 25.2% of the variation in Total Ad Volume can be attributed to variation in Peace Corps Ad Volume.

2. Industry Ad Volume is positively related to Total Ad Volume. The 23.3% of the variation in Total Ad Volume can be attributed to variation in Industry Ad Volume.

3. University Ad Volume is positively related to Total Ad Volume. The 63.1% of the variation in Total Ad Volume can be attributed to variation in University Ad Volume.

4. Post Doctorate Ad Volume is positively related to Total Ad Volume. The 32.6% of the variation in Total Ad Volume can be attributed to variation in Post Doctorate Ad Volume.

5. Graduate Ad Volume is positively related to Total Ad Volume. The 41.7% of the variation in Total Ad Volume can be attributed to variation in Graduate Ad Volume.

6. University Ad Volume is positively related to Peace Corps Ad Volume. The 19.5% of the variation in Peace Corps Ad Volume can be attributed to variation in University Ad Volume.

TABLE VII

REGRESSION OF AD VOLUME CATEGORIES ON AD VOLUME CATEGORIES
R^2 VALUES

AD VOLUME CATEGORIES	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
C_1									
C_2	25.2								
C_3	1.7	1.9							
C_4	23.3	3.3	2.0						
C_5	63.1	19.5	2.6	0.0					
C_6	32.6	5.2	0.1	1.6	47.9				
C_7	41.7	23.9	6.3	1.1	33.6	"			
C_8	26.8	2.1	2.5	0.8	6.4	0.1	5.9		
C_9	14.2	5.3	0.0	0.8	2.3	0.7	3.8	0.7	

AD VOLUME CATEGORIES

"C" Values:
- C_1 = Total Ad Volume
- C_2 = Peace Corps Ad Volume
- C_3 = Positions Wanted Ad Volume
- C_4 = Industry Ad Volume
- C_5 = University Ad Volume
- C_6 = Post Doctorate Ad Volume
- C_7 = Graduate Ad Volume
- C_8 = Foreign Ad Volume
- C_9 = Employment Service Ad Volume

TABLE VIII

REGRESSION OF AD VOLUME CATEGORIES ON AD VOLUME CATEGORIES
CALCULATED t VALUES

AD VOLUME CATEGORIES	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
C_1	"								
C_2	4.68	"							
C_3	1.05	1.11	"						
C_4	4.57	1.49	-1.4	"					
C_5	10.55	3.95	1.33	-0.13	"				
C_6	5.60	1.88	-0.3	-1.04	7.72	"			
C_7	6.82	4.52	2.1	0.04	5.74	2.84	"		
C_8	2.30	1.9	1.3	0.71	2.10	0.80	2.01	"	
C_9	1.70	1.92	0.0	0.71	1.24	0.69	1.61	-0.67	"

AD VOLUME CATEGORIES

"C" Values:
C_1 = Total Ad Volume
C_2 = Peace Corps Ad Volume
C_3 = Positions Wanted Ad Volume
C_4 = Industry Ad Volume
C_5 = University Ad Volume
C_6 = Post Doctorate Ad Volume
C_7 = Graduate Ad Volume
C_8 = Foreign Ad Volume
C_9 = Employment Service Ad Volume

7. Graduate Ad Volume is positively related to Peace Corps Ad Volume. The 23.9% of the variation in Peace Corps Ad Volume can be attributed to variation in Graduate Ad Volume.

8. Post Doctorate Ad Volume is positively related to University Ad Volume. The 47.9% of the variation in University Ad Volume can be attributed to variation in Graduate Ad Volume.

9. Graduate Ad Volume is positively related to University Ad Volume. The 33.6% of the variation in University Ad Volume can be attributed to variation in Graduate Ad Volume.

10. Foreign Ad Volume is positively related to University Ad Volume. The 6.4% of the variation in University Ad Volume can be attributed to variation in Foreign Ad Volume.

11. Foreign Ad Volume is positively related to Total Ad Volume. The 26.8% of the variation in Total Ad Volume can be attributed to variation in Foreign Ad Volume.

12. Graduate Ad Volume is positively related to Post Doctorate Ad Volume. The 11% of the variation in Post Doctorate Ad Volume can be attributed to variation in Graduate Ad Volume.

13. Foreign Ad Volume is positively related to Graduate Ad Volume. The 5.9% of the variation in Graduate Ad Volume can be attributed to variation in Foreign Ad Volume.

Techniques of lagging, leading, and nonlinear functions were also used but were not statistically significant.

In order to determine the relationship between the nine discrete categories of ad volume in Physics Today and labor force information for physicists, each discrete ad volume category was regressed on each of six categories of labor force information for physicists from unpublished Current Population Survey (CPS) data acquired from the Science Resource Studies, National Science Foundation. The Current Population Survey provides quarterly labor force, unemployment, and employment data for physicists and physics instructors for the years

1972 through 1977. This data appears in Appendix R. Quarterly averages for Physics Today ad volumes were used for comparison with quarterly CPS data. The six categories of CPS data were regressed on each category of Physics Today ad volume. The results of these calculations appear in Table IX. Table X presents the calculated t value for each correlation. The significance of these correlations was determined by testing the null hypothesis $H_o: B_1 = 0$. The table t value for 70 degrees of freedom at the 0.05 level of significance is 1.996. The following statements result from the above computations.

1. The CPS Physicist Labor Force Data is negatively related to Peace Corps Ad Volume. The 23.6% of the variation in Peace Corps Ad Volume can be attributed to variation in CPS Physicist Labor Force Data.

2. The CPS Physicist Employment Data is negatively related to Peace Corps Ad Volume. The 24.6% of the variation in Peace Corps Ad Volume can be attributed to variation in CPS Physicist Employment Data.

3. The CPS Physics Instructor Unemployment Data is positively related to Peace Corps Ad Volume. The 9.1% of the variation in Peace Corps Ad Volume can be attributed to variation in CPS Physics Instructor Unemployment Data.

4. The CPS Physicist Labor Force Data is negatively related to Industry Ad Volume. The 6% of the variation in Industry Ad Volume can be attributed to variation in CPS Physicist Labor Force Data.

5. The CPS Physicist Employment Data is positively related to Industry Ad Volume. The 7.3% of the variation in Industry Ad Volume can be attributed to variation in CPS Physicist Employment Data.

6. The CPS Physics Instructor Data is positively related to University Ad Volume. The 7.7% of the variation in University Ad Volume can be attributed to variation in CPS Physics Instructor Data.

7. The CPS Physics Instructor Labor Force Data is positively related to Graduate Ad Volume. The 14.5% of the variation in Graduate Ad Volume can be attributed to variation in CPS Physics Instructor Labor Force Data.

TABLE IX

REGRESSION OF CPS LABOR FORCE INFORMATION
ON AD VOLUME CATEGORIES
R^2 VALUES

CPS LABOR FORCE INFORMATION	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
C_{10}	0.5	23.6	1.3	6.0	1.2	5.8	0.2	0.6	0.7
C_{11}	1.0	24.6	1.2	7.3	0.8	4.4	1.3	0.2	0.9
C_{12}	2.3	0.1	0	1.7	1.6	3.9	14.5	3.4	0.6
C_{13}	0.1	0	1.3	1.1	0.0	0.1	10.7	2.2	3.2
C_{14}	0.4	0.1	1.9	1.4	0.1	0	8.3	1.7	2.6
C_{15}	4.1	9.1	3.0	0.4	7.7	0.3	11.2	2.8	2.6

AD VOLUME CATEGORIES

"C" Values:
C_1 = Total Ad Volume
C_2 = Peace Corps Ad Volume
C_3 = Positions Wanted Ad Volume
C_4 = Industry Ad Volume
C_5 = University Ad Volume
C_6 = Post Doctorate Ad Volume
C_7 = Graduate Ad Volume
C_8 = Foreign Ad Volume
C_9 = Employment Service Ad Volume
C_{10} = Physicists Labor Force
C_{11} = Physicists Employment
C_{12} = Physicists Unemployment
C_{13} = Physics Instructor Labor Force
C_{14} = Physics Instructor Employment
C_{15} = Physics Instructor Unemployment

TABLE X

REGRESSION OF CPS LABOR FORCE INFORMATION
ON AD VOLUME CATEGORIES
CALCULATED t VALUES

CPS LABOR FORCE INFORMATION	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
C_{10}	-0.62	-4.64	-0.94	-2.11	0.91	2.08	-0.41	-0.63	-0.68
C_{11}	-0.85	-4.78	-0.93	2.34	0.73	1.79	-0.97	-0.36	-0.80
C_{12}	1.30	0.27	-0.11	1.10	1.07	1.69	3.45	-1.57	0.64
C_{13}	-0.31	0.02	-0.97	-0.89	0.06	0.23	2.90	-1.26	1.52
C_{14}	-0.54	-0.30	-1.17	-0.98	-0.24	0.17	2.52	-1.09	1.37
C_{15}	1.74	2.65	1.46	0.55	2.24	0.48	2.97	-1.43	1.36

AD VOLUME CATEGORIES

"C" Values:

C_1 = Total Ad Volume

C_2 = Peace Corps Ad Volume

C_3 = Positions Wanted Ad Volume

C_4 = Industry Ad Volume

C_5 = University Ad Volume

C_6 = Post Doctorate Ad Volume

C_7 = Graduate Ad Volume

C_8 = Foreign Ad Volume

C_9 = Employment Service Ad Volume

C_{10} = Physicists Labor Force

C_{11} = Physicists Employment

C_{12} = Physicists Unemployment

C_{13} = Physics Instructor Labor Force

C_{14} = Physics Instructor Employment

C_{15} = Physics Instructor Unemployment

8. The CPS Physics Instructor Labor Force data is positively related to Graduate Ad Volume. The 10.7% of the variation in Graduate Ad Volume can be attributed to variation in CPS Physics Instructor Labor Force Data.

9. The CPS Physics Instructor Employment Data is positively related to Graduate Ad Volume. The 8.3% of the variation in Graduate Ad Volume can be attributed to variation in CPS Physics Instructor Employment Data.

10. The CPS Physics Instructor Unemployment data is positively related to Graduate Ad Volume. The 11.2% of the variation in Graduate Ad Volume can be attributed to variation in CPS Physics Instructor Unemployment Data.

Techniques of lagging, leading, and nonlinear functions were also used but were not statistically significant.

Employment in the nuclear energy field (Appendix S) was regressed on Nuclear Industry Ad Volume. Results of this calculation were R^2 = 15.8. Seven years of nuclear employment data resulted in five degrees of freedom. Testing the null hypothesis $B_1 = 0$, the calculated t value was 1.90, table t value at the 0.05 level of significance was 2.571. Therefore, no inferences may be made about the relationship between employment in the nuclear energy field and Nuclear Industry Ad Volume for physicists.

Techniques of lagging, leading, and nonlinear functions were also used but were not statistically significant.

Volume of Advertisement in _Physics Today_ As a Measure of Labor Market Tightness for Physicists

A variety of experiments with the CPS data and the _Physics Today_ Ad Volume resulted in exceptionally high correlations when the CPS data was used in the form Employment/Labor Force. Employment/

Labor Force is a measure of labor-market tightness. Employment/Labor Force regressed on total ads in Physics Today, where total Employment/Labor Force is the combined data elements for both physicists and physics instructors. Physicist Employment/Physicist Labor Force regressed on Industry Ad Volume and Physics Instructor Employment/Physics Instructor Labor Force regressed on Industry Ad Volume. Two forms of these data were run in each case: raw data and the log form of the raw data. The null hypothesis $H_o: B_1 = 0$ was tested in each case.

Log Physicists and Physics Instructor Employment/Log Physicists and Physics Instructor Labor Force regressed on log Total Ad Volume and resulted in a correlation of 56.7% with a calculated t value of 5.11. Table t value at the .05 level of significance with 20 degrees of freedom is 2.086.

Log Physicist Employment/Log Physicist Labor Force on log Industry Ad Volume resulted in a correlation of 72.4% with a calculated t value of 7.24. Table t value at the 0.05 level of significance with 20 degrees of freedom is 2.086.

Log Physics Instructor Employment/Log Physics Instructor Labor Force regressed on log University Ad Volume and resulted in a correlation of 88.2% with a calculated t value of 12.21. The table t value is 2.086 for 20 degrees of freedom at the 0.05 level of significance.

Physicists and Physics Instructor Employment/Physicists and Physics Instructor Labor Force regressed on Total Ad Volume and resulted in a correlation of $R^2 = 49.7\%$ with a calculated t value of 4.44. The table t value at the 0.05 level of significance with 20 degrees of freedom is 2.086.

Physicists Employment/Physicists Labor Force regressed on Industry Ad Volume and resulted in a correlation of R^2 = 74.3% with a calculated t value of 7.60. The table t value at the 0.05 level of significance with 20 degrees of freedom is 2.086.

Physics Instructor Employment/Physics Instructor Labor Force regressed on University Ad Volume and resulted in a correlation of 89.0% with a calculated t value of 1.7. The table t value at the 0.05 level of significance with 20 degrees of freedom is 2.086.

In both the log form and the natural form in each of the above cases, the null hypothesis $H_o: B_1 = 0$ is rejected because the calculated t value is greater than the appropriately chosen table t value.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The primary purpose of this study was to develop an indicator of manpower needs in the atomic energy field. The uncertainty of the continuation and expansion of traditional manpower planning efforts for this field supported the merit of investigating relationships between the volume of advertisement for employment needs in the atomic energy field and actual employment in this field. The volume of advertisement was to be the "Occupational Index for the Atomic Energy Field."

Summary

The determination of relationships between the Occupational Index for the Nuclear Energy Field and employment in this field required the development of the index itself and a measure of confidence in advertising for recruitment purposes by employers. Employers' perception of the value of recruitment advertisement should reflect their utilization of this recruitment technique. Employment in the nuclear energy field is found in survey results, bearing the same name, conducted by the Department of Labor, Bureau of Labor Statistics.

The testing of the following two null hypotheses would more clearly establish the value of the occupational index.

1. H_o = An aggregate occupational index does not correlate with actual total employment in the nuclear energy field.

2. H_o = A disaggregated occupational index (1 - n) does not correlate with actual employment by occupation (1 - n) in the nuclear energy field.

The research methodology consisted of (1) a survey of select employers in the nuclear energy field to obtain employers' perceptions of the value of recruitment advertising and a listing of journals which were most used for recruitment advertisement; (2) acquisition and review of these journals for appropriateness; (3) constructing an occupational index from ads appearing in these journals; and (4) determining the relationship between the resulting index and employment in the atomic energy field through regression analysis.

A Personnel Recruitment Information Request was sent to the Directors of eight national laboratories with an endorsement letter from the Energy Research and Development Administration. These national laboratories had been at the apex of development of the atomic energy field. The request was answered by all eight national laboratories. Their perception of recruitment advertisement was tabulated and a listing of journals in which they advertised was compiled.

Three measures of employers' perception of recruitment advertisement was obtained: (1) effectiveness, (2) cost-effectiveness, and (3) expenditures. When ranking various recruitment techniques for effectiveness, the employers placed more confidence in help-wanted ads in journals than in private or state employment services. They also placed more confidence in help-wanted ads in newspapers than in private or state employment services. When ranking various recruitment techniques for cost-effectiveness, the employers perceived that help-wanted ads in journals are more cost-effective than private or state employment services and that help-wanted ads in newspapers are more cost-effective than private or state employment services. Help-wanted ads in newspapers and journals were the second and third highest expenditure for recruitment techniques reported by the employers. Testing the means of these two recruitment techniques by use of the t-test revealed no significant difference between the two expenditures.

The eight national laboratories reported more than 150 journals in which they advertised for employees. Twenty-three journals were used by at least three national laboratories. A review of these 23 journals revealed that a majority of the journals were not available in their complete form for the period under consideration (1966-1977). This led to the decision to narrow the scope of the study to one occupation--Physicists. Physics Today, the Journal of the American Physics Society, was chosen because of its availability through standard library sources and the completeness in which its earlier issues were microfilmed.

It was found that all advertisements which might be used to indicate a need for physicists could be placed into nine discrete categories of ad volume: (1) Total Ad Volume, (2) Employment Service Ad Volume, (3) Peace Corps Ad Volume, (4) Industry Ad Volume, (5) Foreign Ad Volume, (6) Post Doctorate Ad Volume, (7) Graduate Ad Volume, (8) University Ad Volume, and (9) Position Wanted Ad Volume. Nuclear Ad Volume is a subset of industry and volume, and is further broken down into two component parts: private employment and GOCO employment.

Ads appearing in Physics Today were individually measured (length x width in centimeters) and placed in their appropriate category for each month from January 1966 through December 1977.

Analysis of interrelationships within the nine discrete categories revealed that variation in total ad volume could be attributed to variation in most of its component parts.

Regression analysis and t-test of the nine categories of ad volume and labor force information for physicists from the Current Population Survey concluded that:

1. Physicists Labor Force is negatively related to Peace Corps Ad Volume and Industry Ad Volume with R^2 values of 23.6% and 6%, respectively.

2. Physicists Employment is negatively related to Peace Corps Ad Volume and positively related to Industry Ad Volume with R^2 values of 24.6% and 7.3%, respectively.

3. Physics Instructor Unemployment is positively related to Peace Corps Ad Volume, University Ad Volume, and Graduate Ad Volume with R^2 values of 9.1%, 7.7% and 11.2%, respectively.

4. Variation in Graduate Ad Volume can be attributed to variation in Physicists Unemployment; Physics Instructors Labor Force, Employment, and Unemployment. These are positively related.

Employment in the nuclear energy field was regressed on Nuclear Industry Ad Volume. No significant relationship was identified.

When CPS data was used in the form Employment/Labor Force (a measure of labor market tightness) and regressed with Physics Today Ad Volume data, high correlations resulted in both natural and log forms. The most impressive correlations were labor market tightness for Physicists regressed with Industry Ad Volume and Physics Instructor labor market tightness regressed on University Ad Volume. Resulting R^2 values were 74.3% and 89.0%, respectively.

Conclusions

The purpose of this study was to develop an occupational index for the atomic energy field which would provide a measure of employers' need through the spectrum of technical employment which would be easily reproducible with a minimum of time and resources.

The study did not yield sufficient evidence to reject either of the proposed null hypotheses:

1. H_o = An aggregate occupational index does not correlate with actual total employment in the nuclear energy field.

2. H_o = A disaggregated occupational index (1 - n) does not correlate with actual employment by occupation (1 - n) in the nuclear energy field.

Information could not be obtained to construct an aggregate occupational index for the atomic energy field. Without an aggregate index, disaggregation was not possible. The development of an occupational index for one occupation--physicists--in the nuclear energy field was undertaken. The merit of the resulting monthly index could not be supported through regression analysis on yearly BLS/AEC employment. The sensitivity of the monthly index does not appear to relate well to yearly fluctuation.

The analysis of categories of advertisement in Physics Today did show relationships between the total ad volume and its component parts, which is logically obvious. Attempts to determine relationships between ad volume categories in Physics Today and labor force information from the Current Population Survey did yield some significant, although not high, correlations. Only two correlations out of 54 combinations were over 20% and these represented negative relationships. One would be hesitant to base a critical decision on the strength of the findings thus far.

Labor market tightness was not considered in the conception of the study nor in planning its methodology. When labor market tightness was regressed with Physics Today advertisement components, it became apparent that it is the key factor for recruitment advertisement. It implies that the intensity with which one recruits, in this case measured by volume of advertisement, reflects not the number employed, not the magnitude of the labor force, but the availability of the individuals being recruited. This availability is measured by labor market tightness in the form Employment/Labor Force. Analyses of the data in this study indicate that 89.0% of the variation in Physics Instructor labor market tightness can be explained in the variation of University Ad Volume in Physics Today and that 74.3% of the variation in Physicists labor market tightness may be explained in the variation in Industry Ad Volume in Physics Today.

Industry Ad Volume and University Ad Volume appear to be a coincidental indicator, or proxy, for Physicist labor market tightness and Physics Instructor labor market tightness, respectively.

The results of the Personnel Recruitment Information Request indicate that employers in the atomic energy field perceive "help-wanted" advertisement in journals as an important recruitment technique and provide a significant portion of their recruitment funds for this purpose.

Recommendations

The results of this study encompassed three areas of information and knowledge: (1) information obtained from employers on recruitment practice, (2) development and evaluation of advertisement indexes, and (3) advertisement indexes as indicators of labor market tightness. The following recommendations are considered sequential steps which need to be taken in order to enhance the credibility of this study and further expand the knowledge gained through its execution.

1. It is recommended that a follow-up study be conducted which would verify and enhance information obtained on the Personnel Information Recruitment Request. This follow-up study would consist of providing each respondent a copy of the summation and analysis of the information which they contributed, a copy of the information they submitted, an analysis of how their perceptions compare with the rest of the survey population, and a request for their opinion of the material which they have received, including current recruitment practices which they may change in light of this study.

2. It is recommended that current help-wanted advertising appearing in Physics Today be monitored and its relationship to the current population survey information noted.

BIBLIOGRAPHY

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APPENDICES

APPENDIX A

INDUSTRIAL SEGMENTS

Nuclear Power Activities

Reactor and Reactor Component Design and Manufacturing
Nuclear Reactor Operation and Maintenance
Processing and Enrichment of Reactor Fuel Materials
Production of Special Materials for Use in Reactors
Chemical Reprocessing of Irradiated Fuel
Reactor Research, Development and Evaluation*
Fuel Fabrication

Weapons Development and Production

Design and Engineering of Nuclear Facilities

Research and Development in Nuclear Energy

Other

Uranium Milling
Radioisotopes
Design and Manufacture of Nuclear Instruments, Gages, and Control Devices
Accelerators*
Environmental and Ecological Research and Evaluation*
Biology and Medical Research*
Commercial Laboratory Services
Health Physics and Industrial Safety
Industrial Radiography
Miscellaneous

*Research and development activities are included within these segments and excluded from RESEARCH AND DEVELOPMENT IN NUCLEAR ENERGY.

APPENDIX B

OCCUPATIONAL CATEGORIES

Engineers

- Chemical
- Civil Engineers
- Electrical and Electronics Engineers
- Mechanical Engineers
- Nuclear and Reactor Engineers
- Metallurgical Engineers
- All Other Engineers

Mathematicians

Physical and Earth Scientists

- Chemists
- Geologists and Geophysicists
- Physicists
- Metallurgists
- All Other Physical Scientists

Life Scientists

- Biological Scientists
- Medical Scientists
- Health Phsicists
- All Other Life Scientists

Technicians

- Draftsmen
- Electrical and Electronics Technicians
- All Other Engineering Technicians
- Physical Science Technicians
- Life Science Technicians
- Health Physics Technicians and Radiation Monitors
- Nuclear Reactor Operators

Welders with Nuclear Certification

All Other Employees

APPENDIX C

PERSONNEL RECRUITMENT INFORMATION REQUEST

PERSONNEL RECRUITMENT INFORMATION REQUEST

BACKGROUND AND PURPOSE

The Conference Board and Deutch, Shea, and Evans have published advertising indexes which reflect the volume of advertising in general (Conference Board) and for scientists and engineers (Deutch, Shea, and Evans). Investigations by the Conference Board and preliminary research on the Deutch, Shea, and Evans Indexes indicate that advertising indexes may be valid leading-indicators of employment.

The purpose of the information requested on the following pages is to collect information which will enable the contruction of an advertising index for the nuclear energy area and an analysis of its utility.

If this indicator proves reliable, additional indexes may be developed for other energy areas. This will assist greatly in planning recruitment efforts and in manpower planning in general.

The information provided by your organization will be used only in combination with information from other organizations. It will not be revealed in such a manner as to enable individual or organizational identity.

Please return the completed forms to me at the following address:

Mr. Larry L. Barker
Oklahoma State University
406 Classroom Building
Stillwater, Oklahoma 74074

1. Please provide the following information.

____
Name of Individual Providing this Information

____
Title

____
How Long Have you Held the Above Position?

____
Name of Organization

____
Street Address

____
City State Zip Code

Telephone No: FTS________________ Commercial____________

2. Please rank the following recruitment techniques for their EFFECTIVENESS in acquiring quality nuclear and nuclear-related scientific, engineering, and technical personnel.

RANK

⬡ campus recruitment

⬡ help-wanted ads in newspapers

⬡ help-wanted ads in journals and professional magazines

⬡ employment service (State)

⬡ employment service (Private)

⬡ recommendations from present professional staff

⬡ professional meeting recruitment

⬡ other (specify) ________________________

The purpose of this question is to obtain expert opinion gained through actual practical experience as to the effectiveness of each of the recruitment techniques identified.

3. Please rank the following recruitment techniques according to their COST-EFFECTIVENESS in acquiring quality nuclear and nuclear-related scientific, engineering, and technical personnel.

RANK

- ◯ campus recruitment
- ◯ help-wanted ads in newspapers
- ◯ help-wanted ads in journals and professional magazines
- ◯ employment service (State)
- ◯ employment service (Private)
- ◯ recommendations from present professional staff
- ◯ professional meeting recruitment
- ◯ other (specify) ______________________________

The purpose of this question is to ascertain the cost-effectiveness of each of the recruitment techniques identified.

4. Please ESTIMATE the amount of expenditure in the following areas of recruitment for your organizations.
Also, please identify the quality of the above information by placing the following appropriate symbol in each data cell:

(a) based on records - No Symbol
(b) good recollection - *
(c) a fair estimate; could have differed by as much as 20% - #

NOTE 1: Include standard items (e.g., Per Diem, travel expenses, etc.) and also (a) advertising in campus newspapers, and (b) direct labor cost.

NOTE 2: Include standard items (e.g., Per Diem, travel expenses, etc.) and also direct labor cost.

Recruitment Techniques	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Campus Recruitment (See Note 1)											
Help-wanted ads in newspapers											
Help-wanted ads in journals and professional magazines											
Employment service (State)											
Employment service (Private)											
Recommendations from present professional staff											
Professional meeting recruitment (See Note 2)											
Other (specify)											

The purpose of this question is to determine (1) the actual emphasis (in dollars) placed on various modes of recruitment, and (2) the significance of each mode of recruitment in each specified time period. Correlation of this information with employment trends will be used to identify any significant trends which have developed and to determine the feasibility and reliability of this information as labor market indicators.

5. Please list all journals, magazines, and newspapers in which your organization has placed "help-wanted" ads from the period 1967-1977. Attach additional sheets if more space is necessary. The purpose of this information is to develop the universe of advertising media utilized by employers with personnel needs similar to your own. The actual ads in each of these journals and magazines will be noted and an index of the volume of ads will be developed in order to determine if such an index may be used to predict growth in employment in a particular occupational area or a particular industry in general.

6. The results of this effort will be available in August. Would you like a copy of the results for your use and/or comment?

YES ○ NO ○

APPENDIX D

DEPARTMENT OF ENERGY ENDORSEMENT LETTER FOR

PERSONNEL RECRUITMENT INFORMATION REQUEST

Department of Energy
Washington, D.C. 20545

March 21, 1978

Dr. Robert G. Sachs, Director
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439

Dear Bob:

May I ask you for a personal favor? (Or at least for my secretary, who has been a key to anything we've done or tried to do in this office. In fact, the favor is really for her fiance.)

Very simple request: please send the enclosed package to your Personnel Department in the expectation that they could spend a few minutes answering the questions and thereby contributing to the advancement of knowledge (and to the fiance's doctorate in technical education).

Many thanks,

David Israel
Associate Director for Field
and R&D Coordination, OER

Enclosure

MULTIPROGRAM LABORATORIES

Robert G. Sachs, Director
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439

George H. Vineyard, Director
Brookhaven National Laboratory
U. S. ERDA
Upton, Long Island, New York 11973

Harold M. Agnew, Director
Los Alamos Scientific Laboratory
University of California
P. O. Box 1663
Los Alamos, New Mexico 87545

Andrew M. Sessler, Director
Lawrence Berkeley Laboratory
University of California
Berkeley, California 94720

Roger E. Batzel, Director
Lawrence Livermore Laboratory
University of California
P. O. Box 808
Livermore, California 94550

Herman Postma, Director
Oak Ridge National Laboratory
P. O. Box X
Oak Ridge, Tennessee 37830

Tommy W. Ambrose, Director
Pacific Northwest Laboratory
Battelle
P. O. Box 999
Richland, Washington 99352

Morgan Sparks, President
Sandia Laboratories
P. O. Box 5800
Albuquerque, New Mexico 87115

APPENDIX E

REQUEST FOR ASSISTANCE FROM THE ASSISTANT
ADMINISTRATOR FOR FIELD OPERATIONS,
DEPARTMENT ENDORSEMENT OF STUDY

Oklahoma State University

SCHOOL OF OCCUPATIONAL AND ADULT EDUCATION

STILLWATER, OKLAHOMA 74074
CLASSROOM BUILDING 406
(405) 624-6275

March 20, 1978

Mr. David R. Israel
Associate Director for Field
& R&D Coordination, OER
U. S. Department of Energy
20 Massachusetts Avenue, NW
Washington, D. C. 20545

Dear David:

As you know, I am currently on a leave of absence from DOE working on my terminal degree at Oklahoma State University in Stillwater, Oklahoma. I have chosen the task of developing an occupational index for the nuclear energy area for my dissertation topic because of my familiarity in this area. It is my personal belief that nuclear energy will eventually play a major role in this nation's energy effort and thus will require an indicator of manpower requirements for proper planning.

Utilization of an indicator of this nature requires determining the amount of confidence which may be placed in it, which is a major objective in my study. First, however, I need to ascertain the role of help-wanted ads in recruitment and the exact advertising media utilized during the period 1967-1977 by AEC, ERDA, and their contractors.

I have enclosed a form which has been edited by employees of DOE Headquarters. I would appreciate the circulation of the forms to the National Laboratories and appropriate prime contractors for completion. The responses to the questionnaire do not necessitate detailed data, but merely the estimates and opinions of the personnel people in each organization. My experience with the field offices and contractors has been that their estimates and opinions are better than most organizations' records.

I need this information before I can develop the index, so a reasonably quick turn-around is desired (about three weeks).

Your assistance in this matter is greatly appreciated. If the occupational index proves to be a reliable leading-indicator of employment activity in the nuclear energy area, it could prove to be quite effective in planning DOE and DOE contractor recruitment activities in the nuclear area.

Sincerely,

Larry L. Barker
Graduate Research Associate

APPENDIX F

JOURNALS & MAGAZINES IN WHICH DOE NATIONAL LABORATORIES ADVERTISE FOR EMPLOYEES

All National Laboratories

Nuclear News
Science
Chemical & Engineering News

Seven National Laboratories

Computer World -- Battelle, BNL, Sandia, Los Alamos, LBL, LLL, AGR

Six National Laboratories

Mechanic Engineering -- BNL, Argonne, ORNL, LBL, Battelle, LLL

Five National Laboratories

Physics Today -- Battelle, Los Alamos, LBL, LLL, AGR
Engineering News Record -- ORNL, BNL, LBL, LLL, AGR

Four National Laboratories

Geotimes -- Los Alamos, LLL, LBL, AGR
IEEE Spectrum -- Los Alamos, Sandia, LLL, AGR
Black Collegian -- Los Alamos, LBL, LLL, AGR
American Ceramic Society Bulletin -- Sandia, LASL, LBL, LLL
Chemical Engineering Progress -- Sandia, Argonne, ORNL, LLL

Three National Laboratories

College Placement Annual -- Sandia, Argonne, LLL
Journal of Electrochemical Society -- LBL, Argonne, LASL
Journal of Metals -- LBL, Argonne, LLL
Power Engineering -- Battelle, ORNL, AGR
Communications of the ACM -- LBL, LASL, LLL
Metal Progress -- Battelle, Los Alamos, LLL
American Industrial Hygiene Assoc. Journal -- Battelle, Los Alamos, LLL
Quality Progress -- Battelle, ORNL, LLL
Oil and Gas Journal -- Los Alamos, LBL, LLL
Laser Focus -- Sandia, Los Alamos, LLL
American Ceramic Society Bulletin -- Sandia, Los Alamos, LBL
Environmental Science & Technology -- LBL, LLL, Argonne

Two National Laboratories

Machine Design -- Battelle, LLL
Quality Progress -- Battelle, LLL
Instrumentation Technology -- ORNL, AGR
Affirmative Action Register -- BNL, LBL
Energy User News -- BNL, AGR
Operation Research -- Sandia, LLL
Mining Engineering -- Sandia, AGR
Datamation -- Los Alamos, LLL
Heating, Pipe & Air Conditioning -- Los Alamos, AGR
Optical Engineering -- Los Alamos, LLL
Optical Spectra -- Los Alamos, LLL
Power -- LBL, AGR
Special Libraries Assn. -- Sandia, Argonne
The (AMA) Journal -- Sandia, LLL
Black Careers -- BNL, LBL
Electrical World -- ORNL, Argonne
Chemical Engineering -- LLL, AGR
Collegiate Women's Career -- LLL, AGR
Ground Water Age -- LLL, AGR
Management Science -- LLL, AGR
Journal of Air Pollution Control Society -- LASL, Argonne
Assn. of Women in Science Newsletter -- Argonne, LASL
Equal Opportunity Forum -- LASL, LLL
Chronicle of Higher Education -- LASL, Argonne
Am. Meteorological Society Employment Bulletin -- Battelle, Argonne

One National Laboratory

Battelle -- Ceramic Bulletin
Radiation Research Society Bulletin
Transactions of American Geophysical Union
National Contract Management Association Newsletter
American Society of Zoologists (job placement service newsletter)
American Veterinary Medical Association

ORNL -- Mfg. Engineering
Numerical Control
Design News

BNL -- Amsterdam News
Newsday

Sandia -- Journal of Accounting
Internal Auditor
Human Factors
Astronautics & Aeronautics Communications
Journal of Medicine

<u>One National Laboratory</u> - Continued

Sandia -- Geophysics
Uranium Empire Reporter
Navy Times
Human Factors Society Bulletin
National Consortium for Black Professional Development
Rocky Mountain Medicine Journal
Traffic Management

Los Alamos -- Computer
Purchasing
Purchasing Management
Welding Journal
Specifying Engineering
Pating and Surface Finishing
Electronic Engineering Times
Electronic Design News
Editor and Publisher
Applied Optics
Purchasing World

LBL -- American Journal of Epidemiology
Architectural Record
Progressive Architecture
Fire Engineering
Bulleting of the Am. Society for Information Science
Control Engineering

LLL -- Journal of Patent Office Society
American Society of Safety Engineers
The Plant Engineer
National Fire Protection Association
Western City Magazine
Tuskegee Engineering Review
Cal Tech Yearbook
Professional Safety
Welding Journal
FASEB
Journal of Occupational Medicine
ASM News
Materials Evaluation
MIT Yearbook
New Mexico State Yearbook
CORE
NCBPD Conference
Electronics
Genetics Journal
No. Calif. Council of Black Professional Engineers
National Defense
Personnel Journal
Personnel Administrator
Women in Business
Plant Engineering
Analytical Chemistry

One National Laboratory - Continued

LLL -- Fire Command
Journal of Nuclear Medicine
New England Journal of Medicine
Journal of American Medical Association
Placement Manuals
Southern Engineering Intercom
California Engineer
Journal of AIAA
OR/MS Today
Journal of Petroleum Technology
Safety Journal
Materials Evaluation
Dignity Institute of Science

Argonne -- Agricultural Engineering
American City & County
ASHRAE Journal
Aspo TAB
Atmospheric Environment
Bent of Tau Beta Pi
Business World for Women
Chicago Medicine
Civil Engineering
Coal Mining & Procession
Consulting Engineer
District Heating
Encore
Health Physics (N.Y.)
Library Journal
MBA
Medical Record News
NABE News
Nature
New Directions for Women
New Engineer
New Scientist
Passenger Transport
Practicing Planner
Solid Wastes Management
Spokeswoman
Water & Waste Engineering
Water Well Journal

APPENDIX G

NEWSPAPERS IN WHICH DOE NATIONAL LABORATORIES ADVERTISE FOR EMPLOYEES

Seven Reporting Laboratories

San Francisco Chronicle/Examiner	-- LBL, LLL, Sandia, BNL, Argonne, Battelle, LASL
Wall Street Journal	-- LBL, LLL, Sandia, BNL, Argonne, Battelle (Palo Alto), LASL

Six Reporting Laboratories

Los Angeles Times	-- LBL, LLL, Argonne, Sandia, LASL, Battelle

Five Reporting Laboratories

Chicago Tribune	-- BNL, Argonne, LASL, LLL, Battelle
Denver Post	-- LLL, Sandia, Argonne, Battelle, LASL
Boston Globe	-- LBL, LLL, Argonne, BNL, LASL

Four Reporting Laboratories

Seattle Times	-- LBL, LLL, Argonne, Battelle
San Jose Mercury News	-- LBL, LLL, Battelle, LASL
San Diego Union/Tribune	-- LBL, LLL, Battelle, LASL
Houston Chronicle	-- Sandia, Argonne, Battelle, LASL
The Dallas Times Herald	-- LBL, Argonne, Battelle, LASL
Phoenix Republic Gazette	-- Sandia, Argonne, LASL, LLL
New York Times	-- LLL, BNL, Argonne, LASL
Pittsburgh Press Post-Gazette	-- Argonne, Battelle, LASL, LLL

Three Reporting Laboratories

Washington Post	-- Argonne, Battelle, LLL
Albuquerque Journal	-- Sandia, Argonne, LASL
St. Louis Post-Dispatch	-- Argonne, LASL, LLL
Seattle Post-Intelligencer	-- Argonne, Battelle, LLL
Navy Times	-- LLL, Sandia, Argonne

Two Reporting Laboratories

The Oregonian/Oregon Journal	-- Battelle, LLL

Two Reporting Laboratories - Continued

Las Vegas Review Journal	-- Battelle, LLL
Albuquerque Tribune	-- Argonne, Sandia
Minneapolis Star Tribune	-- Sandia, LASL
Contra Costa Times	-- LLL, LBL
El Mundo (Oakland)	-- LLL, LBL
El Mundo (Berkeley)	-- LLL, LBL
Houston Post	-- Argonne, LLL
Electronic News	-- LLL, LBL
Richmond (Va.) Independent	-- LBL, LLL
Hayward Daily Review	-- LBL, LLL
Kansas City Star	-- Sandia, LASL
Oakland Tribune	-- LLL, LBL

One Reporting Laboratory

Battelle -- Yakima Herald Republic
Wenatchee World
Spokesman Review/Spokane Daily Chronicle
Eugene Register Guard (Eugene, Oregon)
International Press Associates, Inc. (Ads run in all Black newspapers in Washington, Oregon & California)
The Idaho Stateman (Boise)
Jimmy Come Lately Gazette (Sequim, Washington)
The Salt Lake Tribune/Desert News
Lynchburg (Va.) News and Advance
Hartford (Conn.) Courant
New London (Conn.) Day
Wilmington (N.C.) Star News
Walla Walla Union Bulletin

Sandia -- El Paso Times
Cincinnati Inquirer
Navajo Times
El Hispano
New Mexico Independent
Toledo Blade
Detroit News
Memphis Communications Appeal
Wichita Eagle-Beacon
Oklahoma City Times
Dallas Morning News
Sandia Public Informer
Port Authur News
Beaumont Enterprise
Times Picayune

LASL -- Arkansas Gazette
Atlanta Journal/Constitution
Santa Fe New Mexican
El Paso Herald Post

LBL -- Berkeley Gazette
Oakland Post

One Reporting Laboratory - Continued

LBL -- Tri-Valley Herald/News
San Francisco Sun/Register
BNL -- New York News
Argonne -- Aurora Beacon
Chicago Defender
Chicago Sun-Times
Denver Rocky Mountain News
El Informador
Joliet Herald News
La Grange Suburban Life
Springfield State Journal Register
Suburban Tribune (Little Trib)
LLL -- Sacramento Bee
Stockton Record
Tracy Press
Palo Alto Times
Huntsville Times
Vallejo Times
Livermore Herald
Daily Pacific Builder
Modesto Bee
Napa Register
Tucson Star Citizen
Sacramento Union
Valley Times
Democrat and Chronicle (Rochester, N.Y.)
Tucson Star
Rochester Times
No. California Electronics News
So. California Electronics News
Reporter Dispatch (White Plains, N.Y.)
Honolulu Star
Reno Gazette State
Philadelphia Inquirer
Santa Ana Register
American Statistical Association
Santa Rosa Press
Livermore Independent
Dallas News
Spokane
Pasco
Detroit
Minneapolis
Albany, N.Y.
Milwaukee
Atlanta
Cleveland
Cincinnati
Electronics Engineering Times

APPENDIX H

TOTAL AD VOLUME

<u>PHYSICS TODAY</u>

1966-1977

	Area	Number Of Ads	Number Of Pages
1966			
January	3890.45	37	20
February	5393.85	52	24
March	4234.31	31	22
April	5098.66	45	29
May	5555.03	36	28
June	5061.23	46	27
July	4384.64	29	22
August	3338.48	28	16
September	2983.23	28	17
October	2535.87	14	12
November	3363.35	33	20
December	3890.82	35	23
1967			
January	2211.19	22	12
February	2770.86	24	13
March	3738.64	36	20
April	2195.04	22	12
May	2814.86	26	15
June	2021.51	20	10
July	1662.68	21	12
August	1991.71	20	10
September	1155.35	16	9
October	2255.08	15	11
November	755.37	6	4
December	2079.83	28	10
1968			
January	2810.61	34	14
February	2379.5	22	14
March	879.39	19	6
April	2040.25	24	10
May	712.25	13	6
June	1758.94	15	8
July	1405.54	15	6
August	1764.4	16	9
September	1679.38	15	8
October	1354.69	18	9
November	1830.59	20	10
December	843.15	13	3

	Area	Number Of Ads	Number Of Pages
1969			
January	1068.53	20	7
February	1466.08	24	9
March	1674.25	25	12
April	1717.4	23	7
May	1292.69	15	8
June	1061.32	14	6
July	971.22	12	
August	773.09	8	4
September	1369.31	19	7
October	928.36	9	7
November	1165.98	9	5
December	1228.86	20	5
1970			
January	612.92	15	
February	583.92	19	4
March	930.7	17	6
April	260.52	7	3
May	95.48	9	1
June	463.64	9	2
July	525.15	9	2
August	535.15	8	
September	581.35	8	4
October	639.1	7	3
November	512.82	8	2
December	400.4	2	2
1971			
January	474.08	9	2
February	666.05	16	3
March	206.29	4	1
April	629.86	9	4
May	541.31	9	2
June	616.26	7	4
July	547.67	7	
August	229.83	4	1
September	676.29	12	3
October	149.38	5	1
November	406.04	11	2
December	371.14	13	2

	Area	Number Of Ads	Number Of Pages
1972			
January	443.21	8	2
February	319.81	11	2
March	738.43	12	4
April	201.23	9	2
May	505.89	6	2
June	186.34	4	1
July	121.66	6	1
August	353.43	7	2
September	631.4	10	3
October	348.3	11	1
November	624.73	14	3
December	558.36	13	3
1973			
January	659.66	18	2
February	801.06	25	5
March	1027.6	25	6
April	250.1	12	
May	665.29	15	5
June	290.29	14	2
July	629.14	15	3
August	625.81	17	2
September	926.31	18	5
October	503.33	21	3
November	521.34	17	3
December	1086.98	33	4
1974			
January	1444.73	36	6
February	743.05	32	4
March	1591.6	37	8
April	638.21	32	3
May	799.23	27	3
June	653.74	30	5
July	375.38	13	3
August	493.06	22	4
September	1148.85	32	5
October	772.05	34	5
November	1009.84	32	4
December	1219.98	70	5

	Area	Number Of Ads	Number Of Pages
1975			
January	1385.65	64	
February	1161.29	46	
March	1685.89	64	
April	1330.31	53	
May	980.58	45	
June	1070.41	42	
July	1103.78	34	
August	521.43	23	
September	1108.67	42	
October	909.38	39	
November	1822.35	54	
December	1293.6	75	
1976			
January	NA		
February	1365.4	78	
March	759.61	62	
April	NA		
May	1231.8	64	
June	1001.41	56	
July	840.95	40	
August	637.46	38	
September	1314.95	57	
October	791.38	49	
November	1223.31	59	
December	1445.63	76	
1977			
January	1758.04	90	
February	NA		
March	1400.75	75	
April	1408.31	79	
May	1309.81	65	
June	1230.69	55	
July	635.34	43	
August	776.21	54	
September	1540.8	70	
October	NA		
November	1346.92	49	
December	NA		

APPENDIX I

UNIVERSITY AD VOLUME - PHYSICS TODAY

1966-1977

	Area	Number Of Ads
1966		
January	58.52	3
February	113.27	7
March		
April	118.58	3
May	48.51	2
June	125.51	5
July		
August		
September	17.71	1
October	106.77	1
November	273.09	6
December	17.71	1
1967		
January	36.19	2
February	76.77	4
March	98.32	5
April	84.19	3
May	84.19	3
June	77.77	5
July	68.53	5
August	85.49	3
September		
October	14.63	1
November		
December	63.91	4
1968		
January	153.5	6
February	84.12	3
March	150.95	6
April	221.25	7
May	60.06	4
June		
July	79.08	3
August		
September	41.58	1
October	67.42	2
November	16.17	1
December	49.28	2

	Area	Number Of Ads
1969		
January	84.47	4
February	147.84	6
March	61.6	4
April	33.88	2
May	55.44	1
June		
July	53.9	3
August	17.71	1
September	33.88	2
October		
November	19.25	1
December	36.96	2
1970		
January	100.87	4
February	70.07	4
March	51.35	3
April	18.48	1
May	9.24	1
June	14.63	1
July	14.63	1
August	22.33	1
September	21.56	1
October		
November	34.65	1
December		
1971		
January	40.81	3
February	66.22	4
March		
April		
May	31.57	1
June		
July	15.6	1
August		
September	90.86	4
October		
November	13.86	1
December		

	Area	Number Of Ads
1972		
January		
February	88.55	4
March	16.94	1
April	15.4	1
May	14.63	1
June		
July	14.63	1
August	33.11	2
September		
October		
November	50.05	3
December	33.48	2
1973		
January	117.81	7
February	103.18	6
March	165.55	11
April	43.89	3
May	73.92	5
June	59.29	4
July	44.66	2
August	16.17	1
September	62.37	4
October	148.61	8
November	90.09	5
December	195.58	13
1974		
January	324.17	14
February	211.75	12
March	304.93	17
April	230.96	13
May	173.61	11
June	178.27	12
July	136.3	7
August	74.69	5
September	235.63	13
October	225.22	12
November	578.25	15
December	522.78	29

	Area	Number Of Ads
1975		
January	500.13	28
February	406.5	21
March	572.21	30
April	333.41	19
May	258.72	16
June	275.44	15
July	232.91	15
August	234.73	12
September	202.5	12
October	145.14	8
November	361.15	20
December	439.67	25
1976		
January	NA	NA
February	603.29	36
March	496.11	28
April	NA	NA
May	358.06	22
June	408.82	24
July	279.45	16
August	213.86	15
September	674.15	29
October	383.12	21
November	358.57	24
December	628.27	37
1977		
January	582.13	37
February	NA	NA
March	442.19	28
April	704.47	36
May	515.47	27
June	510.69	25
July	306.3	20
August	256.68	15
September	690.96	35
October	NA	NA
November	237.18	14
December	NA	NA

APPENDIX J

POST DOCTORATE AD VOLUME

PHYSICS TODAY

1966-1977

	Area	Number Of Ads
1966	NA	NA
1967	NA	NA
1968	NA	NA
1969	NA	NA
1970		
January - August	NA	NA
September	15.5	1
October - December	NA	NA
1971	NA	NA
1972	NA	NA
1973		
January - June	NA	NA
July	29.26	2
August	13.09	1
September	37.73	2
October	NA	NA
November	NA	NA
December	15.4	1
1974		
January	30.03	1
February	31.57	2
March	53.13	3
April	27.72	2
May	66.59	4
June	13.86	1
July	9.62	1
August	NA	NA
September	12.71	1
October	200.58	6
November	68.53	3
December	31.57	3

	Area	Number Of Ads
1975		
January	141.69	8
February	36.2	4
March	100.86	7
April	197.52	12
May	191.73	13
June	76.61	6
July	77.0	5
August	55.83	4
September	67.37	6
October	106.65	8
November	82.4	5
December	122.05	8
1976		
January	NA	NA
February	132.95	11
March	150.38	9
April	NA	NA
May	121.4	9
June	263.19	17
July	102.49	7
August	114.31	9
September	175.44	13
October	103.07	9
November	164.99	8
December	270.53	18
1977		
January	189.03	15
February	NA	NA
March	264.67	17
April	197.3	14
May	137.9	11
June	268.49	9
July	149.74	11
August	375.99	30
September	256.71	15
October	NA	NA
November	218.32	10
December	NA	NA

APPENDIX K

GRADUATE AD VOLUME - PHYSICS TODAY

1966-1977

	Area	Number Of Ads
1966		
January		
February	32.34	2
March		
April	19.25	1
May		
June		
July	19.25	1
August		
September	18.49	1
October		
November		
December	51.59	2
1967		
January	67.76	3
February	47.28	3
March	15.4	1
April		
May	15.4	1
June		
July		
August		
September		
October		
November		
December	31.57	1
1968		
January	47.74	3
February	30.08	2
March	97.02	3
April	80.08	3
May		
June		
July	16.7	1
August		
September	32.34	2
October	46.54	2
November		
December	16.94	1

	Area	Number Of Ads
1969		
January	68.53	3
February	19.25	1
March	30.8	2
April	36.96	2
May	23.21	1
June	18.48	1
July		
August		
September	17.71	1
October	16.17	1
November		
December	63.14	3
1970		
January	80.08	3
February	36.19	2
March		
April		
May		
June	33.11	2
July		
August		
September		
October		
November	21.56	1
December		
1971		
January		
February	16.94	1
March	18.48	1
April	61.6	1
May		
June		
July		
August		
September		
October		
November	16.94	1
December	16.17	1

	Area	Number Of Ads
1972		
January	30.03	2
February		
March	48.51	3
April	16.17	1
May		
June		
July	15.4	1
August		
September		
October	15.4	1
November	84.7	4
December	36.19	2
1973		
January	43.89	3
February	36.19	2
March	58.52	4
April	30.8	2
May	14.63	1
June	29.26	2
July		
August	19.25	1
September		
October		
November	76.23	5
December	89.32	6
1974		
January	108.57	7
February	63.91	4
March	33.88	2
April	85.86	6
May	41.58	2
June	44.27	3
July		
August	15.4	2
September	8.08	1
October	23.49	3
November	50.44	4
December	135.9	9

	Area	Number Of Ads
1975		
January	197.13	13
February	157.01	10
March	191.62	12
April	90.86	7
May	100.48	6
June	52.36	4
July		
August	7.7	1
September	31.19	3
October	102.42	5
November	143.99	10
December	260.27	16
1976		
January	NA	NA
February	194.11	13
March	159.9	10
April	NA	NA
May	80.93	6
June	32.48	3
July	23.63	1
August	7.38	1
September	10.34	1
October	80.65	5
November	114.9	9
December	66.16	5
1977		
January	280.60	18
February	NA	NA
March	156.19	12
April	144.15	9
May	114.61	7
June	58.49	3
July	7.38	1
August		
September	7.38	1
October	NA	NA
November	178.14	9
December	NA	

APPENDIX L

FOREIGN AD VOLUME - *PHYSICS TODAY*

1966-1977

	Area	Number Of Ads
1966		
January	33.89	1
February	187.2	2
March	80.08	1
April	186.85	2
May	480.48	2
June	106.26	4
July	91.12	2
August	121.66	2
September	20.02	1
October		
November		
December	197.12	6
1967		
January	16.17	1
February	30.09	1
March	127.82	5
April	96.02	2
May	190.96	2
June	15.4	1
July	67.76	1
August	353.43	2
September	38.5	2
October		
November		
December	203.82	11
1968		
January	194.81	8
February	67.76	2
March	144.53	4
April	185.57	5
May	105.49	2
June	102.41	4
July	131.67	3
August	421.19	5
September	422.99	4
October	69.8	2
November	100.1	3
December	82.39	3

	Area	Number Of Ads
1969		
January	140.14	5
February	113.19	4
March	223.3	4
April	355.78	8
May	72.38	2
June	155.28	3
July	234.59	3
August	133.47	2
September	287.98	4
October	99.33	2
November	401.17	3
December	482.79	7
1970		
January	224.84	5
February	214.32	7
March	238.19	6
April	84.7	2
May	18.48	2
June	77.77	4
July	49.28	3
August	149.38	4
September	207.9	4
October	46.2	2
November	103.18	4
December	80.08	1
1971		
January	112.95	5
February	149.38	7
March	107.33	3
April	214.83	5
May	174.02	6
June	215.86	5
July	196.35	4
August	214.43	3
September	148.46	4
October	88.55	4
November	118.58	5
December	221.76	8

	Area	Number Of Ads
1972		
January	50.51	3
February	145.53	4
March	88.55	3
April	84.7	4
May	90.86	3
June	186.34	4
July	45.43	1
August	113.19	2
September	120.12	5
October	224.84	7
November	72.38	3
December	97.02	4
1973		
January	177.64	7
February	208.67	9
March	82.65	3
April	41.94	5
May	68.02	2
June	117.81	5
July	166.37	6
August	318.01	7
September	121.15	4
October	190.19	7
November	164.06	4
December	108.57	6
1974		
January	460.46	8
February	213.29	7
March	194.04	7
April	175.09	6
May	120.5	4
June	122.81	5
July	110.11	3
August	261.04	7
September	173.25	6
October	64.28	4
November	97.03	4
December	256.78	12

	Area	Number Of Ads
1975		
January	143.22	6
February	60.44	3
March	119.74	6
April	258.07	7
May	67.75	5
June	193.23	7
July	298.37	9
August	54.28	3
September	139.76	6
October	345.46	8
November	426.7	11
December	207.52	11
1976		
January	NA	
February	155.42	6
March	187.23	6
April	NA	
May	359.86	10
June	50.80	4
July	210.05	10
August	129.97	7
September	330.05	9
October	133.22	7
November	195.12	10
December	141.48	7
1977		
January	211.67	9
February	NA	
March	113.72	7
April	199.98	12
May	276.23	10
June	273.67	13
July	90.38	6
August	91.84	6
September	137.36	8
October	NA	
November	262.96	7
December	NA	

APPENDIX M

INDUSTRY AD VOLUME - PHYSICS TODAY

1966-1977

	Area	Number Of Ads
1966		
January	3297.8	21
February	4880.34	36
March	4084.07	28
April	4579.21	36
May	4832.77	29
June	4421.1	32
July	3915.45	22
August	3047.93	23
September	2520.97	20
October	2108.78	10
November	2731.44	23
December	3509.67	24
1967		
January	1947.34	14
February	2502.77	14
March	3245.05	21
April	1714.79	12
May	2277.65	16
June	1601.61	9
July	1170.65	11
August	1306.13	11
September	842.73	10
October	1990.71	10
November	560.56	3
December	1616.99	9
1968		
January	2094.24	13
February	1948.62	11
March	293.62	3
April	1354.69	6
May	348.81	4
June	1410.64	7
July	1074.92	6
August	1146.86	8
September	934.27	4
October	920.99	8
November	1225.88	10
December	643.72	5

	Area	Number Of Ads
1969		
January	595.21	5
February	896.28	8
March	1088.79	10
April	1030.26	7
May	955.06	7
June	688.36	6
July	587.25	4
August	515.13	3
September	835.96	8
October	747.41	5
November	531.3	3
December	548.95	5
1970		
January	141.68	2
February	160.93	3
March	400.15	5
April	53.39	1
May	35.42	4
June	320.32	1
July	382.69	3
August	320.32	1
September	320.32	1
October	560.56	3
November	353.43	2
December	320.32	1
1971		
January	320.32	1
February	418.11	3
March	80.08	1
April	320.32	1
May	335.72	2
June	400.4	2
July	335.72	2
August		
September	436.97	4
October	60.83	1
November	149.89	3
December	102.26	2

	Area	Number Of Ads
1972		
January	351.89	2
February	15.4	1
March	400.4	2
April		
May	400.4	2
June		
July	14.63	1
August	207.13	3
September	480.48	3
October	108.06	3
November	257.44	3
December	201.48	2
1973		
January	320.32	1
February	404.51	5
March	495.11	4
April	133.47	2
May	494.09	6
June	83.93	3
July	374.22	4
August	214.63	4
September	675.8	6
October	149.9	5
November	14.63	1
December	662.71	6
1974		
January	474.24	4
February	163.24	3
March	800.8	4
April	80.08	1
May	356.51	2
June	274.51	6
July	106.26	1
August	110.76	4
September	719.18	11
October	211.89	5
November	28.87	3
December	157.08	5

	Area	Number Of Ads
1975		
January	354.2	3
February	489.59	7
March	491.64	3
April	240.24	2
May	320.32	1
June	435.43	6
July	480.48	3
August	133.47	2
September	625.5	10
October	176.21	6
November	640.64	5
December	83.92	5
1976		
January	NA	
February	220.54	5
March	41.96	1
April	NA	
May	208.46	5
June	135.62	3
July	215.88	4
August	164.56	5
September	106.07	3
October	68.82	4
November	360.20	5
December	155.11	5
1977		
January	467.14	7
February	NA	
March	241.97	7
April	136.79	5
May	232.23	5
June	104.88	3
July	82.14	5
August	51.7	3
September	420.62	8
October	NA	
November	435.55	7
December	NA	

APPENDIX N

PEACE CORPS AD VOLUME - PHYSICS TODAY

1966-1977

	Area	Number Of Ads
1966	NA	NA
1967	NA	NA
1968	NA	NA
1969	NA	NA
1970	NA	NA
1971	NA	NA
1972	NA	NA
1973		
January		
February		
March		
April		
May		
June		
July		
August		
September	14.63	1
October		
November	16.17	1
December	15.4	1
1974		
January	14.63	1
February	14.63	1
March	15.4	1
April	13.86	1
May	15.4	1
June		
July		
August		
September		
October	12.32	1
November	12.32	1
December	12.32	1

	Area	Number Of Ads
1975		
January	12.32	1
February	11.55	1
March	11.55	1
April	13.09	1
May	11.55	1
June	12.32	1
July		
August		
September		
October		
November	8.47	1
December	8.47	1
1976		
January		
February	8.27	1
March	8.57	1
April		
May	8.27	1
June	8.27	1
July		
August		
September		
October	8.27	1
November	7.38	1
December	7.97	1
1977		
January	7.97	1
February		
March	7.97	1
April	7.9	1
May	7.97	1
June	7.97	1
July		
August		
September		
October		
November		
December		

APPENDIX O

POSITION WANTED AD VOLUME - PHYSICS TODAY

1966-1977

	Area	Number Of Ads
1966		
January	276.43	9
February	40.04	3
March - December	NA	NA
1967		
January - March	NA	NA
April	15.4	1
May - December	NA	NA
1968		
January - November	16.94	1
1969		
January	NA	NA
February	15.4	1
March	15.4	1
April		
May	20.79	1
June		
July	15.4	1
August		
September	33.11	2
October		
November		
December	31.57	2
1970		
January	NA	NA
February	20.02	1
March		
April	18.48	1
May	32.34	2
June	17.71	1
July	17.1	1
August	43.12	2
September	16.17	1
October	32.34	2
November	NA	NA
December	NA	NA

	Area	Number Of Ads
1971		
January	NA	NA
February	15.4	1
March		
April	33.11	2
May		
June		
July		
August	15.4	1
September		
October		
November	106.77	11
December	26.95	2
1972		
January	10.78	1
February	70.33	2
March	23.87	2
April	84.96	3
May		
June		
July	31.57	2
August		
September	30.8	2
October		
November		
December	30.03	2
1973		
January	NA	NA
February	48.51	3
March	65.61	2
April		
May	14.63	1
June		
July	14.63	1
August	44.66	3
September	14.63	1
October	14.63	1
November	NA	NA
December	NA	NA

	Area	Number Of Ads
1974		
January	14.63	1
February	44.66	3
March	29.26	2
April	24.64	3
May	25.04	3
June	20.02	3
July	13.09	1
August	31.17	4
September		
October	34.27	3
November	14.24	1
December	103.55	11
1975		
January	36.96	5
February	NA	NA
March	38.11	4
April	36.96	4
May	30.03	3
June	25.02	3
July	15.02	2
August	35.42	1
September	42.35	5
October	33.50	4
November	9.62	1
December	85.85	9
1976		
January	NA	NA
February	50.82	6
March	51.41	6
April	NA	NA
May	81.53	10
June	22.15	3
July	9.45	1
August	7.38	1
September	18.90	2
October	14.23	2
November	22.15	2
December	15.95	2

	Area	Number Of Ads
1977		
January	19.5	3
February	NA	NA
March	5.02	1
April	17.72	2
May	25.4	4
June	6.5	1
July	NA	NA
August	NA	NA
September	27.77	3
October	NA	NA
November	8.27	1
December	NA	NA

APPENDIX P

EMPLOYMENT SERVICE AD VOLUME - PHYSICS TODAY

1966-1977

	Area	Number Of Ads
1966		
January	223.81	3
February	140.66	2
March	160.16	2
April	194.71	3
May		
June	408.36	5
July	358.82	4
August	168.89	3
September	406.05	5
October	320.32	3
November	114.73	4
December		2
1967		
January	143.73	2
February	113.95	2
March	252.05	4
April	284.64	4
May	246.66	4
June	326.73	5
July	355.74	5
August	246.66	4
September	274.12	4
October	249.74	4
November	194.81	3
December	163.54	3
1968		
January	320.32	4
February	248.2	4
March	193.27	3
April	198.66	3
May	197.89	3
June	245.89	4
July	103.17	2
August	196.35	3
September	248.2	4
October	249.94	4
November	488.44	6
December	33.88	1

	Area	Number Of Ads
1969		
January	180.18	3
February	274.12	4
March	254.36	4
April	260.52	4
May	165.81	3
June	219.2	4
July	80.08	1
August	106.78	2
September	160.67	2
October	65.45	1
November	214.06	2
December	65.45	1
1970		
January	65.45	1
February	82.39	2
March	241.01	3
April	85.47	2
May		
June		
July	65.45	1
August		
September		
October		
November		
December		
1971	NA	NA
1972		
January		
February		
March	160.16	1
April		
May		
June		
July		
August		
September		
October		
November	160.16	1
December	160.16	1

	Area	Number Of Ads
1973		
January		
February		
March	160.16	1
April		
May		
June		
July		
August		
September		
October		
November	160.16	1
December		
1974		
January		
February		
March	160.16	1
April		
May		
June		
July		
August		
September		
October		
November	160.16	1
December		
1975		
January		
February		
March	160.16	1
April	160.16	1
May		
June		
July		
August		
September		
October		
November	149.38	1
December		

	Area	Number Of Ads
1976		
January		
February		
March	160.16	1
April		
May		
June	80.08	1
July		
August		
September		
October		
November		
December	160.16	1
1977		
January		
February		
March	160.16	1
April		
May		
June		
July		
August		
September		
October		
November	6.5	1
December		

APPENDIX Q

NUCLEAR INDUSTRY AD VOLUME

YEAR/MONTH	TOTAL		GOCO		PRIVATE	
	Area	Number Of Ads	Area	Number Of Ads	Area	Number Of Ads
1966						
January	118.58	1			118.58	1
February	696.18	5	480.49	2	215.69	3
March	507.18	3	427.1	2	80.08	1
April	800.81	6	640.65	5	160.16	1
May	443.25	6	283.1	5	160.16	1
June	539.52	5	32.34	1	507.18	4
July	160.16	1			160.16	1
August	987.65	8	320.32	4	667.33	4
September	194.04	2			194.04	2
October	293.63	2	293.63	2		
November	783.49	7	276.32	4	507.17	3
December	630.53	6	596.65	5	33.88	1
1967						
January	458.41	4	458.41	4		
February	698.91	5	507.18	3	191.73	2
March	694.03	4	533.87	3	160.16	1
April	213.55	1	213.55	1		
May	213.55	1	213.55	1		
June	0					
July	136.8	2	136.8	2		
August						
September	80.08	1	80.08	1		
October	320.32	1			320.32	1
November	0					
December	106.77	1	106.77	1		
1968						
January	533.88	2	213.55	1	320.33	1
February	160.16	2			160.16	2
March	80.08	1	80.08	1		
April	0					
May	0					
June	0					
July	0					
August	53.39	1			53.39	1
September	0					
October	0					
November	114.73	2			114.73	2
December	0					

YEAR/MONTH	TOTAL		GOCO		PRIVATE	
	Area	Number Of Ads	Area	Number Of Ads	Area	Number Of Ads
1969						
January thru August	0					
September	155.29	2	106.77	1	48.51	1
October	106.77	1	106.77	1		
November	0					
December	0					
1970						
January	0					
February	0					
March	213.55	1	213.55	1		
April thru September	0					
October	80.08	1			80.08	1
November	0					
December	0					
1971						
January thru June	0					
July	80.08	1	80.08	1		
August thru December	0					
1972						
January thru September	0					
October	53.39	1	53.39	1		
November	0					
December	0					
1973						
January thru March	0					
April	53.39	1	53.39	1		
May thru August	0					

YEAR/MONTH	TOTAL		GOCO		PRIVATE	
	Area	Number Of Ads	Area	Number Of Ads	Area	Number Of Ads
1973 - Continued						
September	22.23	1	22.23	1		
October thru December	0					
1974						
January	0					
February	0					
March	320.32	1	320.32	1		
April	0					
May	0					
June	80.08	1	80.08	1		
July	0					
August	0					
September	24.64	1			24.64	1
October	133.47	1	133.47	1		
November	46.2	1	46.2	1		
December	0					
1975						
January	11.94	1	11.94	1		
February	0					
March	106.77	1	106.77	1		
April	106.77	1	106.77	1		
May	0					
June	106.77	1	106.77	1		
July	0					
August	53.39	1			53.39	1
September	53.39	1	53.39	1		
October	16.17	1	16.17	1		
November	106.77	1	106.77	1		
December	0					
1976						
January	Missing					
February	49.64		15.96		33.68	2
March	0					
April	Missing					
May	80.08	1	80.08	1		
June	0					
July	0					
August	91.30	2	80.08	1	11.22	1
September	91.89	2	11.81	1	80.08	1
October	0					

YEAR/MONTH	TOTAL		GOCO		PRIVATE	
	Area	Number Of Ads	Area	Number Of Ads	Area	Number Of Ads
1976 - Continued						
November	355.73	4	35.41	1	320.52	3
December	77.99	3	77.99	3		
1977						
January	34.27	1	34.27	1		
February	Missing					
March	54.36	2	21.86	1	32.5	1
April	110.5	3	30.42	2	80.08	1
May	14.47	1	14.47	1		
June	154.76	3	154.76	3		
July	58.19	3	58.19	3		
August	18.02	1	18.02	1		
September	123.46	2	123.46	2		
October						
November	181.43	3	160.16	2	21.27	1
December						

APPENDIX R

CURRENT POPULATION SURVEY FOR PHYSICISTS AND PHYSICS INSTRUCTORS

1972-1977

PHYSICISTS CURRENT POPULATION SURVEY

1972-1977

	Labor Force	Employed	Unemployed
1972			
1st Quarter	28	26	2
2nd Quarter	19	19	0
3rd Quarter	21	21	0
4th Quarter	52	25	0
1973			
1st Quarter	27	27	0
2nd Quarter	25	25	0
3rd Quarter	28	27	1
4th Quarter	21	21	0
1974			
1st Quarter	10	10	0
2nd Quarter	16	16	0
3rd Quarter	21	21	0
4th Quarter	23	23	0
1975			
1st Quarter	18	15	3
2nd Quarter	13	12	1
3rd Quarter	24	23	1
4th Quarter	26	25	1
1976			
1st Quarter	29	28	1
2nd Quarter	24	23	1
3rd Quarter	32	32	0
4th Quarter	27	27	0
1977			
1st Quarter	27	24	3
2nd Quarter	30	30	0
3rd Quarter	29	28	1
4th Quarter	29	27	2

PHYSICS INSTRUCTORS CURRENT POPULATION SURVEY

1972-1977

	Labor Force	Employed	Unemployed
1972			
1st Quarter	13	12	1
2nd Quarter	13	13	0
3rd Quarter	15	15	0
4th Quarter	20	20	0
1973			
1st Quarter	18	18	8
2nd Quarter	10	10	0
3rd Quarter	13	13	0
4th Quarter	15	15	0
1974			
1st Quarter	13	13	0
2nd Quarter	11	11	0
3rd Quarter	11	11	0
4th Quarter	14	12	2
1975			
1st Quarter	15	13	2
2nd Quarter	8	8	0
3rd Quarter	6	6	0
4th Quarter	13	13	0
1976			
1st Quarter	18	18	0
2nd Quarter	16	16	0
3rd Quarter	7	7	0
4th Quarter	14	14	0
1977			
1st Quarter	26	25	1
2nd Quarter	19	19	0
3rd Quarter	11	11	0
4th Quarter	23	23	0

APPENDIX S

EMPLOYMENT FOR PHYSICISTS IN THE NUCLEAR ENERGY FIELD

Occupation		1968	1969	1970	1971	1973	1975	1977
Physicists	TOTAL	4,452	4,415	4,295	4,003	3,735	3,853	4,160

SOURCE: Unpublished DOL/DOE data.

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VITA

Larry Lee Barker

Candidate for the Degree of

Doctor of Education

Thesis: AN OCCUPATIONAL INDEX FOR THE NUCLEAR ENERGY FIELD

Major Field: Vocational-Technical and Career Education

Biographical:

Personal Data: Born in Tulsa, Oklahoma, August 13, 1945, the son of Mr. and Mrs. Lester W. Barker.

Education: Graduated from Will Rogers High School, Tulsa, Oklahoma, May, 1963; attended the University of Tulsa from 1963 to 1964; received the Associate of Science degree from Oklahoma State University in 1968, with a major in Electronics Technology; received the Bachelor of Science degree from Oklahoma State University in 1968, with a major in Technical Education; received the Master of Science degree from Oklahoma State University in 1973; completed requirements for the Doctor of Education degree at Oklahoma State University in July, 1979.

Professional Experience: Avionics Navigation Equipment Specialist, United States Army, 1969-1970; Manpower Fellow, Oklahoma State University, 1969-1971, Education and Manpower Analyst, United States Atomic Energy Commission, 1972-1973; Manpower Analyst, Division of Labor Relations, United State Energy Research and Development Administration, 1973-1975; Manpower Analyst, University Programs Division, United States Department of Energy, 1975-1978; Graduate Assistant, Oklahoma State University, 1977-1978; Education Specialist, Education Programs Division, United States Department of Energy, 1978 - present.

Professional Organizations: Phi Delta Kappa, Red Red Rose, Kappa Delta Phi