THE MORALITY OF NUCLEAR PLANNING??

H.C. DUDLEY

THE MORALITY OF

NUCLEAR PLANNING??

H.C. DUDLEY

Published by KRONOS Press in association with the *Center for Interdisciplinary Studies,* Glassboro State College, Glassboro, New Jersey, 1976.

3-1303-00015-3982

Library of Congress Catalog Card Number: 76-11464

Publisher: KRONOS PRESS, Glassboro, New Jersey 08208
Distributor: RadSafety Associates, P. O. Box 452, Hinsdale, Illinois 60521

DEDICATION

To Joan and Bob and Sue for their understanding – and forbearance.

TABLE OF CONTENTS

PREFACE

PART ONE *Fads and Fashions in Physics. 1875-1975* 1

INTRODUCTION 3

Chapter I **OF TIME AND TWINS AND FLYING CLOCKS** 5

Chapter II **THE PERSONAL TRAGEDY OF ALBERT EINSTEIN** 13

Chapter III **THE THIRD OPTION** 27

Chapter IV **SCIENTIFIC CENSORSHIP AND THOUGHT CONTROL** 35

PART TWO *New Ways of Looking at Physics* 45

Chapter V **IS THERE AN ETHER?** 49

Chapter VI **RADIOACTIVITY REEXAMINED** 61

Chapter VII **MECHANICS OF A SUBQUANTIC MEDIUM** 71

IN CONCLUSION 89

IN APPRECIATION 91

APPENDIX I 93

APPENDIX II 99

APPENDIX III 103

INDEX 109

ABOUT THE AUTHOR 113

PREFACE

During January of 1975, press conferences were held by two groups of eminent U. S. scientists. Both groups had Nobel Laureates as members; they differed mainly with respect to the *probabilities* of nuclear disasters arising out of one or more of the following:

(1) Spread of long-life radioactive isotopes, ^{90}Sr, ^{137}Cs; by-products resulting from the operation of fission reactors dependent on Uranium and/or Plutonium.

(2) Dangers of large scale poisoning by Plutonium as the result of accidental or criminal release of ^{239}Pu into the environment, since this man-made isotope is one of the most radiologically toxic materials known.

(3) Accidental melt-down of a fission reactor, generating a self-sustaining multi-ton white-hot glob of metal that could melt its way to the center of the Earth (the so-called "China Syndrome").

(4) A vast nuclear accident triggered by high order fusion devices detonated in the atmosphere or in the sea.

This controversy between the "experts" is mainly as to what limits of *probability* (also read *morality*) are acceptable. For certainly the nations of the earth are arming to the teeth with all manner of nuclear weapons; and the solution to the current energy crisis seems to be an exponential increase in the numbers of fission reactors.

The present differences of scientific opinion and projections of nuclear safety result only from the application of various systems and formulae of mathematics. Thus, the human race seems content to base its probable survival on some vague, ill-defined hieroglyphics, scrawled on pieces of paper. Strange critters, these homo-sapiens, passengers on spaceship Earth.

This present precarious state of humanity has its roots in developments in science which began more than a century ago, when what has been called "non-Euclidean geometries" (and by some "metaphysical mathematics") were beginning to be applied to certain interesting scientific puzzles which later were included in the field of nuclear physics.

One of the main objectives of this volume is to analyze certain bizarre developments in science, particularly physics, which have made their appearance since radioactivity was discovered, some 80 years ago. These changes in the basic ways of going about the business of science are the counterpart of the equally bizarre changes in political and economic climates which have occurred during the same period.

It was into that period when mathematics was beginning to take precedence over observational science that Albert Einstein was born (1879) to become both a leader and a victim in a drama that is just now coming to a crucial point – as evidenced by the calm acceptance by too many – that man may indeed be obliterated. Where is the morality that will permit present generations to negate that which so many past generations have sought; so painfully, patiently, laboriously pulling themselves up out of the caves?

This volume has three purposes:

The first is to pose the question – Is it morally acceptable for the great majority of mankind to be forced to depend for their safety on a very special brand of mathematical gymnastics which physicists use in their solution of nuclear problems? *Remember that this type of reasoning is not utilized by these same scientists in dealing with the day to day problems of their personal lives.*

The second purpose is to examine the historical development of the means by which physicists interpret the very visible effects of nuclear reactions. This traces how Einstein, a true scientist and humanitarian, was victimized by a runaway campaign that over-publicized and over-emphasized that which was the least worthy of his scientific contributions, causing him, and the rest of us, to later ignore the good solid studies for which he received the Nobel Prize in 1921.

The third purpose is to focus attention on certain concepts which were well nigh universally accepted by older scientists as being logically necessary to explain much of the workings of the physical world. For many, many years there have been scientific arguments and learned discussions between "etherists" and "non-etherists." Emphatically, this volume is not another in this long line of philosophical disputation. It is, however, an attempt to feed back into an earlier (pre 1920) climate of opinion, that which has developed out of the current "Information Explosion." We are just now in the midst of a scientific revolution of unprecendented magnitude, which had its beginning about 1950.

Such is my heresy.

Chicago, 1975 *H. C. Dudley*

Part One

Fads and Fashions in Physics 1875 – 1975

PART ONE

Fads and Fashions in Physics

1875 – 1975

Alice in Wonderland

"I can't believe that," said Alice.

"Can't you?" the Queen said in a pitying tone. "Try again: draw a long breath and shut your eyes."

Alice laughed: "There's no use trying," she said; "one can't believe impossible things."

"I daresay you haven't had much practice," said the Queen. "When I was younger, I always did it for a half an hour a day. Why sometimes I've believed as many as six impossible things before breakfast."

Through the Looking Glass

Lewis Carroll (1832 – 98)

INTRODUCTION

Preparation for the writing of this volume began more than sixty years ago, as the author was on a train, excitedly awaiting its departure. Kid-like I was bouncing around like a puppy, when I noticed the cars on the next track. Excitedly I yelled, "Look, we've started!" My father then had me look out the wondow at the ground. We were not moving, the train on the next track was backing up. Such was my first introduction to a "preferred frame of reference." This lesson, with variations, was repeated many times over the years as I rode many trains.

My next lesson came in the early 1920's, when I attended a high school assembly at which was shown a movie explaining Special Relativity. This showed how a ball being thrown back and forth by two boys inside a moving passenger railroad car appeared to them to be a simple back and forth movement of the ball. However to boys alongside the track the ball appeared to be moving erratically, either quite fast or quite slow, depending upon whether the ball was thrown along with the train's motion, or in the opposite direction. This was used as an explanation of the meaning of "Relativity." Another example was the actual curved path of the ball as it was dropped from the window, and the straight downward path observed by the boys who were riding on the train. As I came out of this "education" movie my remarks were anything but complimentary. "All they had to do was look out the car window to see what the real motion of the ball was."

Another part of my early education came about as I built galena crystal radio receivers, and hashed up the airways with a keyed transmitter made with a Model T spark coil. Asking my father "How come?", he tried to explain the "ether" to that brash pre-teenager. Later in my college days (1927–31), this undefined medium was used to develop Maxwell's equations for the propagation of light and all other electro-magnetic radiation.

The 1920's saw the wide acceptance of the conceptual model of the atom as systems made up of electrons (e^-) and protons (p^+) forming the nucleus, with the excess nuclear + charge equaled by the orbiting outer electrons. It was all so simple, neat, and fitted into the Periodic Table so well. And clear proof of the presence of electrons inside the nucleus was their emission as beta particles in many radio-active decay processes. All this I was required to learn, and learn well.

So came graduation in 1931, and in 1932 Chadwick had the poor judgment to discover the neutron. For this he received the richly deserved Nobel Prize in 1935, and I had to relearn the whole nuclear system in graduate school. Not only this, but the "ether" was being consigned to the dustbin of unnecessary hypotheses and assumptions, while Relativity had taken on the aura of a self-evident truth, questioning of which brought down ridicule on the head of the doubter. The electron was becoming a wave, or more probably a mathematical abstraction, rather than an easily understood particle of matter with a discrete electrical charge, that Millikan had so carefully measured. And where did the positron (e^+) fit into all this?

The material which appears hereafter in this volume is an outgrowth of my early years, for by the time I had completed graduate school I viewed all theories with a jaundiced eye, quite certain that all would be radically revised, or be rendered untenable as new data became available in the next decade or so.

This material is presented in somewhat an autobiographical fashion, without apology, for I find myself most fortunate to have lived sufficiently long as to have

an unusual exposure to the development of the sciences.

In many aspects, one foot is in the classical period of physics while the other is planted firmly in the present developing period of subquantic physics. My first teachers were those who had received their early scientific training pre-1905, and were of the experimentalist "school" of Ernest Rutherford and A. A. Michelson. And it is these two men whom I have long considered to be the towering scientific giants of the 1900–1930 era. For, out of their combined theorizing and laboratory wizardry, the present nuclear age was born.

Those who have received their training by the methods of teaching physics in vogue since 1940 may question the necessity of stressing what they may consider to be the ancient history of physics. I do not agree, obviously, for here lies the key to why so much of present physical theory is unable to cope with the mass of new data in solid state physics and quantum electro-dynamics.

These are the several reasons for my iconoclastic approach to, and critique of, current mathematical theory, which has now won almost unquestioning acceptance by the scientific community. But the three decades, 1945–1975, have seen a veritable mountain of new data, which must be clearheadedly integrated into the current attempts to construct more complete conceptual, *mechanistic* models of both the macrocosmos and the microcosmos, à la Rutherford and Michelson.

Chapter I

OF TIME, AND TWINS, AND FLYING CLOCKS

Wives Grow Old; Lts. Soar in Space Age

Air Force Chief of Staff, General Thomas D. White has posed some "Space Age" problems which will have a serious impact upon future military careers and the domestic well-being of service families.

Speaking before the American Society of Mechanical Engineers and the American Rocket Society in Dallas on 17th March, the General observed that the Theory of Relativity offers "startling" possibilities.

Using the calculation based on Einstein's Theory, he said it has been computed that if a man could travel near the speed of light for several hours away from the earth and back, the earth would be several years older--although his watch would show he had been gone a matter of hours.

"Imagine taking off on a flight into outer space and returning to find one of your young lieutenants is now the commanding general," he postulated.

"Even worse," the General jocularly remarked, "on your return home your wife would be several years older than she was before."

– *Army-Navy-Air Force Journal,*
March 22, 1958

To the child, it is the interval of existence which has elapsed since his last meal or since he got out of bed. It is also the interval of existence which must elapse before the next meal. In short, it is a measure of "then" to "now" or of "now" to "then." Such a concept of unidirectional "Time's Arrow" is not just of children, it is that of all adults, including *all* scientists, when they are dealing with their own day-to-day lives.

In all areas of the biological sciences the mathematical equations which define the sequence of a series of phenomena assume that "TIME" is a period of existence, an elapsed interval, in which Event A has a causal relation to some ensuing event B, and that B cannot take place without A having occurred prior to B. This is what we simply call the life processes. And at no time have experimentalists in the biological sciences observed otherwise.

In the physical sciences this same sequence of events is observed and so treated, *except in that quite restricted area where velocities of bodies approach that of light or where the subdivisions of matter are in the atomic range or smaller.*

It is proposed here to examine the development of the concepts of what is called "Time Reversal" or by theoretical mathematical-physicists "Time Dilation." For it is on this fundamental assumption that "Time" is not just a period of existence, that the whole of modern nuclear theory is based and on the most tenuous evidence imaginable. Time takes on the characteristics of a mathematical function capable of assuming attributes not observable either by the man-in-the-street or the scientist in working out problems concerning the every-day world of direct observation.

As indicated in later chapters of this volume, mathematicians began more than a century ago to combine systems of metaphysical philosophy with methods of computation such that they made predictions which are at variance with that which is observable in the biological sciences or in any man's personal experience. One of these predictions has been termed the "Twin Paradox," generating for the past 70 years literally dozens of papers, speeches, letters-to-the-Editor each year, showing how such an idea is idiotic, and on the other hand a condescending, pitying stance by those who know full well that their mathematical reasoning is unassailable.

The so-called "Twin Paradox" is the titillating, intriguing notion that one twin, if caused to travel at some velocity close to that of light, will, on rejoining the stay-at-home twin, find himself younger than his sibling. We see how this mind-boggling concept has gained credence in such science fiction devices as The Time Machine, time warps, etc. It is quite surprising to this writer to find among so many educated persons the unquestioning acceptance as truth, what to me is simply an interesting mathematical game, with no more relation to reality than Monopoly. Such is the power of the press!

And here is an instance where, as in so many other controversies, it is a question of definition of terms. One side insists that "Time" is a period of existence, defining the symbol "T" as a mathematical function having scalar properties. If predictions made as the result of calculations using a scalar T are in conformity with subsequent observations, then the concept of "Time" as a period of existence is supported by this evidence. And if the experience of all men throughout the ages is worthy of note, then undoubtedly the term "Time's Arrow", which describes Time as unidirectional, must be considered correct.

On the other hand, let us examine the basis for those calculations which predict that one human may go out into space, travelling at some high velocity, such that the following equations will predict that this person's aging will be retarded, perhaps even essentially stopped if his velocity is great enough.

The following is known as the Lorentz Transformation, in which the three dimensions of space--x, y, z-- are combined with t, to show that t and t' are two separate and distinct aspects of the existence of two bodies.

$$x' = \frac{x - vt}{\sqrt{1 - (v^2/c^2)}}, \qquad z' = z,$$

$$y' = y, \qquad t' = \frac{t - (vx/c^2)}{\sqrt{1 - (v^2/c^2)}}.$$

These equations are remarkable because they assume that *space and time are not independent entities but are related.*

In this mathematical operation "Time" is defined as (t), a variable, a mathematical function able to take on various values, these values are dependent on the velocity (v) of the bodies. This approach is highly imaginative but can only be considered of practical scientific consequence if it predicts specific observable events.

Although these mathematical procedures were invented prior to 1900, it was not until the mid-1930's that experimental support developed for what so many scientists considered outlandish, impossible predictions. With the discovery of the variation of the decay rates of mu mesons at different velocities it was shown that those with high velocities decayed slower than those with low velocities. These findings were judged by *those committed to Relativistic modes of thinking* to be proof positive of the validity of the Lorentz Transformation; and such has appeared in textbooks of physics for more than 30 years.

Many who are not well versed in experimental procedures or not oriented toward the laboratory aspects of the physical sciences fail to realize that the interpretation of the meaning and significance of data is, like beauty, in the mind (eye) of the observer. Also, it must always be kept in mind that our sophisticated apparatus and meters are but extensions of our senses, which feed information to our minds for evaluation and synthesis. And therein, mirages often appear to confound and mislead, due to lack of information; sometimes assumptions are made which become ticking time bombs. Thus it is necessary to emphasize that in the Relativistic interpretation of meson decay data used to "prove" the Twin Paradox, there is contained the two following very crucial assumptions: a) that the space through which the mesons are moving is inert, devoid of mass and/or energy; b) that the meson is the same physical entity at both high and low velocities.

As indicated in a later chapter "Is There an Ether?" these assumptions no longer seem tenable; therefore it appears that insofar as laboratory studies are concerned, we have returned to the pre-1900 status in "proving" the Twin Paradox.

Flying Clocks

The next act in this drama resulted from the modern developments in measuring "Time" in very short, sequential segments, as well as the production of commercial jet aircraft which became high velocity laboratories.

Earlier in this century there were many predictions that the relativistic Twin Paradox would undoubtedly be demonstrated on a macro scale, when man could loft an artificial satellite. With the successes in rocketry, there were orbited many satellites since 1957, capable of providing platforms for clocks at 8 km/sec., with respect to a point fixed on the earth's surface. Official plans were early announced detailing the manner in which such a study would be carried out.

"NASA scientists plan to synchronize two super-accurate atomic clocks, then place one in a satellite and fire it into orbit 4000 miles above the earth" (1959).[1] To date no announcement of the success or failure of this program has come to the attention of this writer.

During the past decade, long range commercial jet aircraft have been developed, such that sustained air speeds of ~ 0.3 km/sec. are now common. Coincident with this, there have been developed signal generators sometimes referred to as "clocks," based on an electromagnetic emission from excited ^{133}Cs, an otherwise stable atom.

Rate changes of ^{133}Cs "clocks" induced by circumnavigating the earth on jet airliners have been reported.[2] The results were in fair agreement with predicted changes, based on the postulates of special relativity applied to local time. Such conclusions require that a special mathematical definition of time be accepted in the calculations (see equations above).

The man-in-the-street's concept of time, like astronomic time, being scalar, cannot be used in these calculations. The earth's peripheral velocity, referred to the galactic center, was ignored when estimating these relativistic effects.

A timepiece dependent on electromagnetic signals arising from a natural nuclear or atomic transition has long been considered to be the optimum means of generating a standard frequency for testing the postulates of special relativity regarding variations of time with motion. The cesium beam "clock" has undergone extensive development over the past decade. This type clock depends on a 5 MHz electromagnetic emission, resulting from an energy transition of a valence electron of excited ^{133}Cs, an otherwise stable isotope. The complete apparatus however is a complex signal generator made up of many parts, several of which may be influenced by various parameters.

A comprehensive analysis of theory, apparatus and sources of error [3] indicates that the output signal frequency of these clocks may be significantly altered by doppler shift, phase shift, spectral purity and 11 other parameters of varying degrees of significance.

Even stationary ^{133}Cs clocks undergo unexplained variations and no two of these clocks keep precisely the same time.[2] Thus it is evident that while these clocks may theoretically be of sufficient sensitivity and accuracy to demonstrate relativistic time shifts, they may also be rather easily perturbed by subtle, unrecognized parameters which might well be interpreted as "relativistic efforts."

The assumed accuracy of clocks dependent on nuclear and/or atomic transitions is predicated on the assumption that such transitions are not influenced by day-to-day, even hour-to-hour variations in environmental conditions. However, decay rates of many radionuclides have been altered by rather simple procedures. As indicated later, these effects are more pronounced in those radionuclides in which the energy enchange is through the inner orbital electrons, i.e. electron capture and internal cenversion. On the basis of these findings it is reasonable to conclude that it should be rather easy to induce variations of frequency arising from any valence

electron energy shift.

Diurnal variation of the rates of ^{133}Cs clocks have been reported. These variations in rate were observed to occur shortly after sunrise, and less so at moonrise. While these changes are in some way associated with the mass and/or position of the sun and moon, these authors indicate "we are observing a phenomenon which does not have any obvious explanation."[4]

Rate changes of ^{133}Cs clocks (C) induced by circumnavigating the earth on jet airliners have been reported.[2] On an easterly course, these clocks lost 59 ± 10 nanoseconds compared with reference (R) standards at Washington, D. C. Similarly on a westerly course, the clocks gained 273 ± 7 nsec. These results were in fair agreement with predicted time changes, based on the postulates of special relativity applied to local time. In these calculations the velocity of C clocks were referred to time and frame of R clocks. Implied in these development is the assumption that R clocks return to the initial position in galactic coordinates every 24-hour period.

It is proposed to analyze the *galactic* motion of ^{133}Cs atoms, and the possible effects of this motion on these atoms and on the other parts of the cesium beam clocks. There follows the development of alternative hypotheses which attempt to explain within the framework of classical mechanics, the observed variation of frequencies of cesium beam clocks, as they circumnavigated the earth.

Because of impressed motions, clocks in reality traced unequal, elongated, complex spirals; resultant of (a) motion with or above the earth's surface; $0.45 \pm \sim 0.3$ km/sec (b) 30 km/sec. about the sun, (c) $\sim$ 160 km/sec. in galactic coordinates (decl. 32°; AT. Asc. 13 hours).[5] Analyzing these motions with respect to the *frame of an isotropic neutrino sea:* vectoring:

$$\text{V ref.} = \vec{0.46} \text{ km/sec} + \vec{30} \text{ km/sec} + \vec{160} \text{ km/sec}$$

$$\text{V cir.} = \vec{0.46} \mp \sim \vec{0.3} \text{ km/sec} + \vec{30} \text{ km/sec} + \vec{160} \text{ km/sec.}$$

For simplicity in approximation; drop $\vec{0.46}$ km/sec and $\vec{30}$ km/sec.

$$\text{V ref} = \sim 160$$

$$\text{V cir} \cong 160 \mp 0.3$$

$$\frac{\text{V cir}}{\text{V ref}} \cong \frac{160 + 0.3}{160} \cong 1 \mp .002$$

True velocity differences between C and R clocks is no greater than $\mp$ 0.2%, in galactic coordinates, which cannot account for the variations in frequency of C clocks, on the basis of special relativity. The validity of the observed *data* is not questioned.

The earth may be considered to be a vessel travelling through the neutrino sea at $\sim$ 160 km/sec, on a course definable by orientation with terrestrial coordinates and the galactic center. An object fixed on the earth's surface traces a complex path through this sea, which is a resultant of three motions (see above). Therefore, this fixed object will possess a *near* constant effective velocity in the isotropic energy-rich neutrino sea.

By varying the velocity and direction of motion of an object with respect to the earth's axis, one varies the effective velocity of object through this flux. This

resultant effective velocity will vary with latitude, longitude and direction of motion with respect to the earth's rotational surface velocity. Thus the energy exchange between the neutrino sea and nuclei or orbital electrons, may be altered in a complex manner. The effective length of a resonance cavity may also be altered. It is these mechanisms which are considered to be the parameters which influenced the rates of the circumnavigating ^{133}Cs clocks, rather than relativistic effects.

Putting it simply, the Earth moved about 15 million miles along its galactic path during the 24 hours that the reference clocks at Washington, D. C. made their daily circuit from noon to noon. This component of motion was not considered in the calculations "proving" the Twin Effect.

Induced variations in laser frequencies; induced changes in nuclear and meson decay rates; perturbations of ^{133}Cs clocks appear to be the means by which interactions with the neutrino sea are being experimentally demonstrated. If this be the case, exciting new frontiers of science are being opened up, particularly in astrophysics and nuclear physics, pre-1930 paradigms notwithstanding.

In closing this chapter I would like to address myself to those scientists who through long training are now committed both technically and emotionally to the mathematical interpretation of physical data.

The methods used to "prove" the Twin Paradox are those used to predict the probabilities of nuclear accidents and are the basis of projecting the limits of safety of both nuclear weaponry and the hundreds of fission reactors which are being built or are on the drawing boards.

Consider that the eminent German mathematician Hilbert once defined mathematics as a game played, according to certain rules, with meaningless marks on paper. You have developed many complex games, played with many unintelligible marks on paper. You have invented many new games, utilizing many "markers," "checkers," or "men." You have changed the rules of the game at will, and often in the middle of a game. You, as trained mathematicians, are the only men who really understand what you are doing, and for that reason most men stand in awe.

There are some of you who doubt where you are heading, but the great, great majority are convinced your course is correctly plotted. Are you prepared to accept the responsibility, should your navigation prove faulty? The experimenter, too busy being a high-level technician and gadgeteer, has entrusted his leadership to your hands. He is dealing not with marks on pieces of paper but with forces that are beyond your comprehension, unless you have actually observed a nuclear explosion. Are you and your craft prepared to stand before the bar of history and defend your present position?

The crux of the problem here was well put by an eminent experimentalist: "Mathematicians who busy themselves a great deal with the formal theory of four-dimensional space, seem to acquire a capacity for imagining this form as easily as the three-dimensional form with which we are all familiar" – W. Ostwald, 1910.

Can we still afford the luxury of patiently waiting for the correct interpretation of scientific data to emerge, now that we are stirring with one hand the glue that sticks the nucleus together, while with the other we literally reach for the stars? Or will it take a nuclear event extending over a million square miles, or more, to convince the survivors that somewhere, somehow, something is amiss with the games you have been playing?

REFERENCES

Chapter I

1. NASA News Release. *N. Y. Daily News,* April 22, 1959.
2. J. C. Hafele and R. E. Keating, *SCIENCE,* 177, 169 (1972).
3. R. E. Beehler, R. C. Mockler and J. M. Richardson, *METROLOGIA,* 1, 114 (1965).
4. D. S. Sader and B. D. Au, *NATURE,* 224, 291, 1969.
5. E. K. Conklin, *NATURE,* 222, 971 (1969).

Chapter II

THE PERSONAL TRAGEDY OF ALBERT EINSTEIN

Relativity is consequently now accepted as a faith. It is inadvisable to devote attention to its paradoxical aspects.

– R. A. Houstoun,
Treatise on Light (1938)
7th Edition, p. 502
Longmans, Green and Co., London

Students of the physical sciences, and of mathematics, have for the past 30-40 years been so busy mastering the basics of their chosen field, that there has been little time or inclination to study the history of their field in order to learn how the assumptions and logic of the early workers in the field established the basic framework, now quite rigid as the result of long usage. Today's scientists and mathematicians assume that all that has gone before is flawless and they can therefore proceed safely without a backward glance. They and most of their teachers remain unaware of the hidden, unstated assumptions which are an inherent part of every scientific field.

This is dangerous business since technical training is no insurance that in days gone by very human frailties have not crept in, blurring judgments and providing the basis for rationalizations which show so clearly why some young upstart's viewpoint or new method of evaluating data *must* be in error.

If one takes as a reference point the date 1875, and examines the rather unusual state of the sciences of that period, it will be found that physics was making rapid strides as the result of the discovery of stable sources of unseen electric current; of unseen electro-magnetic radiations; of visible effects in unseen gases produced by this electric current. No longer were the experimenters working with easily observed and measured phenomena. To explain unseen phenomena one must rely on the imagination, on mental images, on conceptual models.

About 1875 there began the application of the rather new, exciting and untried systems of mathematics to these unseen phenomena. These mathematical manipulations often predicted phenomena which the experimenter could not duplicate at the laboratory bench. This did not deter the mathematical theorist in the least, for his limits were of the mind, of his imagination. The straight line was assumed *not* to be the shortest distance between two points. The unidirectional flow of time, as observed in our everyday lives, was reversed simply by changing +t to -t. To aid in other problems, the insoluble, imaginary expression $\sqrt{-1}$ was used in the calculations involving unseen electric currents. Increasingly as the years went on, *I assume! Therefore it is!* began to take on more and more respectability.

There was a meld of philosophical methods with the abstractions of metaphysical mathematics, such that the methods of the experimenters, i.e. Faraday, Kelvin, Fizeau, Hertz, Fresnel, Cavendish et al., were looked upon as of secondary importance by an ever increasing number of those who considered themselves scientists, rather than philosophers and/or mathematicians.

Some scientists at that time recognized the dangers of such a trend and the effects such mental gymnastics were having on scientific thought. The following was a most timely warning that unfortunately went unheeded:

> "To the followers of Pythagoras the world and its phenomena were all illusion. Centuries later the Egyptian [?] mystic Plotinus taught the same doctrine, that the external world is a mere phantom, and the mystical schools of Christianity took it up in turn. In every age the mystically inclined have delighted in dreaming that everything is a dream, the mere visible reflection of an invisible reality. In truth the delusion lies in the mind of the mystic, not in the things seen. The alleged untrustworthiness of our senses we flatly deny. We frequently misinterpret the messages they bring, it is true, but that is no fault of the senses. The interpretation of sense impressions is something to be learned; we never learn it fully; we are liable to blunder through all our

days, but that gives us no right to call our senses liars. It is our judgment, not the sense of sight, that is occasionally deceived. We not only wrong our honest senses but also lose our grip upon this most substantial world when we let mistaken metaphysics persuade us to doubt the testimony they bear."

– *Scientific American*
July 1875
Reprinted: July, 1975, p. 10B.

To an experimentalist the above paragraph may be summarized as advising all scientists to adhere religiously to the spirit and letter of the SCIENTIFIC METHOD that we all were required to learn as beginning students of the physical and biological sciences. And the experimenter should always keep in mind that our apparatus and measuring instruments, no matter how sophisticated, are but extensions of our senses, thus liable to "let mistaken metaphysics persuade us to doubt the testimony they bear."

It was at Ulm, Germany that Albert Einstein was born, 1879, to become the most widely publicized scientist ever to have lived. And it was into this milieu of science-mathematics-philosophy that the young man, seemingly of no particular promise, grew into manhood. This scientific climate of opinion was at that time essentially limited to Western Europe, receiving its greatest impetus from the deluge of discoveries made in this same area 1895-1900.

Between the ages of 16 and 25 Einstein learned of such discoveries as x- and gamma rays, of the electron, of spontaneous transmutation of the atom, of radium that continuously gave off heat without any apparent reduction in weight. Here was another host of unseen phenomena which could be evaluated by the use of metaphysical mathematics! Names which were to become famous in the next decades were utilizing the metaphysical methods of 1875 to explain this host of new phenomena. Why? The phenomena which were being observed and quantified were so foreign to any which had been observed prior to 1895 that the theories and conceptual "models" which sufficed to explain pre-1895 "classical" physics were certainly unable to account for this mass of new data. In effect there was a "theoretical vacuum." As an obscure, almost unknown patent clerk in Switzerland, young Einstein had the time and opportunity to pour over the scientific papers appearing in the journals that come to the nearby library. He studied. He thought. He was a mystic. And in 1905 he wrote five papers on various aspects of these new phenomena. All were accepted for publication--which, by the way, contrasts the treatment accorded the young unknowns of today who take unorthodox approaches to science. The present peer review systems are so stifling that any manuscript so iconoclastic as Einstein's initial papers would now have little chance of appearing in any ranking journal. This is particularly true in physics, and especially so in the United States. More on this later.

Of the five papers published by young Einstein in 1905, three were destined to bring him fame. These three papers would by 1940 be recognized as basic to the physical sciences.

A theoretical study of the only visible manifestation of perpetual motion, termed "Brownian Movement," was completed by Einstein. This was an extension of the existing knowledge concerning the incessant, random motion imparted by atomic collisions to finely divided solid particles when suspended in a liquid. An example of this is carbon particles in India ink. By special microscopic techniques

it is possible to show that these particles can be visualized as constantly dancing points of light. This theoretical study was a mathematical treatment of observable events and was one of the two studies which won for Einstein the Nobel Prize in Physics, 1921.

The second paper which provided the basis for the Prize was the extension of the theoretical studies of Max Planck, who in 1900 proposed that light was not necessarily a continuous wave train but reacted as if it were a series of bundles of energy (E=hf) which he termed "quanta." For this work Planck received the Prize just three years before Einstein.

In this aspect of his historic work Einstein combined the experimental findings of J. J. Thompson (Nobelist, 1906), which demonstrated the existence of the electron (e-), with the theoretical approach of Planck. By this method Einstein provided the basis for explaining the experimental results of others, which had shown that the kinetic energy of an electron emitted by a metallic surface, was dependent on the wave length (i.e. color) of the light falling on the surface.

This is termed the "Photoelectric Effect," and is the basis for the operation of many modern electronic units. These studies led others to apply the concept of the photoelectric effect in clarifying the complex processes of x-ray adsorption in solid materials.

These two theoretical papers are the reason for Einstein's receiving the richly deserved Nobel Prize in 1921, although many historians of science have led our students to believe that it was the much more publicized Theory of Relativity that earned for him this coveted honor. For this reason it is here emphasized that the papers on Brownian movement and the photoelectric effect, based on directly observable phenomena, are just as valid now as when written 70 years ago. Also it is of utmost importance to note that these theoretical developments required little or no use of the metaphysical mathematics and philosophical assumptions which were becoming so popular in Western Europe at that time.

Let us turn now to that third 1905 paper, usually called the "Theory of Special Relativity," which together with a more generalized version, General Relativity (1915), have generated mountains of papers and correspondence every generation since 1905. In these one finds controversy, ridicule, "proofs," "disproofs," and all too often the most unscientific of attitudes imaginable. In those who support the theories there is so often evidence of a quasi-religious, unquestioning faith. Equally as vehement, pre-1930, were those who were most critical of methods which made use of systems of metaphysical mathematics and free-wheeling philosophies.

As with all controversies, and especially when unquestioned *faith* is an armament, there is a middle ground wherein stands TRUTH, which will be unveiled when additional information is obtained by observation and *experiment.* Such has always been the course of every field of experimental and applied sciences. Such is the history of science!

CAN NATURE DECEIVE?

> The scientists, in playing their game with Nature, are meeting an opponent on her own ground, who has not only made the rules of the game to suit herself, but may have even queered the pitch, or cast a spell over the visiting team. If space possesses properties which distort our vision, deform our measuring-rods, and tamper with our clocks, is there any means of detecting the fact? Can we feel hopeful that eventually cross-examination will break the disguise? . . .
>
> Ultimately, we can only rely on the evidence of our senses, checked and clarified of course by artificial apparatus, repeated experiment, and exhaustive inquiry. Observations can often be interpreted unwisely, as an anecdote told by Sir George Greenhill illustrates:
>
> At the end of a session at the Engineering College, Coopers' Hill, a reception was held and the science departments were on view. A young lady, entering the physical laboratory and seeing an inverted image of herself in a large concave mirror, naively remarked to her companion: "They have hung that looking-glass upside down." Had the lady advanced past the focus of the mirror, she would have seen that the workmen were not to blame. If nature deceived her it was deception which further experiment would have unmasked.
>
> — Clement V. Durell,
> *Readable Relativity* (1938)

In contrast to the theoretical methods which he had utilized in treating Brownian movement and the photoelectric effect, Einstein in developing Relativity allowed himself to become an integral part, in fact a leading disciple, of the "school" which made use of metaphysical mathematics. This group assumed time to be an independent variable, combinable with three coordinates of space (Minkowski's space-time). He assumed as true the following unproved attributes of the physical world:

A. That there exists no "ether," no generalized subquantic medium by which absolute motion could be determined.

B. That mass and energy are interconvertable ($E=Mc^2$)

C. Reversability of time

With these unsupported hypotheses Einstein flew in the face of the majority opinion then held by professional scientists, and particularly experimentalists. He embarked on a course that brought eventual disillusionment.

It is proposed to present here a biographical sketch giving aspects of his scientific career which have only been lightly touched on by his contemporaries, and largely ignored by his biographers.

Einstein made use of a system of computation developed in Germany (1850-1875) which assumes that a line projected in space curves, that parallel lines converge. This was basic in developing what has become known as the General Theory of Relativity. Using these methods he predicted that a beam of light as it passed close to the sun would be deflected 1.75 seconds of arc, as the result of the gigantic gravitational field. Note particularly that he specified *only* gravitational effects. Such a phenomenon had been qualitatively predicted by Isaac Newton before 1700.

The observed *weighted* deflection was 1.98 arc seconds, providing the initial impetus of one of the most unusual chapters in all of man's history, not just scientific history.

An obvious question: Why should a rather obscure mathematical theorist, whose prediction of an obscure astronomic event generate such world-wide interest, producing a ticker-tape parade down New York's Wall Street in 1921? I asked myself this question as a teen-ager and college student, observing the outpourings of publicity in Sunday newspaper supplements, in the Rotogravure sections, news reels, and "educational" movies. I again asked myself this question in 1957 when a study was begun of the historical background of the various systems of physical theory which were then being taught as the fundamentals of atomic and nuclear science. As will be shown below the final pieces of the puzzle fell into place in mid-1975.

If one wishes to study the thinking of those who early opposed the relativistic theories (and there were many!) it becomes a major research project even to learn of the authors of such heresy. The usual abstracting services are strangely silent. Between the years 1905 and 1930 the doctrines of relativity and of n-dimensional and non-Euclidean geometrics has a "good press." The theory was publicized by the most astute, adroit application of subtle "soft sell" techniques ever to be devised. Modern-day advertising executives could learn much of psychology in studying the showmanship by which persons in high and influential places were favorably impressed, how the general public was "educated," how scientists were swayed by the "fads" of the day.

Relativity, the New Science, became the rage of the intelligentsia, the "smart" drawing-room set. Further, to bolster the claims of this "new" and "different" science, data were culled, and that which upheld the theory was praised and publicized, while more valid information was ignored (See the Appendices).

There were some men who lived during the development of the basic postulates of modern theories who doubted the logic on which they rest. Moreover, these men resented the use of the promotional methods of the market place, which were blatantly used to fasten on the minds of men, at all levels of culture, what many considered to be a false scientific doctrine. Certain of these men, having the courage of their convictions, published books reporting on various aspects of the situation as they saw it at first hand.

To attempt to dismiss all such publications as the work of crackpots, as the railings of "cranks rebelling against the father-image of established authority," is to belittle the work of technically trained men of high renown, respected in their fields of specialization. In order that students of the physical sciences may know that there were (and are now!) other views in fundamental physical theories than are presented in recent physics texts, there follow reviews of the more pertinent of these works (See Appendices for further details).

One of the first,[1] also one of the most scholarly, works to point out the fallacies in logic was by Charles L. Poor, who obtained his Doctorate in mathematics and astronomy at Johns Hopkins University, 1892. He served as professor of astronomy at Hopkins, 1900-1910, and as professor of celestial mechanics at Columbia University, 1910-1944. In his volume, Dr. Poor clearly indicates the false premises of *n*-dimensional and non-Euclidean geometries, and of the dual frames of reference used by Lorentz and later theorizers. His greatest contribution is the pinpointing of the manner in which the proponents of relativity selected and culled astronomic data, no doubt unconsciously, to uphold their own preconceived

ideas (see Appendix II). In this evaluation of the "scientific advertising" used so effectively in promoting "The Theory," Dr. Poor gives a calm, dignified appraisal of a field of knowledge in which he has few equals.

Another writer to question seriously the basis of relativity was Arthur Lynch, a most remarkable man of unusual courage and breadth of interest. He was a graduate engineer, a linguist; he studied physics in Berlin, took his medical degree in London, and later an electrical-engineering diploma in Paris. He served in the British Parliament for 10 years, and practiced medicine in London for twenty-six years. In 1927 he published his first volume on scientific fallacies, and in 1931 his second. He shows clearly that relativity is an unhappy union of philosophy, metaphysical mathematics, and science [2] (See Appendix III).

In these two little-known works Dr. Lynch takes on the character of the iconoclast, the rebel, against many of the scientific beliefs of the 1920's. In this respect he weakens his arguments and somewhat obscures flashes of keen insight into many of the errors of logic in science, some of which still exist in our thinking today. The great service Lynch renders is to give an on-the-spot observer's biting account of the causes (cultural, political, mathematical, and philosophical) which resulted in the rapid rise in popularity of the Theory of Relativity. He clearly outlines the well-managed showmanship that "sold" this theory to those in influential places who could not understand the language in which it was presented, much less the abstractions of metaphysical mathematics on which the theory rests for its development (See Appendix III).

The third writer to publish in English a volume critically discussing at length the Einstein theories was J. J. Callahan. [3] He was a Catholic priest and educator, having received his training in rigorous logic and reasoning at Duquesne University and at the Gregorian University at Rome. In this volume Dr. Callahan discusses the illogical character of neo-geometries and the multiple frames of reference used in the mathematical development of the fundamental ideas of relativity by Lorentz, Poincaré, Einstein, Minkowski and others.

Another scientifically trained writer to tilt with Einstein's theories, and a contemporary of all those mentioned above, was a Russian-born electrical and aeronautical engineer, George de Bothezat. He secured his electrical-engineering degree in Liège, 1907, a Doctorate in Paris, 1911. He was an aeronautical leader in Russia before 1918 and later in the United States. He patented many inventions and organized and directed a sizeable commercial enterprise. In 1959 his name survived and appeared in the Manhattan telephone directory: de Bothezat Division, American Machine and Metals Company. This unusual man took the battle to the enemy's camp, lecturing at Princeton University during the 1930's, questioning Einstein's doctrine of isochronous time.

The volume by de Bothezat makes difficult reading, as the author's meaning is not clear in many cases. [4] But certainly it is clear in one important aspect. Because he was a mathematician, de Bothezat saw that by the mathematical processes utilized by Einstein, Grossman, and Minkowski all manner of hypotheses could be proved. This observation of course was not original with de Bothezat, as it was shown earlier by many French mathematicians, particularly Painlevé.

No doubt some will object to the use of the terms "sell" and "promotion" to describe the methods by which the Theory of Relativity was so quickly popularized. Perhaps some others feel that such methods are not suitable or ethical in the world of science. It all depends on the viewpoint. In the present era, nearly every laboratory of any size, be it academic, commercial, or governmental, has as part of

its organization a publicity or public relations department. This is staffed by persons whose livelihood depends on getting the laboratory's findings, reports, papers, and accomplishments into as many news outlets as possible.

Being convinced that many of the mathematical systems responsible for modern physical theories contain illogical, erroneous assumptions, this writer has attempted to determine the processes through which this type of mathematics, and the Theory of Relativity, have taken such a hold on the minds of countless millions. It is believed that four volumes published some few years ago explain how and why these ideas have gained such a following. These books are not erudite, scholarly, studies in psychology, mathematics, or physics. They are popularly, well written blueprints of the way men's minds en masse are influenced and the individual's supposed free-will actions channeled into a pattern set by those who apply subtle pressures.

A summary of the new techniques of advertising are discussed in Vance Packard's *The Hidden Persuaders.* No doubt there will be many who will scoff at the statements in this volume; nevertheless, advertising budgets in the millions of dollars are risked on these principles of mass psychology. The effectiveness of this type of pressure is quickly evidenced by the sales volume of the goods and the services being publicized. (5)

In a second volume, *Science Is a Sacred Cow,* A. Stander gives us a glimpse into the manner by which scientists delude themselves and apply the same subtle suasions to the members of the learned professions as are used by the men who guide modern-day advertising. This book will make many scientists cringe as they see some of their most treasured illusions trampled upon by another well-trained scientist. (6)

With regard to the subject which we are considering, Mr. Stander has this to say:

> And yet Einstein did not destroy the Absolute. There is always an Absolute in science. In the nineteenth century it was the ether, but when the ether fell to pieces and disintegrated, there was no Absolute left at all--a condition intolerable to scientists, although they don't know it. Einstein made space and time relative, but in order to do this he had to take something else, which was the velocity of light, and make it absolute. The velocity of light occupies an extraordinary place in modern physics. It is *lèse majesté* to make any criticism of the velocity of light. It is a sacred cow within a sacred cow, and it is just about the Absolutest Absolute in the history of human thought. There is a textbook on physics which openly says, "Relativity is now accepted as a faith." This statement, although utterly astounding in what purports to be a science, is unfortunately only too true.

The third volume for studying the methods by which men's minds are influenced is C. D. MacDougall's *Hoaxes.* (7) This also shows very graphically that any explanation, even if it is grossly incorrect, is considered better than none at all. This is not to imply that the mathematicians, philosophers, theoreticians, and physicists who developed modern physical theories were consciously engaged in perpetrating hoaxes. They were not, for each in his own field sincerely believed that he was completely justified in his basic assumptions, and accurate in his reasoning and mathematical calculations.

The reasons "Why We Don't Disbelieve" and the "Incentives to Believe" are clear-

cut discussions of the underlying pattern of mass acceptance of the things which appear on the printed page, be they truth, half-truth, or complete falsehood. The following list of the "Incentives to Believe" explains in one or more important instances the motivation which caused many to embrace, champion, and popularize the Theory of Relativity during its all-important formative period, 1905-30; also to continue as a quasi-religious dogma to 1975:

The means whereby health, wealth, and happiness may be obtained;
The essential evidence that one's church, political party, race, city, state and nation is superior;
The fragments of knowledge to establish a scientific, literary, artistic, historical or other hypothesis;
The spectacular incidents to give sanctions to prejudices, attitudes and opinions;
The heroes to worship and the vicarious thrills by which to escape an otherwise dull and routine existence.

The fourth volume in this group, Caplow & Reece's *The Academic Marketplace,* is a report of a sociological study of ten of the larger universities of the United States, giving the results of an investigation of the personnel practices, basic problems, and motivations of the faculties of these eminent centers of learning. (8) The findings were a revelation, for in the areas of study which are discussed here, mathematics and physics, the following statements stand out: "Today, a scholar's orientation to his institution is apt to disorient him to his discipline and to affect his professional prestige unfavorably. Conversely, an orientation to his discipline will disorient him to his institution, which he will regard as a temporary shelter where he can pursue his career as a member of the discipline. . . . Several respondents referred to the 'guild aspect' of certain disciplines--especially mathematics and physics. Their comments seem to assert that, in these fields at least, for the successful professor the institutional orientation has entirely disappeared."

Thus it would seem that indeed these two disciplines form two guilds, which owe their first loyalty to the other members of the craft, not to the school where they are, for the time being, doing their work. This well may explain why criticism and questioning of modern physical theories based on mathematical constructs are so often received in stony silence as ranks close.

In the four volumes cited above appears to be the answer to the puzzle posed by Professor Bridgeman in 1936: ". . . but it seems to me that the arguments which have led up to the theory (Relativity), and the whole state of mind of most physicists with regard to it, may some day become one of the puzzles of history." (9) And so we see how men of science can be influenced in their thinking and in their judgment by suasions and pressures, often self-imposed, but in recent years, through indoctrination during their formative undergraduate days.

The scientist who has received his training during the past 40 years has received scant introduction to other alternative hypotheses, for in all present-day general physics and nuclear texts, classical physics is limited to the material world of direct observation. In these texts the "laws" that govern the microcosm, together with the results of the Michelson-Morley experiments (1887), show clearly that there can be no "ether"--that matter and energy in small packages are governed by special rules not applicable to the observable world. Three centuries of laboratory data are summarized in a relatively few paragraphs.

Two rather recent reports by distinguished contemporaries of Einstein give a most illuminating overview of the events which resulted in his being catapulted to fame, or more correctly, notoriety. For such was the result of a public relations campaign comparable to that generated for a budding movie star.

The first of these reports was by Nobelist P. A. M. Dirac who, when in his acceptance speech for the Oppenheimer Award (1969), made the following statement regarding his own work:

> This work was done in the 1920's when the whole idea of relativity was still quite young. It did not make a splash in the scientific world until after the end of the first world war and then it made a very big splash. Everyone was talking about relativity, not only the scientists, but the philosophers and the writers of columns in the newspapers. I do not think there has been any other occasion in the history of science when an idea has so much caught the public interest as relativity did in those early days, starting from the relaxation which occurred with the ending of a very serious war.[10]

The second of the recent reports came to this writer's attention in June 1975, and did in fact provide the missing pieces in the puzzle as to why a young, essentially unknown scientist should be so quickly smothered in honors. This report, in the form of an article[11] by Professor S. Chandrasekhar makes such stimulating and enlightening reading that this writer highly recommends it to every student of the sciences at all levels of training. It is in these paragraphs that the following appears:

> (Ernest) Rutherford turned to Eddington and said, "You are responsible for Einstein's fame." And more seriously he continued:
> The war had just ended; and the complacency of the Victorian and Edwardian times had been shattered. The people felt that all their values and all their ideals had lost their bearings. Now, suddenly, they learnt that an astronomical prediction by a German scientist had been confirmed by expeditions to Brazil and West Africa and, indeed, prepared for already during the war, by British astronomers. Astronomy had always appealed to public imagination; and an astronomical discovery, transcending worldly strife, struck a responsive cord. The meeting of the Royal Society, at which the results of the British expeditions were reported, was headlined in all the British papers; and the typhoon of publicity crossed the Atlantic. From that point on, *the American press played Einstein to the maximum.*

Dr. Chandrasekhar continues:

> Let me go back a little to tell you about the circumstances which gave rise to the planning of the British expeditions (of 1919). I learned of the circumstances from Eddington (in 1935) when I expressed to him my admiration of his scientific sensibility in planning the expeditions during the 'darkest days of the war.' To my surprise, Eddington disclaimed any credit on that account—indeed he said that, left to himself, he would not have planned the expeditions since he was fully convinced of the truth of the general theory of relativity!—In any event,

Eddington clearly realized the importance of verifying Einstein's prediction with regard to the deflection of the light from the distant stars as it grazed the solar disc during an eclipse.

Examine carefully the above paragraphs for in these will be found certain key phrases:

Rutherford to Arthur Eddington–

"You are responsible for Einstein's fame."

"Eddington. . .indeed said that left to himself he would not have planned the expedition, since he was fully convinced of the truth of the general theory of Relativity."

Here can be seen the underlying reason why Professor Poor in 1922, and Professor Freundlich in 1931, both professional astronomers, reported that the astronomic data obtained by the Eddington expeditions had been culled and selected in order to uphold preconceived conclusions.

At the peak of the campaign to popularize Einstein and his works, there occurred a most surprising and important development. At a meeting of the most eminent physicists and theoreticians (Solvay Congress) in 1927, Niels Bohr adroitly furthered his own brand of theory, since known as Bohr-Heisenberg Quantum Mechanics of the "Copenhagen School." At this meeting Bohr in effect ridiculed Einstein's basic assumption of causality, which requires that Event A be preceded by some prior event. Bohr, on the other hand, espoused the concept of "acausality" which assumes that Event A may arise spontaneously, requiring no initiating event. At this Congress the young theoretician Louis deBroglie, who two years later was to receive the Nobel Prize, was won over to the Copenhagen School which he supported until the mid-1950's.

Although Einstein's *popular* image was untarnished, younger scientists followed Bohr, and Einstein was effectively isolated from the main stream of theoretical physics for the remainder of his life.

It is indeed ironic that in the teaching of physics for more than 40 years, there have been courses which have stressed Relativity, while in the next classroom the theories of Bohr are given overriding priority. However, at no time is it pointed out to students that the basic philosophies which underlie these two systems are mutually exclusive. If Bohr is correct, then Einstein cannot be correct; and vice versa. Interestingly, both systems *require* the absence of an "ether" or "subquantic medium." For if such a medium or substrate does exist, both systems of theory are untenable.

Following the failure of his efforts after 1931 to modify the General Theory of Relativity in order to take into account magnetic and electrostatic forces, coupled with his decreasing stature in the rapidly developing theoretical areas, Einstein received another very personal blow. This was as the result of his famous letter of 1939 written to President Franklin Roosevelt in which he recommended that research be initiated on nuclear explosives.

Einstein was a gentle man, a true internationalist, and above all a pacifist. The use of two fission bombs against Japan in 1945 was for him a personal tragedy, as it was for many of the other scientists who were actively engaged in the Manhattan Project. In the press Einstein was then lauded as the Father of the Bomb, a title which he most certainly detested. And as fusion devices became realities before he

died, we can only speculate as to his inner feelings.

The personal tragedy of Albert Einstein was that he was beguiled by the fame and notoriety generated as the result of a most improbable sequence of events. Thus he, scientists and the general public were led to overlook the good, solid work based on experimental results, which won for him the Nobel Prize in 1921.

Philosophically, looking back on his life at age 70, Einstein gave a clear evaluation of what he believed were his accomplishments. This was in a letter made public many years after his passing:

Personal Letter to Professor Solovine, date 28 March 1949–

> You can imagine that I look back on my life's work with calm satisfaction. But from nearby it looks quite different. There is not a single concept of which I am convinced that it will stand firm, and I feel uncertain whether I am in general on the right track. (12)

The tragedy of Einstein, translated to the entire scientific community, is that of the failure of the open, self-corrective long-term processes which are normal to all science, or at least should be. In Chemistry, Biology, Astronomy, the Medical Sciences, Geology, and Engineering in all branches, there have since 1930 been many and varied competing alternative hypotheses and theories. These rose, were modified and often fell before the evidence of new data and innovative techniques.

In nuclear science and theory, however, the assumptions which developed pre-1930 have taken on the aura of self-evident truths, in the nature of a quasi-religious dogma which cannot, must not, be questioned. In fact since about 1940, those who did cast doubts were looked upon as clearly lacking in common sense.

In 1959, a letter to the writer from a scientist then employed at the Oak Ridge Laboratories stated:

> Most of us who share your general viewpoint tend to be 'gun shy' (or job shy, or what have you) in such matters because we are aware of our minority position and the ridicule normally to be expected from highly respected and firmly entrenched theoreticians.

Professor Herbert Dingle (University of London) (13) in 1972 questioned the morality of continued unquestioned acceptance of the basic postulates of Relativity. This produced published insulting ridicule.

The crux of the problem which is being discussed in this volume is the scientific morality of those who insist that there shall be no alternative hypotheses permitted in nuclear science which question present dogma. Just why is physical theory so sacrosanct, when all other areas of science are subject to the very healthy stimulation and discipline of competing viewpoints and alternative hypotheses?

REFERENCES

Chapter II

1. Charles L. Poor, *Gravity Versus Relativity* (New York: G. P. Putnam's Sons, 1922).
2. Arthur Lynch, *Science: Leading and Misleading* (London: John Murray, 1927).
   ----------, *The Case Against Einstein* (London: Phillip Allan, 1932; New York: Dodd-Mead, 1933).
3. J. J. Callahan, *Euclid or Einstein?* (New York: Devin-Adair Co., 1931).
4. George de Bothezat, *Back to Newton* (New York: G. E. Stechert & Company, 1936).
5. Vance Packard, *The Hidden Persuaders* (New York: David McKay, 1957).
6. A. Stander, *Science Is A Sacred Cow* (New York: E. P. Dutton, Everyman Edition, 1958).
7. C. D. MacDougall, *Hoaxes* (Rev. ed.; New York: Dover Books, 1958).
8. Theodore Caplow and R. H. Reece, *The Academic Marketplace* (New York: Basic Books, 1958).
9. P. W. Bridgeman, *Nature of Physical Theory* (1936).
10. P. A. M. Dirac, *Development of Quantum Theory* (N. Y.: Gordon and Breach, 1971).
11. S. Chandrasekhar, "Verifying the Theory of Relativity," *THE BULLETIN OF THE ATOMIC SCIENTISTS* (June, 1975).
12. Solovine Letter. Quoted in B. Hoffman, *Albert Einstein–Creator and Rebel* (N. Y.: Viking Press, 1972).
13. Herbert Dingle, *Science at the Crossroads* (London: Martin Brian & O'Keefe, 1972).

Chapter III

THE THIRD OPTION

---------Definition of a Super Nova---------

Two hundred years after the inhabitants
of a planet discover atomic energy.

Anon. 1946

Before me lie many newspaper clippings which appeared during the first two weeks of June 1975. These clippings report that Western Germany is providing Brazil with nuclear know-how and sophisticated apparatus. Argentina, Chile, South Korea, Pakistan, Iran and others will soon be inducted into that not-so-exclusive "Nuclear Club" by present members.

Those scientists who now try to convince the politicians of the foolhardiness of such are looked upon by the general public as impractical eggheads, peddlers of DOOM. Such scientists are but mirroring the state of mind of most of those scientists of 30 years ago, who developed the first fission reactors and bombs.

During WW II the eminent scientists of that era offered two options to President Roosevelt. These were in effect: Accept the possible slavery of the Nazi Axis or develop and explode atomic bombs.

There was a third option that was kept under wraps, *TOP SECRET,* discussed only behind closed doors, although sometimes guardedly by the lower echelons of "The Manhattan Project." This was the possibility of the triggering of a vast nuclear accident when and if a fission device was detonated.

The tension under which the leaders of the project were laboring during the developmental period became clear 14 years later when TOP SECRET was broken (1959) in an interview with Nobel Prize winner Arthur H. Compton: under the title "The Bomb--The End of the World." Pearl S. Buck remembered thinking:

> And if hydrogen, what about the hydrogen in sea water? Might not the explosion of the atomic bomb set off an explosion of the ocean itself? Nor was this all that Oppenheimer feared. The nitrogen in the air is also unstable, though less in degree. Might not it too, be set off by an atomic explosion in the atmosphere?
>
> 'The earth would be vaporized,' I said. 'Exactly,' Compton said, and with what gravity! 'It would be the ultimate catastrophe. Better to accept the slavery of the Nazis than to run the chance of drawing the final curtain on mankind!' Again Compton took the lead in the final decision (1945). If, after calculation, he said, it were proved that the chances were more than approximately three to one million that the earth would be vaporized by the atomic explosion, he would not proceed with the project. Calculation proved the figures *slightly* less--and the project continued.
>
> Pearl S. Buck
> "The Bomb--The End of the World?"
> *American Weekly.*
> March 8, 1959

What if Oppenheimer, Fermi, Compton *et al.* were right in 1945, and the odds were 3 to one million of a world-wide conflagration? But now the bombs are a thousand times as powerful. Does this lower the odds to 3,000 per one million or properly 3 in 1,000?

Perhaps these leaders followed in the footsteps of James Watt, and empirically stumbled onto a new method of obtaining useful work without understanding the fundamental source of the energy. They knew nothing of the neutrino sea around *them* in 1945.

And in 1750 Watt knew nothing of the sea of oxygen around *him.* Heat was then defined as a substance called caloric or phlogistine. Yet he developed the

steam engine, which also changed the course of world events.

More on this 1945 era waited another 8 years before it appeared in print.

The first trial of a high order fission explosion, the first Atomic Bomb (code name "Fat Man"), was set for Monday morning, 16 July 1945, 5:30 AM at Camp Trinity, N.M. The mental state that morning of those who had made the calculations of the probability of the "ultimate catastrophe" was described some 22 years later.

> On arrival (General) Groves immediately sensed the tremendous excitement in the air. Everyone was overtired, and tension was mounting visibly as zero hour approached. Groves was particularly worried about Oppenheimer, who seemed to be reaching the limits of his endurance. Groves wanted the laboratory's director to be as calm as possible when making the final command decisions. There were altogether too many excited people around giving him advice on what he should do. Groves was annoyed, too, with Fermi, who was making bets with his colleagues on whether the bomb would ignite the atmosphere, and if so, whether it would destroy only New Mexico--or the entire world. Fermi was also saying that, even if the bomb failed to go off, it would still be a worthwhile experience--it would prove, in that case, that an atomic explosion was probably impossible.
>
> *Manhattan Project*
> S. Groueff
> Little, Brown and Co. 1967, p. 352.

So "Fat Man" was successfully detonated at Trinity, with two more over Japan (1945), two at Bikini (one under water) (1946). Between 1948 and 1958 there were about 50 more fission and fusion devices exploded in the far reaches of the Pacific. Several other nations have developed and tested these devices, thus, notifying the world of their nuclear capabilities. Is this not sufficient evidence that no such vast nuclear accident can occur? NO!

The probability of such an accident in 1945 was calculated to be $\sim 3/1{,}000{,}000$. This simply means that the chances of such a holocaust occuring are not numerous, but certainly *NOT* zero. And by the well established principles of statistics and probability each detonation is a fresh new event, not predictable from a few previous rolls of the dice.

One may drive an automobile for years and never have so much as a scratched fender. But the likelihood of a serious accident can be measured by the ever increasing auto insurance premiums. That such events do occur all too frequently is well documented in the junk yards that are scattered on the outskirts of our cities. Thus, is illustrated the workings of probability, as possibilities become reality.

The criteria in 1945 for assessing the dangers of an "ultimate catastrophe" triggered by an atomic explosion consisted of (1) laboratory data available since 1939 on fission (2) theoretical assumptions and concepts developed beginning about 1905 and (3) the assumptions of the applicability of the mathematical systems used in developing the basic theories from which the safety projections were made.

In 1939 Hans Bethe developed a theory which explained the source of the sun's energy as a six step process by which 4 hydrogen atoms $^{1}(H)$ were converted to one Helium Atom $^{4}(He)$, with the production of large amounts of energy. For these studies Prof. Bethe received the Nobel Prize in 1967.

One of these six steps required the presence of the same kind of Nitrogen atoms

that make up 80% of the earth's atmosphere:

$$^{14}N + {}^{1}H = {}^{15}O + \text{energy} \qquad (1)$$

For such a reaction to start, requires a temperature of the interior of the sun, about 100,000,000 degrees. For such a reaction to continue, the energy released must be retained near the site of production, with containment pressure measured in tons per square inch. These are the conditions which exist in the interior of the sun. According to Bethe, other reactions are:

$$^{1}H + {}^{1}H = \text{Deuterium (D)} + \text{Energy} \qquad (2)$$
$$D + D = {}^{3}He + \text{neutron} + \text{Energy} \qquad (3)$$
$$D + D = {}^{3}H + {}^{1}H + \text{Energy} \qquad (4)$$

With reactions (3) and (4) being the more probable under the conditions of containment and high temperature.

A probable secondary reaction following the formation of ^{3}H by reaction (4) is;

$$^{3}H + D = {}^{4}He + \text{neutron} + \text{a large energy yield.} \qquad (5)$$

Reaction (5) produces more than four times the energy per atom as do reactions (3) and (4), with a much higher probability of occurrence of (5), once the ^{3}H is formed by reaction (4). Under the conditions of a hydrogen-rich mixture, containing some ^{14}N and D, it seems logical to predict that reaction (5) may provide the means of sustaining a chain reaction as a result of the high energy yield being contained by a high pressure environment.

As indicated, the interior of the sun provides the required hydrogen-rich high pressure – high temperature environment necessary for all five of these reactions to continue for billions of years. The seas also provide a hydrogen-rich environment. Containment pressure measured in tons per square inch exists under millions of square miles of water. The explosion of a conventional fission or fusion device would provide the 100 million degree temperature necessary to initiate reactions (1) thru (5).

Another theoretical approach is thru the examination of "nuclear binding energy" which is a measure of the energy stored within the nucleus of an atom. By plotting the binding energy against the mass of the atoms one generates a curve which has marked discontinuities at that section where the lighter elements lie. (H, He, B, Be, Li). From these data one can predict that such reactions as (2) thru (5) will take place. Extending this, one finds that in the segment of the curve at ^{14}N and ^{16}O, constituents of our atmosphere, there is another break in the curve. This is not so marked as lower down, with the lighter elements, still it is sufficient to explain the ^{14}N reaction in Bethe's solar sequence. Thus, one can conclude that both ^{14}N and ^{16}O may be caused to undergo fusion with the ^{1}H in atmospheric moisture.

The probability of a sustained chain reaction in the atmosphere does not appear as great as in the sea since there is no high pressure containment mechanism. However, as Fermi, Oppenheimer, Compton et al. calculated, this probability is by no means zero with the 1945 model bombs.

To add weight to the above comments, it is necessary to have experimental data. But nuclear explosion research is of course classified TOP SECRET, since this is

definitely an area of weapons research.

There is however some published data on those reactions that offer the greatest promise for electric power generation thru fusion, these being reactions (4) and (5) shown on page 31. Using this information, following in the footsteps of Bethe, since he too had little data to go on in 1939, we should for safety's sake apply the information available in 1975.

As a result of the success of the Manhattan Project, and other wartime technological developments, the major governments of the world, and industry, have poured 2 to 3% of the GNP into all types of research and development. These vast expenditures have generated what is well called the "Information Explosion". Over the last 30 years new laboratory information on the interactions of the atom have become available, new theoretical concepts are developing. The old order changeth! These studies show that fission and fusion can be triggered by lasers; that the rate of radioactive decay can easily be altered; half lives once thought to be constant are easily varied. The energy yields of fusion devices are not accurately predictable.

The very theoretical foundations of the whole of nuclear science are being questioned as the result of reexamining a concept that was taught as basic in all physics text books pre-1920. This being the necessity of the presence of an all-pervading gas-like medium which fills all space, then called the "ether" or "aether". The calculations of 1945 assumed that the "ether" does not exist, yet in 1975, astronomy and cosmology are beginning to define this earlier "ether" as the "neutrino sea", an energy-rich subquantic, particulate medium which fills all interstellar space. In fact, it now appears that there is more unseen mass between the stars than is present in all stars and their planets.

Another result of the vast expenditure of R. and D. funds over the past three decades has been the development of weapons and their delivery systems that stagger the imagination. Men have literally found the way *in 30 short years* to send the few survivors back to the caves. We can, on the basis of the "overkill" capabilities of present nuclear armaments of the U. S. and Russia, cause our culture to follow the route of the Mayans and Aztecs. Yet, the world's leaders, and the people too, accept this state of affairs with equanimity.

These weapons systems include intercontinental ballistic missiles and satellites, accuracy ± 1 mile, armed with multiple war heads that can spew out H bombs like confetti. Submarines are on the prowl, each armed with H torpedoes and long range H rockets. Similarly armed SAC planes are flying constant patrol. And what is the probability of some *accidental* goof-up that will cause a high order fusion detonation in sea water? Note what Oppenheimer feared in 1945, and that the Earth's surface is 85% water. Remember too, that there is plenty of hydrogen and oxygen down there, along with some nitrogen, even deuterium to act as the trigger. The obvious question: What is the probability of a fusion device initiating a sustained chain reaction in sea water?

Because of the complexity of modern warfare, there is among the rank and file of the U. S. military a spoof on this called MURPHY'S LAW: "If any thing can go wrong, it will." And proof of the validity of this "Law" is the U. S. submarine at the bottom of the South Atlantic, crew long dead, but H Bomb rocket heads intact. A Russian sub met the same fate more recently in mid-Pacific. Same results. A cruising SAC plane, off the coast of Spain a few years ago dropped or jettisoned its H bombs as it made ready for a crash landing. Fortunately, the bombs did not detonate, but the fissionable material was scattered over the landscape.

An interesting study in mass psychology is just now unfolding, for the knowl-

edge that nuclear explosions had the potential of vast, unwanted destruction has been in the hands of very prominent scientists for more than 30 years. It is not known to this writer whether Presidents Roosevelt and Truman were made aware of these calculations. Nor is it known from any published material, whether those who were instrumental in developing fusion devices (1948-58) ever seriously considered the potentials of producing explosions which were a 1,000 times as powerful as those of 1945. In any case, they all were rolling dice for high stakes and the rest of us did not even know that we were sitting in the game. History will be the final judge of the Morality of this approach to science.

Another aspect of this unusual drama is that following the publications by Pearl Buck (1959) there was no great outcry. Why? We were too busy building and stocking underground shelters; designating and marking with yellow signs, areas in public buildings as "Civil Defense" hideaways. One then reads of the threats of the "Cold War"; of missles in Cuba; of the probability of 100 million deaths in the U. S. should Russia make use of her capabilities of a transpolar nuclear missile attack.

Since the early 1960's we have heard many projections of doom: Population Explosion; Environmental Blight; Ozone Layer Exhaustion, etc. Each of these have had widespread exposure in all news media, resulting in highly commendable efforts to correct these threats to the SPACESHIP EARTH.

We have all read the acrimonious controversies which have recently exploded on the front pages of our newspapers detailing the threats of increased incidence of cancer resulting from fission reactor leakage. Also stressed has been the increased probability of fetal and infant mortality and/or monstrosities; of increased genetic effects passed even to the third and fourth generations. These are threats of slow death; of injury to the innocent, and therefore are emotionally upsetting. This appeals directly to the near universal desire to protect our young, our only real, tangible stake in the future.

On the other hand, there appears to exist on another subject, an unusual mental block; a head-in-the-sands, ostrich-like syndrome which can be likened to those three monkeys that were so often used as paper weights many years ago. SEE NO EVIL! HEAR NO EVIL! SPEAK NO EVIL! Ergo! Evil does not exist.

The U. S. public, as well as the leaders of the major world powers, seem to have been mesmerized by so many threats to the world's well being. Thus, there is no longer generated a sense of urgency when another alarm is sounded, even though it is an updated version of a boxed item on the front page of a California newspaper at the time of the Bikini Atom Bomb Tests, July, 1946.

> –Definition of a SUPER NOVA–
> "Two Hundred years after the inhabitants
> of a Planet discovered Atomic Energy."
> Anon.

Proponents of fission power visualize the near-exponential increase in the number of fission power reactors to alleviate the coming energy shortage. Others study the "China Syndrome." They are asking such questions as:

(1) Can a U or Pu reactor, going super critical, melt down to a seething white hot mass? Then what?

(2) Under what conditions will such an accident generate a self-sustaining metallic fireball which will melt its way to the center

of the earth?

The underlying unstated assumption in all calculations and projections of nuclear safety, as now applied to power installations or weaponry, is that presently-accepted theories define all possible parameters of nuclear reactions. Again, it is necessary to emphasize that these safety projections assume an energy-free and mass-free space. Thus the theoretical approach outlined herein indicates that present safety projections are inadequate.

Will someone please use modern computer techniques to repeat the calculations of Oppenheimer, Compton, Fermi, *et al.* (1945) as to the probability of a vast nuclear accident being initiated by 1945 fission explosions. Then revise the computer program by plugging in the 1,000 times greater energy yields often derived from 1975 fusion devices.

Reprogram the problem in order to include the parameters of a high order fusion explosion in the presence of sea water, at a containment pressure of 5 tons/sq. in. (depth, 4 miles). Repeat the program using pressures at 1, 2 and 3 miles depth. What are the probabilities of a sustained chain reaction being generated?

In view of the Information Explosion 1945-1975, generating a scientific revolution of unprecedented proportions, can we just now afford the luxury of waiting a generation or two before the new information seeps into the textbooks of physics – *finally* to be fed into our computer banks, *then* to be incorporated in the estimates of the State of the Union Message, or placed on the agenda of the United Nations.

Chapter IV

SCIENTIFIC CENSORSHIP AND THOUGHT CONTROL

Unfortunate Reality

The Question

One is troubled to know whether peer review stacks the deck against younger and nonestablishment scientists whose credentials are no match for those of more imposing competitors. If the system shuts out the bright beginners and independents in order to ration scarce support only to scientists whose reputations are already made, we will come to regret it.

Wm. D. Carey, Publisher
Science 189, 331, 1975

The Answer

Do you think the present peer review system. . .denies funding to those individuals whose ideas or proposals in any way challenge the reviewers?

YES 87%

Are the technical journals. . .largely controlled by hierarchal groups that reject papers that do not fit into the paradigm mold of current theory?

YES 74%

Survey by *Industrial Research*
Oct. 1974, p. 97.
(3,417 respondents)

Those who have progressed through any of the high school science courses have been exposed to a concept commonly called THE SCIENTIFIC METHOD. This is taught as somewhat of a creed that professional scientists live by, with near religious fervor. In essence, it means that the scientist must be a doubter, ever questioning, ever reasoning. The scientist must be guided by the evidence deduced by careful experimentation and observation. The following may be said to be the creed of one of the world's most gifted experimenters who discovered the basic principles on which today's electrical world operates:

> The scientist should be a man willing to listen to every suggestion, but determined to judge for himself. He should not be biased by appearances; have no favorite hypothesis; be of no school; in doctrine have no master. He should not be a respector of persons but of things. Truth should be his primary object. If these qualities be added to industry, he may indeed hope to walk within the veil of the temple of nature.
>
> – Michael Faraday
> (1791-1867)

But those who have grubbed out their livelihood at the blackboard, the laboratory bench or at the designer's table know full well that the ideal is far more sinned against than honored.

About 15 years ago there appeared a timely article entitled, "Resistance of Scientists to Scientific Discoveries" (Barber, 1) which sketched the long history of senior scientists' inhumanity to other scientists with new ideas that differed signigicantly from their own cherished views, while of course being buttressed by the established climate of opinion of other senior scientists.

A study of the History of Science, any science, will show how scientists are quite human, with all the vanities of other mortals, even though to themselves, their self-image remains untarnished. In a most perceptive article entitled "Should the History of Science be Rated X" (Brush, 2), the following statement is made: "I will examine arguments that young and impressionable students should be shielded for. . . .these writings do violence to the professional ideal and public image of scientists as rational, open-minded investigators, proceeding methodically. . .seeking objectively for the truth, let the chips fall where they may."

Now turning to the History of Science, 1975, we find that there are hearings being held in the halls of Congress to examine the "Peer Review" systems which have evolved ostensibly as the means of equitably distributing the $15+ billion dollar annual Federal Research and Development budget. There is evidence of cronyism; of faking the recommendations of referees; of all sorts of log-rolling quite as astute as in the everyday power politics at city, state and national levels (See *Science* 8 August 1975, p. 435).

And the scientific community is aghast at the suggestions of some writers that professional scientists would stoop to such practices. As for myself, having been on the science scene for nearly half a century, such revelations are not surprising, they are about 20 years overdue.

In 1959 I wrote the essentials of the following[3]; it was again included in a piece published in *Science* in 1964[4]:

> It is evident that Putnam and others are surprised at the "McCarthyism" that is utilized to enhance the views of F. Boas and downgrade the find-

> ings of W. C. George. But this approach has been used for centuries, and still remains, in this "enlightened" 20th century, an effective method of promoting a group's ideas, concepts, and scientific interpretations. Galileo was muzzled by cleric and scholar alike; Young's wave theory of light was suppressed for a century by Newton's idolizers. . .
>
> Scientific research has become a competitive, multibillion dollar business. With bigness came administration separate from the laboratory, interested primarily in a smooth-running organization, not its principal products--data and new ideas. With affluence came the accountant, to see that monies were properly apportioned, spent, and recorded. We have thus *inadvertently* evolved a very efficient system of control, of checks and rechecks, of consorship by selection, which eliminates the bizarre, the unusual, the unacceptable: selection of graduate candidates and their thesis subjects; selection for membership in scientific societies; selection of papers for publication in scientific journals; selection or research projects to receive financial report.

Early in 1974 there was a flurry of excitement, generated by what was essentially a rerun of a 1950-55 scenario. This was the opening of the A.A.A.S., the world's biggest scientific society, to a discussion of the concepts of one Immanuel Velikovsky. Dr. Velikovsky had written two books some 20 years earlier that analyzed the evidence of ancient history in such a way as to question the conclusions of the professional astronomers. And this in the last analysis is the cardinal sin of Dr. Velikovsky. The scientific community responding made every effort to have these books, these ideas, banned. And this is the ultimate in foolishness that has now come back to smear so many self-images of scientific rectitude. In 1974 the same drama was played out in San Francisco, different actors of course, and different scenery. The results? The self-same foolishness, only this time ridicule was added, a two-edged sword that was wielded by the "Establishment."

My own interest in what has become known as the "Velikovsky Affair" is in the quite overt application of scientific censorship and thought-control, which is usually accomplished much more circumspectly. The following is from an editorial which was published following the A.A.A.S. meeting:

"The quantity and tone of the polarized comments, Re: The 'Velikovsky Affair,' which have appeared recently in a wide spectrum of publications, are symptomatic of a serious sickness that afflicts the super-organized, competitive, multi-billion dollar *business* called Science. This malaise is far more generalized than is indicated by the pros and cons on the validity of Velikovsky's postulates or his methods of presentation."

The idealized image of the scientist as an open-minded skeptic, guided by the scientific method, is convincingly sketched in high school and freshman science classes. The brutal realities are another matter. (see Brush, *Science*, March 22, 1974, p. 1164). Is it any wonder that there is an anti-science backlash among so many knowledgeable people, or why so many of our brightest idealistic youngsters seek careers outside the basic sciences? The self-image so dear to the hearts of many scientists is no longer acceptable to non-scientists nor to those who control federal research funds. Altruistic pleas in the name of "Science for Science's sake" are about as effective as a buggy whip on a modern Mustang.

Scientific consorship and thought control, draped in the holy robes of the "peer review system," are being used to insure that "Them that has gits" the funding

considered so necessary for the on-going research teams. Also the NIH syndrome (Not Invented Here) plays such an important part in the evaluation of research proposals by unbiased (?) peers (and competitors). One would hardly pick Ford and Chrysler to pass on General Motors' next year's designs for the rotary engine.

Just how much chance has a young unknown with a bright new idea that cuts across the cherished paradigms of the proposal evaluators? (See Jueneman and Roy, *Chem. & Eng. News,* Nov. 19, 1973, p. 3 and Dec. 4, 1973, p. 4.)

Since the way to promotion and pay is via scientific publication, the present selection system of determining who shall publish, is the second obstacle course that the new idea, new data, must run. The kiss of death of the unbiased, fearless (and anonymous!) referee is well known to those who try to publish outside readily acceptable norms. (See Jones, *New Scientist,* March 21, 1974, p. 758.)

And what do some 3,000 industrial scientists and engineers think of this system? Some 69% believe that the progress of science is being retarded (*I.R.* June 1973, p. 77). One can only wonder what portion of the U. S. total annual research budget of 3×10^{10} dollars goes down the drain as the result of the several well-organized, smooth, censorship-by-selection procedures, which serve to snuff out new ideas and to maintain the power and prestige of those who are currently at the top of the pecking order. (Rather like some other sectors of public life that we have heard so much about lately, Yes?)

"The current 'Information Explosion' is another scientific revolution, which has already shown that many of our hallowed paradigms rest on sand. What is sorely needed just now is less pride in knowledge held, and more of that exciting urge for new fields to conquer, to see what is on the other side of the next hill, to recapture the free-wheeling motivation of the young scientists of 70 years ago, during *that* scientific revolution."

– H. C. Dudley
Industrial Research
July, 1974, p.7.

It is not necessary to go back 20 years to find instances of the enforcement of thought control. Fortunately, the Editors of one of our leading journals had the intestinal fortitude to stand up and be counted in an effort to see that justice be done in the case of a Nobel Prize winner who had the audacity to propose a new approach to the understanding of cancer.

Albert Szent-Gyorgyi received the Nobel Prize for Physiology and Medicine in 1937 for research on Vitamin C and fumaric acid. He has recently been endeavoring to secure funds and laboratory facilities for studies on the causes and treatment of cancer.

The following is a most illuminating statement, outlining the difficulties of this grand old man of biochemistry:

"One of the more controversial research reports *C&EN* has carried in recent years appears on page 16. Controversy surrounds not only the merits of Dr. Albert Szent-Gyorgyi's cancer theory, but whether it should be written about at all.

In connection with the story, *C&EN* consulted more than a dozen scientists, plus organizations in the cancer field. A few scientists believe Szent-Gyorgyi's ideas to be 'promising and worth attention,' if perhaps 'way out of the mainstream.' On the other hand, most consulted reject the theory, one reason being that the

Nobel Laureate recently has been 'off the track' scientifically.

Several scientists, however, go farther. One cancer organization executive will only comment 'off the record,' and says it would be best to give no publicity. And a noted scientist advises, 'the less said the better' by 'responsible' publications.

There seem to be four reasons for such advice: belief that the theory is so baseless and speculative it does not warrant serious consideration; concern that public criticism of the theory only would hurt a 'grand old man' who has contributed so much to biochemistry; dislike for publicity and fund-raising methods used by the National Foundation for Cancer Research (a private group set up solely to support Szent-Gyorgyi's research after he had difficulty finding funding); and fear that publicity might confuse and mislead the public on a subject so sensitive as cancer.

The affair raises a dilemma for science journalists. For example, notes a prominent newspaper science writer who has not reported the theory: 'By the very fact you cover it (even if critically), it gives display and more importance to it.'

C&EN finds compelling reasons to report on the theory that more than answer the objections above. First, although a minority, several respected scientists believe the theory deserves further attention. Szent-Gyorgyi himself expects initial criticism and rejection, even making a virtue of them. And whatever the criticisms of his recent track record or of the foundation's activities, the theory should be judged on its own merits.

Moreover, the theory has not 'gone away by itself.' It has been reported by, among others, the *National Observer, Science News,* a Paul Harvey radio network newscast, and the United Press International newswire, and even reached media in Israel and Hungary. But coverage has been uncritical, with no reactions by other scientists, and based mainly on a somewhat misleading press release from the foundation. Those advising against reportage by responsible science writers seem a bit ostrichlike.

It is time all sides of the matter be put 'on the record.' The way of science is to argue an issue openly, letting scientists judge for themselves. We don't see how, as a responsible science publication, we can *not* cover it."

— Richard J. Seltzer
Chemical and Engineering News
28 July 1975, p. 2.

My reaction to the above was that of disgust at the extent to which those at the top echelons of science would stoop, piously rationalizing in order that their personal empires might not be menaced in the slightest.

There is a serious sickness which afflicts U. S. science. The editorial above makes the diagnosis and pin-points the focus of infection. Censorship! Thought Control!

Having now been on the science scene for nearly a half-century, observing the extension of this disease from a mild fever to the present fulminating cancerous growth, I published in 1964 the quotation which appears on a previous page.

We have now progressed (?) to the point where vaccination with a Nobel Prize offers little protection. If one's hypotheses, experimental design and/or data do not fit neatly into the mainstream efforts of those who hold the purse strings or who judiciously assign research priorities, ergo, you must be off base, perhaps as reported for Prof. Szent-Gyorgyi "off the track scientifically."

Review again Mr. Seltzer's editorial and you find examples of a broad spectrum of thought control.

There is the "prominent science writer" who delegates to himself the perogative of deciding what is valid news, who and what are worthy enough for ME to read about. If I should be in a position to tell HIM what He should publish I'm sure that I'd be hauled into the Federal courts by next week.

All this may well provide the material for a dozen future Ph.D. theses on the History of Science, 1975 or the Psychology of Rationalization in Scientific Censorship.

Such sheer egotism! Such sheer disregard for the freedoms on which this nation was founded. Such sheer disregard for the very essence of all we were taught so many years ago as the SCIENTIFIC METHOD. Such desire for unbridled power to control the thoughts, actions and destinies of other human beings. HEIL! CENSOR!

During 1975 there were Congressional hearings on the various abuses of what euphoniously are called "Peer Review Systems." There has been precious little reported on this in the general media or by scientific writers. Why! The general reaction of much of the higher echelons of the U. S. scientific community is to brush all this off as a passing minor squall that will blow itself out in a few months. Then back to business as usual.

Perhaps it would be smarter to take a careful look at the results of a survey taken among working scientists and engineers.

> Do you think the present peer review system. . .denies funding to those individuals whose ideas or proposals in any way challenge the reviewers?
> YES 87%
>
> Are the technical journals. . .largely controlled by hierarchal groups that reject papers that do not fit into the paradigm mold of current theory? YES 74%
>
> (3417 Respondents)

Somewhere in all this there is a message for those who administer the total annual U. S. R. and D. budgets of $35 billion, which is our insurance of survival in the uncertain future. And certainly there needs to be some policing of those who with essentially no accountability, control such a respectable portion of the GNP.

There is a considerable credibility gap showing up as the research review processes, which have grown up like Topsy, begin to show a seamy side.

It is time that the scientific community face up to the unpleasant fact that we now stand before Legislators and the general public, not clothes in the fine raiment of our self-image but much more like the King, when the little boy says, "But Daddy, the King has no clothes on at all."

Three cheers for the editors of *Chemical and Engineering News* and *Industrial Research* for following the pathway of journalistic morality, and for seeing that far too much of what passes for scientific reporting has been carefully washed, screened and filtered to support established reputations, pet projects and ever bigger slices of the shrinking research pie.

Having discussed the problems of scientific censorship in the fields of Astronomy and Medical Biochemistry, let us now turn to that area which is our major interest in this volume, namely nuclear science and nuclear safety.

Elsewhere in later chapters there are developed concepts which require a marked revision of the new accepted ways of going about the business of nuclear physics. Consistently, the source of nuclear energy is not considered to be $E = Mc^2$ but is instead a return to a time, pre-1920, when the following paragraph was published

in a standard textbook of physics:

> To account for the transmission of waves through space containing no ordinary matter it seems necessary to assume the existence of a universal medium filling all space and even interpenetrating matter itself, as shown by the existence of transparent substances. That this medium can react on matter is shown by the fact that radiant energy is transmitted from ether to matter in the case of absorption, and from matter to ether in the case of emission of radiation by material sources.
>
> In recent years doubt as to the necessity for assuming the existence of an ether has been expressed by some who believe that it is sufficient to attribute the power of transmitting radiation to space itself. It may be doubted whether this is more than a dispute about terms. We cannot discuss the question here, but pending the settlement of the controversy it seems wise to continue the use of the word ether as at least denoting the power of space, vacant or *occupied by matter,* to transmit radiation.
>
> – A. W. Duff, editor
> *TEXT BOOK OF PHYSICS*
> P. Blakiston's Son and Co. 1912,
> p.565.
> Chapter on LIGHT, by
> E. Percival Lewis.

As will be made clear in ensuing chapters, the old concept of an "ether" has given way to the "neutrino sea" acting as an energy-rich subquantic medium. And it is the potential energy content of this particulate medium which is postulated to be rendered observable in nuclear events. Such is the major point of schism between what is developed herein and what has appeared in the textbooks of physics for almost 40 years.

The above may well be anathema to those who are indoctrinated in, or perhaps better yet, converted to a quasi-religious faith in a set of assumptions and postulates laid down pre-1930. Physics has not for many years been a physical science, a study of interactions of matter and/or energy. In place of a body of knowledge based on experimentation, there has evolved a series of mathematical-philosophical games which have only a nodding acquaintence with the real world in which we live, and in which nuclear power reactors operate and nuclear explosions take place. Examples of these games are given in *Chapter I* by which one twin may be caused to age slower than his brother.

Are there instances of censorship in the field of nuclear physics? Most certainly! One of the most clearcut examples of such is the rejection of the papers by J. L. Anderson who showed that the modes of beta decay of three radioactive isotopes could be altered by rather simple means. These papers may well be classics in the future, for their long-range theoretical significance seems at this time to be assured. These papers were rejected by editors of the American Physical Society, and were later published by a journal of the American Chemical Society.

Five papers of my own were rejected by the A.P.S. editors, with three later published in the journals of the Italian Physics Society, and others in U. S. publications.

Perhaps one of the clearest expositions of the closed, restricted state of U. S. physics is given in the statement of policy of the editors of the official organ of the

American Association of Physics Teachers:

> Papers announcing new results of original research are generally more appropriately published in one of the research journals. . .Papers presenting original research that clarifies past misunderstandigns or allows a more encompassing view of a subject are certainly acceptable. Controversial or isolated new results yet to be judged in the research literature are not acceptable. Included in the latter category are papers *purporting* to discredit bodies of physical theory (such as special relativity, quantum mechanics, and thermodynamics) which are a part of the *generally accepted physics curricula.* Although these theories are not necessarily complete and immutable, a serious criticism of them is more properly presented to the appropriate specialist audience.*
>
> *American Journal of Physics*
> Volume 43, 1975, p. 1.

In the above quotation the words PURPORTING and GENERALLY ACCEPTED PHYSICS CURRICULA have been italicized for these are the key to the current restrictive practices and policies of this and other "respectable" journals of the U. S. physics community. For in specifying Relativity, Quantum mechanics and Thermodynamics as areas in which considerable numbers of unacceptable manuscripts are being received, it is made clear that a goodly number of physicists are dissatisfied with the present methods used to develop the very concepts which are so very basic to the presently accepted methods of explaining observable events.

But the criticism of these concepts or of the conclusions which are drawn therefrom will not be tolerated. This is confirmed when one examines the policies of all of the APS journals as stated by the editor-in-chief, 1973.

The methods by which reviewers, funding agencies, manuscript referees, research proposal reviewers are able to stifle the creativity is quite well outlined in the article by R. J. Seltzer, above. And when these practices delay the open-minded evaluation of Velikovsky's interpretation of events millennia past, no damage is done except to the vanity of his followers. When the new approach to the causes and treatment of cancer is delayed, as in the case of Szent-Gyorgyi, there is no long-range harm done; except of course in the case of future cancer victims, the new knowledge coming too late.

But by what school of philosophy, of ethics, is it possible to justify delaying the development of new knowledge and understanding of nuclear processes? In effectively preventing the examination alternative hypotheses; insisting that only that which is "a part of the generally accepted physics curricula" shall be heard, insisting that our students shall not be contaminated by untested concepts, how is it possible to progress beyond our present state of half knowledge?

Theoreticians and most nuclear physicists see as actual events, the mathematical calculations which are only marks on pieces of paper or computer read-outs. These are more remote from reality than were the cloistered monks of yester-year. For while they calculate, the rest of humanity must live in a world in which MIRVA rockets can spew out H-bombs like so much confetti; when fission reactors multiply like rabbits.

Those who calculate, prognosticating as to the probabilities of nuclear accidents, have you ever personally observed at close range a nuclear explosion? I have,

*Many ask where?

twice. Have you ever received an overdose of nuclear radiation? I have, several times. So it would appear that I have the vested right to challenge your calculations, for in them I see fallacious reasoning which carries a menace for my children, and their children.

If the reader has come thus far in this volume, you then realize that I have invited a deluge of ridicule from certain segments of the scientific community, for this is becoming more and more the weapon of those who must hold unsullied, at all cost, the status quo of concepts learned long ago.

But the author has seen much water go under the keel, and has ridden out many a blow. But never at anchor. There's the gauntlet, gentlemen.

REFERENCES

Chapter IV

1. B. Barber, "Resistance of Scientists to Scientific Discoveries," *SCIENCE,* 134 (1961), p. 596.
2. A brush, "Should History of Science be X Rated?" *SCIENCE* (March 22, 1974), p. 1164.
3. H. C. Dudley, *New Principles in Quantum Mechanics* (Exposition-University Press: N. Y., 1959), p. 13.
4. H. C. Dudley, Letter to Editor. *SCIENCE,* 24 (Jan. 1964), p. 307.

Part Two

New Ways of Looking at Nuclear Science

PART TWO

New Ways of Looking at Nuclear Science

Innovation: Don't keep forever on the public road, going only where others have gone and following one after the other like a flock of sheep. Leave the beaten track occasionally and dive into the woods. Every time you do so you will be certain to find something that you have never seen before.

—Alexander Graham Bell (1914)

The history of science shows that the progress of science has constantly been hampered by the tyrannical influence of certain conceptions that finally come to be considered as dogma. For this reason, it is proper to submit periodically to a very searching examination, principles that we have come to assume without discussion.

—Louis de Broglie
Revolution in Physics (1953)

Chapter V

IS THERE AN ETHER?

This subquantic medium would be made up of an entirely chaotic wave field – storing up a formidable quantity of hidden energy. – This medium might be conceived of as a sort of a gas, undoubtedly made up of leptons and perhaps neutrinos, which move in all possible directions, with all possible energies.

–L. deBroglie and J. P. Vigier
Theory of Elementary Particles
Elsevier Publ. Co. 1963, p. 131

As a result of the rapid series of successes of the applied sciences during the World War II period (1939-45), the major governments of the world have steadily increased their support for scientific research to the point where, at present, the total expenditures for research and development equal 2 to 3% of the GNP of the major industrialized nations. This unprecedented flow of money has attracted and trained an ever increasing percentage of the population in scientific pursuits.

"Information explosion" is the proper term to describe the mass of new and significant data accumulated during the past three decades. The advent of new apparatus, new techniques, and new data has led to a fuller understanding of basic mechanisms on both astronomic and nuclear scales. With fuller understanding, has come the realization that earlier mass and energy "models" have been made untenable.

The new information enables one to penetrate deeper into old problems. Through long usage, certain theories, certain interpretations of experimental results, have assumed the mantle of self-evident "truths". The new data show that these "truths" can no longer logically be accepted. In short, scientists must unlearn a good part of what long has been taught as *TRUTH.* This for some may be an unpleasant ordeal.

In reality, one should consider any theory a temporary structure, a scaffolding, from which the *Wall of Knowledge* is slowly built, bit by bit, generation by generation. Is the scaffolding (or its designer) dishonored if the Wall, progressing, requires new and more advanced scaffolding and shoring?

During the development of any hypothesis or theory, there is implanted unknowingly by the originator, a time bomb, which eventually demolishes every theory. This self-destructive device is the assumption that all physical factors (Mass and/or energy), which enter into a reaction, are known, and that all possible parameters have been defined.

The theorizer thus establishes the postulates and assumptions on which he logically develops his train of reasoning. By so doing, he limits the applicability of his "model". When additional parameters are discovered by succeeding generations, all theories require revision. They eventually become obsolete, and are discussed only in dusty reference books. Such is the history of science.

Several "time bombs" have exploded during the past two decades. For example, examine celestial mechanics and nuclear science.

Celestial Mechanics

In the seventeenth Century, Isaac Newton brought mathematical rigor to the Keplerian theories of planetary motions. He postulated that the binding force was the mutual attraction of mass for mass, termed gravity, this force varying as $1/d^2$, where d is the distance from center to center of the masses.

Because of the scant knowledge of electric and magnetic forces existing at the time, Newton assumed that gravity was the only force acting between celestial bodies. Modern astronomy and celestial mechanics developed in this climate of opinion.

In the mid-Nineteenth Century, Lord Kelvin and others studied the clear weather phenomena of an electric charge (+) in the air, with reference to the earth (–). Surface potential gradients of up to 450 volts/meter were observed. In the 1890's, Nikola Tesla observed transmission of electric signals thru this electric field and postulated the sun to be the generator of the field, with the sun's potential at $\sim 10^8$ volts.(1)

Beginning in 1958, space probes have shown interplanetary space to be very lively, with interlocking magnetic and electric fields. Both the earth and Jupiter have extensive magnetospheres which are shaped by the supersonic solar wind ($\sim$ 400 km/sec) composed of p^+ and e^-.[2-8]

The earth's (+) charged electrosphere (clear weather phenomenon) appears to be induced by a (–) charge of 10^{28} esu on the sun. The earth's surface is (–) charged, with a potential difference of $\sim 3 \times 10^5$ volts (+) at a height of $\sim$ 20,000 meters.

Potential gradients, recently determined during clear weather, near the surface, vary both seasonally and daily (range 150 to 550 volts/m). The earth may be likened to a spherical capacitor with the earth's surface the inner (–) plate, the air the dielectric, and the electrosphere the outer (+) plate.[8]

It was shown in the late 1950's that small rockets, with high surface/mass ratio could be caused to rise highest ($\sim$ 400%) when the weather condition favored charge retention, and when the potential gradient was at a maximum. The rockets at ground potential (–) were attracted by the (+) charged zone above. Thus, the gravitational "constant" was significantly altered.[9]

The above discoveries and changes in viewpoint indicate that the simplistic Newtonian concept of celestial mechanics must be modified. New concepts must include the parameters of magnetic and electrostatic interactions of celestial bodies. These forces contribute to a resultant of three "forces at a distance".

Text books of astronomy published before 1965 might just as well be written in ancient Sanskrit, for all of their present usefulness. Such is one of the most far-reaching "spin-offs" of space programs.

Radioactivity

Now to the basics of nuclear science and two more "Time Bombs". In your training you learned that radioactivity resulted from "spontaneous" processes by which certain atoms emitted various particles and gamma rays. But, as a digression, again examine the term "spontaneous". The concept of "spontaneous generation" of complex living organisms was well established and generally accepted by biologists in 1850. For more than 20 years, Pasteur labored to show that the life forms which appeared "spontaneously" in sterilized culture tubes and dishes were nothing more than once-airborne bacteria, yeast, and spores.

Finally, by 1875 this concept of spontaneous generation, resulting purely from the lack of information, was laid to rest. The biological sciences thus were freed of the illogical assumption that experimentally observed events could arise "spontaneously," without prior causes.[10]

My heresy is to believe that in all sciences the use of such terms as "spontaneous" or "acausality" is illogical; surrender to a temporary lack of information, which will be corrected in a generation or two.

Radioactivity was discovered by Becquerel in 1896. In 1906, Millikan stated that "Radioactivity has been found to be independent of all physical as well as chemical conditions. The lowest cold or greatest heat does not appear to affect it in the least. Radioactivity seems to be as unalterable a property of the atoms of radioactive substances, as is weight itself".[11]

This state of mind established the modern view, which is quite generally held today. But toughminded old Lord Kelvin, an experimentalist *par excellence*, refused to concede that radioactivity was a spontaneous process whereby, without cause, atoms could transmute themselves to an entirely new species.

Physicists, lacking a cause-effect sequence to explain a most interesting new phenomenon, surrendered to a lack of information. They adopted biology's rejected child, "spontaneous generation", renaming the little devil, "spontaneous disintegration." Of such was spawned the present quasi-religious faith, the theoretical dogma, "acausality."

The electroscope and spinthrascope were used in early study of radioactive alpha-decay rates. The inherent limitations of these early instruments led to erroneous conclusions:

- That radioactive decay rates are constant.
- That these rates cannot be altered by change of the energy state of the electrons orbiting the nucleus.
- That radioactivity results from processes which involve only the atomic nucleus.

Refinements in electronics resulted in the development of sophisticated counting apparatus. This equipment was used in the demonstration by several investigators (1949 to 74) of rather easily induced changes in the disintegration rates of 14 radionuclides, including ^{14}C, ^{60}Co, and ^{137}Cs. The observed variations in the decay rates, (changes in the half life) were produced by changes in pressure, temperature, chemical state, electric potential, stress of monomolecular layers, etc.[12,13]

These findings, together with complex and alternative disintegration modes, by which certain radionuclides decay (example ^{64}Cu, β^-, β^+ or electron capture), have led to the conclusion that radioactivity *must* result from some complex cause, of which earlier physicists had no inkling. The decay "constant" is now considered to be a variable. The value is dependent on the energy state of the entire atom as the basic unit system, not just on the energy state of the atomic nucleus.[14-16]

Radioactivity is thus shown experimentally not to be, as described by Millikan, "an unalterable property of the atom." Half lives are not constant.

The initial controlled, experimentally induced changes in radioactive decay rates, were observed by Segre, Wiegand, and Leiniger (1949) utilizing ^{7}Be, a radionuclide decaying by capture of a K-shell electron: half life, 54.5 days. It was earlier postulated, that the electron density near the nucleus would be altered by variation in the energy state of the two L-shell valence electrons, produced by chemical combinations. A change of decay rate of $\sim 0.1\%$ was observed (Be/BeO).

The complex decay of ^{90}Nb was determined (1965) in combination as the fluoride. When compared with the elemental form, the half life was altered by as much as 3.6%. The decay is by internal conversion, which is postulated to be influenced by variations of the energy content of the four N-shell valence electrons. This process, in turn, alters the effective charge density adjacent to the nucleus.

The first demonstration of induced variation of decay characteristics of β^- emitters was by Anderson. He caused small but statistically significant changes in the pattern of observed counts from ^{14}C. The findings resulted from incorporating ^{14}C into a polar organic molecule, and stressing the bonds as a monomolecular layer.

Electric charge on the counting sample of + 90 V produced similar changes in the decay pattern. These findings were confirmed with ^{60}Co and ^{137}Cs, both β^- emitters, the emission being followed by gamma emissions.

Analysis of Anderson's results indicate beta decays appear to be interdependent.

Decay *Event A* influences Decay *Event B*, this being similar to a neutron induced chain reaction of fissionable material (See *Chapter VI).*

To recapitulate: small changes in the energy content of L-shell electrons of ^{7}Be, and similar changes in the O-shell electrons of ^{137}Cs, have produced variations in decay characteristics representative of 12 other radionuclides.

Thus the equation: $N=N_0e^{-kt}$ can no longer be considered valid. The decay "constant" has been shown to be a variable, dependent on the energy content of the entire atom, rather than being dependent only on the mass-energy relationship of the nucleus. Thus *k* becomes a stability index, defining the state of certain atoms, which have been termed "linear resonant systems; subject to parametric excitation."[14]

Since it is possible to alter radioactive decay rates, it is logical to conclude that such processes result from some finite, causal process. The practical importance of these findings is to expand the now rather-restricted views on mechanisms for fusion and fission.

In modern physics texts, radioactive decay is described as a series of truly random, unrelated events, each occurring "spontaneously", without prior cause. Thus, the "disintegration constant" necessarily becomes a true constant that is not alterable by ordinary means. With respect to theoretical and nuclear physics, the easy alteration of these "constants", no matter how small, is of utmost importance. Such is my interpretation of the significance of these data.

The Ether

Change in "fashion" or what also may be termed "climate of opinion," in science is well illustrated by the rise, fall, and presently-developing concept of an "ether".[14-16]

Until about 1915, there prevailed a generally-accepted assumption that certain phenomena logically required the presence of a generalized medium, *ether* or *aether.* This continuum could not be defined or characterized because of the lack of experimental data.

The null results of the famed Michelson-Morley experiments (1881 to 1889), coupled with an *ad hoc* assumption by Einstein (1905), had by 1940 resulted in the abandonment of any concept of the ether as a medium necessary for the transmission of electromagnetic radiation. The continuum would be a generalized, absolute frame of reference, if physical interaction with such a medium could be accomplished.

Recent astrophysical studies show that the orientation of the M-M apparatus foreordained the null results. These conclusions are graphically used in all current physics texts to "prove" the lack of an "ether", or of the necessity of such a medium for the propagation of light.[14,18]

Michelson and Morley centered their attention on the earth's orbital velocity (30 km/sec). They had no knowledge of the existence of galaxies, or galactic motions in relation to each other, or of the motion of our solar system in our galaxy. Orientation of their interferometers in planes tangent to the earth's surface insured that the angle of approach of an "ether drift" would be nearly perpendicular to the plane of the interferometer. Rotation of the instrument in this plane would only slightly alter the effective velocity of the "ether" at the two arms of the interferometers. The null results are thus explainable on the basis of pre-1900 classical mechanics. The limited information available to Michelson and Einstein is

emphasized by the following:

– By referring to stars in this galaxy, the earth's velocity, with respect to the galactic center is in the range of 200 to 220 km/sec, as determined by several astronomic studies conducted since 1930.

Since 1960, the existence of a nearly isotropic 3.5 cm. electromagnetic radiation flux (3°K) has been demonstrated by several studies. This is postulated to result from the "big bang," a celestial primordial event. Conklin estimates the earth's absolute motion, with this flux as the generalized frame of reference, as ~ 160 km/sec. Directions of this motion in local coordinates: Rt. Ascension, 13 hours; declination 32 degrees.[17]

The modern development of an ether concept began in 1951 when Dirac, (Nobel Laureate in theoretical physics, 1933) posed the question "Is there an Ether?" as the title of a paper. He answered in the affirmative, developing the concept of an essentially-isotropic sea of electrons (e^-) in random motion.[18] DeBroglie (Nobel Laureate in theoretical physics, 1929) postulated a "subquantic medium" in 1959.[19] Later he characterized this medium "as a gas made up of leptons and probably neutrinos."[20, 21]

During the past decade there has been developing in astro-physics the concept of a generalized "neutrino sea." This flux of uncharged particles arises from the nuclear reactions in the myriad of nearly randomly-distributed stars. This subject is extensively reviewed in the "Cosmic Neutrino" by B. Kuchowicz.[20]

The "subquantic medium" or "neutrino sea" has been defined as an energy-rich substrate, the common denominator in all particle reactions:

Muon neutrinos of e°; Rest mass ~ 0.6 Mev.

Electron neutrinos: Rest mass ~ 60 ev.

Particle velocity range: a continuum from near zero to near c.

Particle density: ~ $10^{12}/cm^3$.

Energy density estimates: 10^8 to 10^{19} ev/cm. [14-16, 21]

It is reasonable to conclude that populations of nuclei under-going what is now termed "spontaneous decay" consist of units, each of which is a linear, resonant system. Parametric excitation of such units by interaction with the uncharged particles of the neutrino sea would provide a cause-effect mechanism for the phenomena of radioactivity. Thus, the observed "decay constant" (k) is considered to be a complex variable, dependent on the energy content of the atom as a whole and the parameters defining interactions with the neutrino flux. In short, k becomes a stability index rather than a constant.

To clarify: there exist resonant systems throughout all physics. In electricity and electronics, it is tuned and LC circuits. In acoustics, it is the vibration of a string induced by the harmonics of an adjacent string. In mechanics, it is your auto with an out-of-balance tire as it tries to shake itself to pieces at a certain speed. These are examples of the transmission of energy at some critical rate or frequency. In Chemistry, it is Le Chatelier's Principle: "A system in equilibrium will react to an outside stress such that the effects of the stress will be minimized". A radioactive atom is considered to be analogous to a "set" mouse trap, an energy-rich system in a state of equilibrium until acted upon by some extraneous mass and/or force.

Thus, science may no longer be required illogically to assume, on the basis of lack of information, that radioactivity is the result of "spontaneous" events, occurring without prior cause. What is needed is another Pasteur to point the way.

The Future

Since new hypotheses and theories suggest new approaches to experimental design and technological applications, it is proposed here to examine three areas which will be significantly affected by these recent developments. As a guide, we will consider the way in which technology was influenced by the discovery of the e^-, p^+, and alpha particles (1895 to 1900), reinforced by the experimental demonstration of the neutron and e^+ (1932).

The interactions of all these particles have long been assumed to occur in energy-free and mass-free space, which contributes nothing to the reactions.

The e^- and e^+ each have rest mass of 0.511 Mev. Since the muon neutrino has an upper limit rest of ~ 0.6 Mev (90% confidence), this has been interpreted as experimental support for the prediction of the existence of an uncharged unit of matter e°, equal in mass to the e^-. The name *neuon* has been proposed.[16]

Interactions of matter and energy under cryogenic conditions have long been explained by means of unusual physical and electrical properties of matter and by hypothetical particles. After much consideration, one finally concludes that one is observing direct interaction with the particulate neutrino sea, the relative motion of all particles approaching zero as the temperature approaches O°K.

Therefore, it is suggested that the technology resulting from reorganization of our thinking, with respect to the energy-rich particulate flux in which we exist, will lead to many practical developments. Among these is electrical power transmission, with power losses approaching zero, at more manageable temperatures than at present.

Nuclear Power

Let us now examine a series of typical "nuclear" reactions, treating these as special cases of decay processes. The reactions are considered to occur in a particulate substrate which contributes energy. Potential energy is converted to observable forms through the interaction of high-velocity neutrons with the surrounding energy-rich neutrino flux (νe, e°). The "by-product" neutrons of all these reactions are considered to be the energy carriers.

Fission: Consider ^{235}U to be a linear resonant system subject to parametric excitation by a neutrino flux.

$$^{235}U + [e^\circ + \nu_e] + E_{x} \rightarrow {}^{231}Th + \alpha + E_B$$

(α decay)

$$^{235}U + [e^\circ + \nu_e] + E_{x2} \rightarrow X + Z + 3n + E_B$$

(spontaneous fission)

In a neutron flux,

$$^{235}U + n \rightarrow {}^{236}U + \nu$$

(n, ν reaction)

$$^{235}U + [e^\circ + \nu_e] + n + E_{x3} \rightarrow X + Z + 3n + E_B + E_F$$

(fission)

where E_X = excitation energies from the flux.
X, Z = fission products.
E_B = excess binding energy released
E_F = energy derived from the flux, the product neutrons acting as catalyst or intermediates in transfer of Kinetic energy of $(e^\circ + \nu_e)$ to products and other adjacent nuclei, thus inducing a chain reaction.

Net observable energy:

$$E_{net} = E_F + {}_B - E_X$$

$$E_X < E_B$$

And $$E_B \ll E_F$$

Thus fission reactions are considered to be fundamentally exothermic, but with the greater part of the observable energy being supplied by the flux through the product neutrons.

Fusion: Consider deuterium (D) to be a stable nonlinear resonant system not subject to parametric excitation by $(e^\circ + \nu_e)$ flux.

$$D + [e^\circ + \nu_e] + E_X \rightarrow p^+ + n + E_B + E_F$$

(exothermic)

$$p^+ + [e^\circ + \nu_e] + E_Z \rightarrow n + e^+ + E_F$$

(endothermic)

where E_X = excitation energy initally is supplied to the system to induce decomposition of D.
E_Z = energy necessary to drive the reaction to the right. This energy is initally supplied to the system.
E_F = kinetic energy derived from the flux, with product neutrons acting as catalyst or intermediates, transferring the flux energy to products and adjacent nuclei, this inducing a chain reaction.

$$E_X \cong E_B$$

$$E_X \ll E_F$$

$$E_Z \ll E_F$$

Net observable energy:

$$E_{net} = E_F + E_B - E_X - E_Z$$

What are now termed "fusion" reactions are considered to be fundamentally endothermic, with *net observed* energy supplied by the flux through the product neutrons.

A mechanism for the transfer of the kinetic energy from the uncharged particles of the flux ($e^\circ + \nu_e$), has as yet not been developed. But the concept of inelastic scattering of neutrons by moderators may be reasonably extrapolated to other uncharged units of matter having less mass. Therefore, with the model of the neutrino sea outlined herein, the transfer of kinetic energy by high velocity e° and ν_e to neutrons, e^-, e^+ and nuclei, would convert the potential energy content of the flux to an observable, measurable form, through inelastic scattering processes.

The intermediate steps which accomplish this energy transfer may involve "neutral currents" or Feynmann mechanisms which are now utilized to describe similar energy transitions. Thus a fresh approach might be made toward "clean" fusion power, rather than continuing down that long tunnel, which has been the path of fusion research since 1950.

The above theoretical approach is unique in that the *philosophical* assumption of $E = Mc^2$ has not been utilized to explain the vast amounts of energy which are rendered observable whenever nuclear explosions occur.

This equation of Einstein is an expression which, by default and long usage, has become the only explanation for certain observed events. All other alternative hypotheses have long since been abandoned, so that the scientific community now feels comfortable in the company of an old friend.

Such was not always the case, as indicated by the following paragraph:

> What is the strange process by which such a vast store of heat is created in the stars? Several answers have been given, of which the most radical of all now appears to be the best. Ever since the discovery of radioactivity it has been realized that matter possesses enormous internal energy by virtue of its own constitution. This relation, at first vague and speculative, was reduced to quantitative form by Einstein, who concluded that mass and energy should be interconvertible. If matter is transformed into heat in the stars, a tremendous amount of heat may be created at the expense of a slow decrease in mass.
>
> —*Scientific American*
> May 1925.
> (Reprinted, May 1975)

The error in the above paragraph is in the statement "reduced to quantitative form by Einstein." For it seems that many assumed the simple mathematical form of the equation to be indicative of the simplicity of some unknown (and still undefined) process by which potential energy is rendered observable.

The elegent simplicity of $E = Mc^2$ is appealing, comparable to $KE = \frac{1}{2}MV^2$, which can be experimentally verified. But the Einstein equation is purely a *philosophical argument* reduced to a misleading mathematical form. For what was combined were the separate, general principles, *Law of the Conservation of Mass* and *Law of the Conservation of Energy,* which were being taught quite generally as immutable in 1925. This equation, which has become famous since the first Atomic Bomb, was in 1925 simply an empirical, *qualitative speculation* describing observed results, not a mechanism for some very puzzling phenomena. There were at that date no *quantitative* results to support any such statement as made in the above quotation. As indicated herein previously, the proofs of the validity of $E = Mc^2$, as

now so generally accepted, assume that there is no "Ether" or "Subquantic Medium" present at the point where the nuclear events take place. Space is empty, inert??

Intellectual Inertia:

There were two earlier eras which have been termed scientific revolutions. The first occurred about 1800 to 1830. During this time the relationship of current electricity and magnetism was demonstrated. The nature of combustion as a chemical process was shown to involve the unseen sea of oxygen around us. Out of these concepts grew much of the industrial revolution of the Nineteenth Century.

During 1895 to 1920 there occurred a second scientific revolution. This period ushered in the Atomic Age. It also brought about a change in methods of scientific reasoning.

We are again in the midst of a scientific revolution of unprecedented magnitude. The current wave of scientific discovery is called an "Information Explosion." It is the intent of this volume to focus attention on certain of those areas of the physical sciences which require open minded re-evaluation.

Kuhn, in "Structure of Scientific Revolution," outlines the reactions of the leaders of science when their favorite paradigms and basic "laws" are threatened by new data. There occurs a "malaise of crisis," which is manifest as an inability to cope with the new information.[22] Barber, in "Resistance of Scientists to Scientific Discoveries," digests the long history of the delays caused by this malaise.[23]

Tart quite recently stated that "a paradigm becomes an implicit framework – it is the natural way of looking at things. It does not seriously occur to the adherent of the paradigm to question it. A paradigm acts like a blinder."[24]

Hackerman aptly puts up the present problem in science, generated by intellectual inertia. "It must be unsettling to be told that even long-standing 'laws' are subject to alteration in the light of fuller understanding – it might be helpful to remind ourselves regularly of the sizeable incompleteness of our understanding."[25]

It is hoped that the well documented tendency of scientists to ignore major basic discoveries, will not prevent this generation from participating in such a stimulating, exciting era as did those young creative scientists of 70 years ago.

REFERENCES

Chapter V

1. J. J. O'Neill, *Prodigal Genius. Nikola Tesla* (New York, Ives Washburn Inc., 1944).
2. J. A. Simpson, et al., *SCIENCE,* 183, 1318 (1974).
3. J. C. Roederer, *SCIENCE,* 183, 37 (1974).
4. J. A. Simpson, et al., *SCIENCE,* 183, 183 (1974).
5. V. A. Bailey, *NATURE,* 186, 508 (1960).
6. R. Burman, *JOUR. AND PROCEED. ROYAL SOC. NEW. S. WALES,* 103, 1 (1970).
7. E. Gerjuoy, *AMER. JOUR. PHYSICS,* 24, 3 (1956).
8. J. A. Chalmers, *Atmospheric Electricity* (London, Pergamon Press, 1957, 2nd Edition).
9. H. C. Dudley, U. S. Patent No. 3,095,167. *Apparatus for Control of Vehicular Flight.* (Applied for Jan. 5, 1960).
10. J. R. Porter, *SCIENCE,* 178, 1249 (1972).
11. R. A. Millikan and H. G. Gale, *First Course in Physics* (New York, Ginn and Co., 1906), p. 479.
12. G. T. Emery, "Perturbations of Nuclear Decay Rates," *ANN. REVIEW, NUCL. SCIENCE,* vol. 22, (1972), p. 165.
13. J. L. Anderson and G. W. Spangler, *JOUR. PHYSICAL CHEM.,* 76, 3603 (1972) and 77, 3114 (1973).
14. H. C. Dudley, *Lett., NUOVO CIMENTO,* 5, 231 (1972).
15. H. C. Dudley, *NUOVO CIMENTO,* 4B, 68 (1971).
16. H. C. Dudley, *Lett., NUOVO CIMENTO,* 5, 641 (1972).
17. E. K. Conklin, *NATURE,* 222, 971 (1969).
18. P. M. Dirac, *NATURE,* 162, 906 (1951).
19. L. DeBroglie, *Non-Linear Quantum Mechanics* (English Trans.), (New York, Elsevier, 1960).
20. B. Kuchowics, *Cosmic Neutrino* (Nuclear Info. Center No. RR 47. Warsaw Poland, 1972).
21. T. deGraaf, *ASTRON AND ASTROPHYSICS,* 5, 335 (1970).
22. T. S. Kuhn, *Structure of Scientific Revolutions* (Univ. of Chicago Press. 2nd Edit., 1970).
23. B. Barber, *SCIENCE,* 134, 596 (1961).
24. C. T. Tart, *SCIENCE,* 176, 1203 (1972).
25. N. Hackerman, *Editorial, SCIENCE,* 183, 4128 (1974).

Chapter VI

RADIOACTIVITY REEXAMINED

The Stage is Set:

Uranium possesses the property of *spontaneously* emitting rays of some sort which have the power of penetrating opaque objects and of affecting photographic plates, just as X rays do. Radio-activity has been found to be independent of all *physical* as well as *chemical* conditions. The lowest cold or greatest heat does not appear to affect it in the least. Radio-activity, therefore, seems to be as *unalterable* a property of the atoms of radio-active substances as is weight itself. – For this reason Rutherford has advanced the theory that the atoms of radio-active substances are slowly disintegrating into simpler atoms.

–*First Course in Physics*
R. A. Millikan and H. G. Gale
(Ginn and Co., 1906), pp. 476, 479.

The discovery by Antoine Becquerel, 1896, of an example of perhaps the most mystifying series of phenomena of the physical sciences, namely "spontaneous" radioactivity, touched off one of the greatest scientific upheavels of all time. For out of this small beginning, the whole of science has been transformed, and the political framework of nations has been shredded.

That there is still room for differences of opinion and varied attitudes is clearly indicated by a recent exchange of viewpoints. The writer published as a Guest Comment [1] the following, under the title of this chapter:

=

Long and well taught is the axiom that radioactive decay rates are described by $N = N_o - kt$, with half-life constant = $0.693/k$. These equations resulted initially from studies done with crude instruments some 70 years ago. Bluntly, they are incorrect, nonetheless appear in our latest textbooks to compound the errors of past generations. This in spite of more recent evidence.

As the result of the development of sophisticated electronics, the k of ^{7}Be was first shown (1949) to vary about 0.1% (Be/BeO). Later (1965) the k of ^{90}Nb was altered about 4% (metal/fluoride). Studies have varied the decay characteristics of 12 other radionuclides with changes in the energy state of the orbital electrons; by pressure, temperature, electric and magnetic fields, stress in monomolecular layers, etc. (Emery; *Ann. Rev. Nucl. Sci.*, 1972, page 165).

The $\beta-$ emitters ^{14}C, ^{60}Co, and ^{137}Cs have had their decay characteristics altered [Anderson and Spangler; *J. Phys. Chem.*, 76, 3603 (1972); 77, 3114 (1973)]. Analysis of these results indicates that decay event A is causally related to decay event B occurring later, such that the time distributions of all decay events were no longer truly random, as required by current theory.

Rather than assuming that radioactivity is a series of "spontaneous" unrelated events occurring without prior cause, a theoretical approach was developed which translates the "neutrino sea" concept of astrophysics and cosmology to nuclear physics. This postulates a radioactive atom to be a "linear resonant system, subject to parametric excitation" [Dudley; Lett., *Nuovo Cimento*, 5, 231 (1972)], defining the "set mousetrap syndrome." Thus k becomes a variable, a stability index, its value dependent on the energy state of the entire atom and on parameters of interaction with an energy-rich subquantic medium (See *Chapter V*).

A new conceptural model of the atom is needed. Consider phenomena which are termed "nuclear" as reactions involving the entire atom as the basic unit system, rather than being reactions involving essentially mass/energy changes of only the nucleus. This suggests some new attacks on very practical problems: Re-examine the presently accepted concepts of fission and fusion in order to more rapidly open new approaches to "clean" nuclear power; and extend as a crash program those studies indicating that altered decay rates may lead to isotopic methods of producing electric power, as well as to facilitate the destruction of long-life fission products.

Perhaps chemists should begin the teaching and researching on the interactions of atoms at *all* energy levels. This in order to provide fresh avenues of approach, not beholden to the traditions and methods of the past 30 to 40 years.

=

The following remarks were published as a Letter-to-the-Editor:[2]

I assume you have already received ample mail in response to Dr. Dudley's "Guest Comment" concerning chemical effects in beta decay rates. The subject is, of course, treated in most standard texts in nuclear chemistry.

Dudley would be very interested in several similar areas of research. The u^- meson, for example, in replacing an electron in the D_2 modecule, has been observed to "catalyze" nuclear fusion. Both u^+ and β^- can also replace a proton in molecules with equally fascinating results, so that "muonium" and "positronium" can be considered isomers of hydrogen. Most nuclear chemists, including myself, have tried to design gamma-ray lasers and other Buck Rogers (or Rube Goldberg) gadgets using these effects. Our failure, as Dudley suggests, in no way should be construed as evidence they can't be built.

My reply follows:

My objection is not due to the suppression of information to professionals; it is due to the fact that students with degrees in chemistry or physics who come here have not been exposed to the data on easily induced changes in "nuclear" decay characteristics. In their formative years students learn only what has been in the textbooks for the past 40 years.

Most professional physicists shun the subject like the plague. Why? Because this information is inimical to the concept of "spontaneous" events arising without prior cause, "Acausality". My heresy is to believe that, in science, the use of such terms as "spontaneous" or "acausality," is illogical; a surrender to the lack of information. What I have been attempting to do recently, is to point out that the information which has become available during the past 25 years has antiquated many of the pre-1930 hypotheses, inherent in physical theory as *now taught.*

=

The following comments were forwarded by an eminent chemist:[3]

The Guest Comment by H. C. Dudley begins with the following statements: "Long and well taught is the axiom that radioactive decay rates are described by $N = N_0 - kt$, with half-life constant = $0.693/k$. These equations resulted initially from studies done with crude instruments some 70 years ago. Bluntly, they are incorrect, nonetheless appear in our latest textbooks to compound the errors of past generations."

I write in defense of the authors of our latest textbooks, of whom I am one. I do not believe that we have made any serious error.

The equation is the reaction-rate equation for a first-order reaction. It is a good equation, even for systems in which the reaction rate depends on the temperature or other parameters describing the system. Dudley has pointed out that for a few radioactive decompositions a

small difference in the value of the decay constant has been observed for different compounds. This fact does not invalidate the reaction-rate equation. It is customary to say that the rate of a radioactive decomposition of a nucleus is independent of the state of chemical combination of the element: Whether or not the deviations from constancy are worth mentioning in a textbook is a matter of judgment.

=

The following was my reply:

I have no quarrel with those who treat radioactive decay processes as first order reactions, for when a *chemical* reaction-rate is constant, it is assumed that the conditions of the reaction are fixed (e.g. temperature, pressure).

In physics texts, however, radioactive decay is described as a series of truly random, unrelated events, each occurring "spontaneously," without prior cause. Thus, the "disintegration constant" necessarily becomes a true constant that is not alterable by ordinary means. With respect to theoretical and nuclear physics, the easy alteration of these "constants," no matter how small, may be compared to the young lady who was diagnosed as "a little bit pregnant." Such is my interpretation of the significance of these data.

There are several areas of theoretical physics which are now being critically examined, which in turn requires an open minded reassessment of our present projections of a nuclear safety. This of course is a subject that is of mutual interest.

=

One of the most important aspects of this exchange is that it offers a public platform for the airing of divergent views, making students aware that there are other, alternative hypotheses, which are not appearing in our textbooks.

Causal Basis for Radioactivity

As outlined above, the neutrino sea is receiving increased consideration as an energy source and sink in cosmological theories. On the basis of more recent data, it is now possible to predict, with a reasonable degree of accuracy, the nature of this more or less generalized isotropic flux, the constituents of which are four stable uncharged particles, at two widely different mass levels:

	rest mass (upper limit)
$\nu_u, \bar{\nu}_u$	~ 0.6 MeV,
$\nu_e, \bar{\nu}_e$	~ 60 eV.

Analysis of the data of ref. (4) indicates that the muon neutrino (ν_u) may indeed be the stable counterpart of an uncharged electron (e°):

$$u^+ \rightarrow e^+ + e^\circ + \nu_e.$$

If the e° is classed as a lepton, this reaction does not necessarily conform to the rules of lepton conservation, although charge, mass, energy and spin may be conserved. We have then a four-body problem in which all the products may have nonzero rest masses. Bardin, *et al.*[5] have calculated the probabilities of this being a reaction yielding five products:

$$u^+ \rightarrow e^+ + \nu_u + \nu_e + e^+ + e^- .$$

The rates of ^{133}Cs clocks have been shown to vary on circumnavigation of the Earth in jet airliners.[6] Analysis of these changes, on the basis of the neutrino sea as the primary frame of reference, indicates that a constant rate may result from a condition of equilibrium in energy exchange. Further, this equilibrium may be altered by varying the effective velocity of the ^{133}Cs *atoms*, rather than applying a special relativity to *clocks* in a restricted fixed frame of reference on the Earth's surface (See *Chapter I*).

As predicted by Lee and Yang[7], experimental studies of high-energy neutrinos[8] have shown that the following nuclear reactions may be induced, in the range of (0.1-0.5) GeV:

$$^{12}C + \nu_e \rightarrow {}^{12}N + \beta^-$$
$$^{12}C + \nu_e \rightarrow {}^{12}N + u^- ,$$

with the cross-sections increasing with energy of the neutrinos, leveling off at $\sim 20.10^{-40} cm^2$. Lower-energy studies [(15-75)MeV] have extended the range in which excitation of the giant resonance of ^{12}C may be expected.[8]

Other neutrino reactions with stable nuclei have been reported. That of $^{37}Cl + \nu_e \rightarrow {}^{37}A_r + \beta^-$ is an established method of study of high-energy solar (ν_e) neutrinos.

Extrapolating high-energy neutrino reactions outlined above, using the characteristics of neutron reactions at all energies as a guide, we can assume that relatively stable uncharged entities (n, ν_u, ν_e) will exhibit similar reaction characteristics. The reaction cross-sections would be expected to vary widely with mass and velocity.[9]

Based on these assumptions, it is postulated that populations of nuclei which are now considered to exhibit spontaneous decay at a constant logarithmic rate, consist of units each of which is a linear resonant system. Parametric excitation of such a unit by an energy input at some critical level or rate may cause the system to react to reduce the effects of this extraneous force, by emitting mass and/or energy, tending toward a more stable system.

Such a model based on the isotropic "neutrino sea" as an energy source, provides a causal basis for the observed exponential $-dN/dt$ in a large population of radionuclides. Uncertainties in predicting the rate of change where N is small would result from the temporary lack of information on the parameters which define the interaction of the medium, particularly the number of ν_u and ν_e which constitute the neutrino flux.

As defined by the parameters outlined herein, with such a model there would be no necessity of assuming acausality in describing the "decay" of nuclei or particles.

Nuclear decay and/or interaction of all matter may then logically be considered to be taking place within the neutrino sea, a substrate, a common denominator in particle physics.[10]

As indicated above, the inherent limited accuracy of the instrumentation first used to study the decay rates of long half-life alpha emitters (1895-1905) led to the sweeping erroneous conclusion that all radioactive decay processes were logarithmic $-dN/dt$, and invariable.

Following the development of more sophisticated particle detectors and counting equipment, Segre, Weigand and Leininger (1949)[11] demonstrated that the electron capture decay of ^{7}Be could be altered $\sim 0.1\%$ as the result of a difference in the energy content of the electron shells (^{7}Be metal vs. ^{7}BeO).

These studies have been extended by many, so that now a total of ten nuclides, decaying by electron capture or internal conversion, have had their decay "constants" varied by altering the energy state of the extra nuclear electrons by chemical combination, pressure, temperature, super conductivity, electric and magnetic fields. To date the largest variation reported is for ^{90}Nb; metal vs. fluoride complex, $\Delta K = 3.9\%$. (For a comprehensive review, see Emery, 12).

In what may well become a classical paper, Anderson [13] has shown that the decay characteristics of ^{14}C, a β^- emitter, may be altered by combining these atoms in polar organic molecules, then stressing these molecules in monomolecular layers. Similar changes in the decay characteristics may be induced by applying a 90 volt (+) electric charge on the samples containing ^{14}C, during counting procedures. The procedures consisted of counting with an end, thin window (3 cm. diameter) Geiger tube positioned over a circular planchet 1.0 cm. in diameter – Net 2000-3000 counts/min.; counting efficiency $\sim$ 5%; dead time of tube $\sim$ 200 micro sec.[14]. Anderson and Spangler [15] have obtained similar results with ^{60}Co and ^{137}Cs, both β^- -gamma emitters.

Examination of the pattern of counts from these β^- emitters, shows a non-Poisson distribution of the observed counts indicating that disintegration (A) influences the time at which disintegration (B) takes place. Therefore, these investigators conclude: "These serial discrepancies raise a substantial question as to the randomness of the detected emissions, and in so far as emission and decay events are appropriately inter-related, the independence of the events themselves."[15] In view of the clearly demonstrated effect of alteration of the energy content of the extra-nuclear electrons on the decay characteristics and rates of many radio nuclides, it is concluded that the disintegration "constant" is indeed a complex variable dependent on

a. parameters defining interaction of linear resonant systems with a generalized neutrino flux.

b. the energy state of the entire atom as the basic unit system. This, rather than considering the nucleus as the site of what is now termed "nuclear reactions."

Since the neutrino flux is assumed to be made up of four type particles, with a continuum of velocities, it is reasonable to conclude that there is a threshold energy input required to initiate Event A and that increments of energy below this threshold will fail to initiate the disintegration of Atom A.

Inter-related Nuclear Events:

As indicated above, the induced non-Poisson distribution of the counts resulting

from ^{14}C, ^{60}Co, and ^{137}Cs decays are phenomena which require close scrutiny since this is a process never before described and is of paramount significance to currently accepted "schools" of theoretical physics.

It is therefore proposed to reexamine several processes by which disintegration A may influence the time of occurrence of disintegration B. These models are predicated on the assumptions outlined above, relative to the neutrino sea as a causal basis for radioactivity, and the entire atom being the unit system for such mass/energy transitions.

Assume that the initial Event A is triggered by a threshold energy input (E_f) from the neutrino flux. The total energy released by Event A = E_A, and since we assume Atom A and Atom B to be in the same energy state, and energy input $\cong$ E_f will be required to initiate decay of Atom B (Event B). Then:

$$X(E_A) \geqq E_f$$

where X = fraction of the energy released by Event A adsorbed by Atom B.

In this case, the probability of Event B occurring would be a linear function of the number of Events A, assuming that there are a larger number of potentially unstable nuclei present.

Since the neutrino flux is assumed to be made up of two types of particles, different reaction characteristics, with a continuum of velocities, it is reasonable to conclude that there may be a threshold energy input required to initiate Event A and that increments of energy below this threshold will fail to initiate the disintegration of Atom A.

Therefore, Event B may result from an additive combination of energy inputs derived from the neutrino flux and from Event A.

$$y(E_f) + X(E_A) = E_F$$

where Y is a fraction of the threshold energy (E_F), supplied by the neutrino flux.

In this case the probability of Event B occurring would be described by a complex function, since Event B is a second order reaction dependent on two physical interactions, both time dependent.

Both of the above mechanisms may operate independently, because of the number of the potentially unstable nuclei present in any sample of a radionuclide.

Models of Energy Transport and Adsorption

Analysis of the mechanics of β^- decay indicate the following energy exchange processes may alter the energy content of the extra nuclear electrons of the atoms of the sample being counted:

1. Recoil of Atom A, impinging on Atom B.
2. β^- emitted in the velocity range of near zero to near c, impinging on Atom B.
3. $\bar{\nu}_e$ [Assuming rest (mass ~ 60 e. v.)] ; velocity range near zero to c, impinging on Atom B.
4. Perturbation of the electromagnetic intermolecular binding forces of the sample by high velocity β^-.

5. Phonon-like perturbations generated by the recoil of the nucleus, propagated through or along the surface of the sample.

This theoretical approach also suggests that there exists mechanisms for inducing disintegrations which are time dependent, Event B occurring at sometime following the initial "excitation" process. Such would be analogous to certain other atomic and nuclear phenomena, for example:

a. Relaxation time of molecular magnetic resonance.

b. Short life times of unstable "Fundamental particles."

c. Delayed Neutron emission by Fission products.

d. Life times of metastable states induced by photon and particle interactions with stable nuclei.

e. Time dependent decay of compound nuclei.

f. Delayed static charge accumulation on plates of recently discharged capacitors.

In Conclusion:

The sheer quantity of experimental results which have demonstrated conclusively the effects of alteration of the energy state of extra nuclear electrons on the decay characteristics of radio nuclides, requires a reorientation of the usual methods of viewing these phenomena.

The experimental results of Anderson and Spangler are, of course, preliminary, but have been checked by others, in the best scientific tradition. Their results *may* be monumental, for should there be a general phenomena of one radioactive disintegration (except Fission) triggering a second such disintegration, an entirely new chapter in nuclear science is beginning to be written.

The models which are presented herein, are offered as temporary working hypotheses, to aid in developing theories which take into account the vast amount of experimental and observational data which have become available over the past three decades.

REFERENCES

Chapter VI

1. H. C. Dudley, *CHEM. AND ENG. NEWS*, Apr. 7, 1975, p. 2.
2. Jacques Read, *CHEM. AND ENG. NEWS*, July 14, 1975, p. 5.
3. Linus Pauling, *CHEM. AND ENG. NEWS*, July 14, 1975, p. 5.
4. *Particle Data Group, Phys. Lett.*, 39B, 27 (1972).
5. D. V. Bardin, et al., *YAD. FIZ.*, 15, 284 (1972).
6. J. C. Hafele and R. E. Keating, *SCIENCE*, 177, 168 (1972).
7. T. D. Lee and C. N. Yang. *PHYS. REV. Lett.*, 4, 307 (1960).
8. F. J. Kelly and H. Uberall. *PHYS. REV.*, 158, 987 (1967); and *PHYS. REV.* C5, 1432 (1972).
9. H. C. Dudley, *BULL. AMER. PHYSICAL SOC.*, 9, 738 (1964). *JOUR. MISSISSIPPI ACAD. SCI.*, 11, 143 (1965).
10. H. C. Dudley, *Lett. NUEVO CIMENTO* 5, 231 (1972).
11. E. Segre, C. E. Weigand and R. F. Leininger, *PHYSICAL REV.*, 75, 39 (1949); 76, 897 (1949); 81, 280 (1949).
12. G. T. Emery, *ANN. REVIEW NUCL. SCI.*, Vol. 22, p. 165 (1972).
13. J. L. Anderson, *JOUR. PHYSICAL CHEM.*, 76, 3603 (1972).
14. J. L. Anderson, *Personal Comm.* (1974).
15. J. L. Anderson and G. W. Spangler, *JOUR. PHYSICAL CHEM.*, 77, 3114 (1973).

Chapter VII

MECHANICS OF A SUBQUANTIC MEDIUM

The first examination of the matter from the point of view of Maxwell's theory was undertaken by J. J. Thomson in 1881. If an electrostatically charged body is in motion, the change in the location of the charge must produce a continuous alteration of the electric field at any point in the surrounding *medium*; or, in the language of Maxwell's theory, *there must be displacement currents in the medium.*

—*History of Theories of Aether and Electricity*
E. T. Whittaker. Vol. 1, 1951. (T. Nelson and Sons), p. 306.

In large part, modern physicists do not study the concepts which were utilized by their predecessors in constructing earlier "models" by which observed phenomena were integrated and synthesized into a body of theory. For this reason, there has evolved a series of assumptions which are hidden, blanketed by a climate of opinion which is continually renewed in textbooks, generation after generation. Such is the case with an evolving, recurring concept usually referred to as "ether."

Isaac Newton, in his *OPTICKS* (1704), published a series of thought provoking questions which he termed "Queries." The following is an excerpt from Query 18 (Book Three, Part 1):

> If in two large tall cylindrical Vessels of Glass inverted, two little Thermometers be suspended so as not to touch the Vessels, and the Air be drawn out of one of these Vessels, and these Vessels thus prepared be carried out of a cold place into a warm one; the Thermometer in vacuo will grow warm as much, and almost as soon as the Thermometer which is not in vacuo. And when the Vessels are carried back into the cold place, the Thermometer in vacuo will grow cold almost as soon as the other Thermometer. Is not the Heat of the warm room convey'd through the Vacuum by the Vibrations of a *much subtiler Medium than Air*, which after the Air was drawn out remained in the Vacuum? And is not this *Medium* the same with that *Medium* by which Light is refracted and reflected, and by whose Vibrations Light communicates Heat to bodies , . . . And is not this *Medium* exceedingly more rare and subtile than the Air, and exceedingly more elastick and active? And doth it not readily pervade all Bodies? And is it not (by its elastick force) expanded through all the Heavens?

In the latter part of the 19th century as the result of the experimental studies of Hertz, demonstrating the properties of electro-magnetic waves on a macro scale, combined with the mathematical approach of Maxwell, the concept of an all-pervading medium again began to dominate much of physical theory. Also, the assumption that matter (or mass) was indeed a manifestation of electrical phenomena began to gain support. There was, however, a hidden assumption in all this; that the "ether" was essentially inert, devoid of any significant amount of mass and/or energy.

As elsewhere shown herein, there were predictions made as to the increase in mass to be expected as velocities of the mass approached the greatest velocity then known, that measured for visible light.

These mathematical predictions were later supported by experiment, with the finding shortly after 1900 that high velocity electrons (beta $^-$) did indeed possess greater mass than their slower counterparts. Ergo, the mathematical-philosophical approach was proven to be correct. Einstein clarified (?) this anomaly by assuming that the mass increase was "Relative" and was observable only by the observer at rest. He postulated that an observer riding on the particle would not observe such a mass increase, since his measuring instruments would be also similarly altered.

If one analyzes the laboratory means by which these increases in mass are *quantitatively* measured, it will be noted that as an *electrically* charged particle is caused to transverse a magnetic field, its path is followed in some type of "cloud" or "bubble" chamber. On the basis of the observed curvature (R) of the ionization track, the known strength of the magnetic field (H), and the measured velocity

(v) of the particle, the "mass" (M) of the electron is determined, obeying the following equation:

$$Hqv = \frac{Mv^2}{R},$$

With (q) the charge on the particle.

It was proposed earlier [1, 2] that this increase in mass was indeed very real, not relative, and would be observable and measurable by the high velocity observer. For the interaction of a charged particle, as it passes through a magnetic field, would perturb the field to an amount equal to the force required to cause the course change. An *inertial* force so generated would be observable and measurable on the particle; and simultaneously, an observable and measurable, equal and opposite force would be transmitted to the stationary generator of the field via the field flux. If F = MA is valid, then we are measuring the same M in both cases. Therefore, it can be logically concluded that observed increases in mass are very real, quite finite, resulting from the addition of increments of uncharged matter in a process analogous to that of an atomic nucleus as it adds neutrons from a generalized neutron flux through which the nucleus is moving.

It is proposed to approach several intriguing problems of experimental physics by a return to the stimulating climate of curiosity so typical of Newton's Queries. Proposition: Assume that there exists an all-pervading flux of uncharged particles, each having finite mass, with this mass (or matter) not dependent on or related to any electrical charge. This flux is postulated to take on the properties of Newton's Medium.

With such a "Model," the following pages are presented, in the hope that they will also be stimulating.

Proposed Test for Neutrino Sea

Astrophysical findings coupled with known properties of a generalized neutrino-antineutrino flux suggest that there exists a finite medium which may be capable of transmitting electromagnetic radiation. Recent theoretical studies support this hypothesis. Previous studies of "ether drift" centered attention on Earth's orbital motion (30 km/s), largely ignoring galactic velocity (220 km/s). It is suggested that critical tests be made using high velocity emitters with flows parallel and perpendicular to the Earth's peripheral motion about our galactic center.[3]

On the basis of astrophysical data, Weinberg [4] concluded that there exists a generalized neutrino-antineutrino flux, the particles of which have a continuum of velocities from near zero to near c. The sources of this "neutrino sea" are the rather randomly distributed stars and galaxies. Chiu [5] suggested that this flux consists of 10^{11} neutrinos/cm^2/sec.

The author postulated this flux to be an isotropic, particulate medium capable of transmitting energy, assuming the existence of generalized electric and/or magnetic fields.[6] Expanding these hypotheses, the writer has postulated this flux to be the medium by which perturbations of these inter-and intragalactic fields are propagated through space. The flux so defined may account for the apparent duality of particles, as well as being the noninert substrate in which all particle interactions take place.[7]

Bohm and Vigier [8] introduced "hidden variables" and de Broglie [9] proposed a "subquantic medium" in causal treatment of nonlinear quantum mechanics. He described the exchange of energy between this medium and an electron as fluctuations about a single quantized state of the electron; with A = action, ν = cyclic frequency, h, k = Planck's and Boltzman's constants and S = entropy we have,

$$h\nu = KT\,\frac{A}{h} = \frac{S}{K}\,.$$

De Silva and Lochak [10] concluded that an ether so defined is isotropic and cannot reveal absolute motion.

Much attention has been given recently to theoretical consideration of the interaction of electrons with neutrinos and antineutrinos. Royer [11] concludes that the effect of the neutrino sea on electromagnetism is too small to be observed. However, Stothers [12] as well as Desrosiers and O'Donnell [13] conclude that the weak interactions ($e\nu$, $\bar{\nu}e$) may be of significance in astrophysical energy exchanges.

In an original approach, Bandyopadhyay, Chauduri, and Saha [14] conclude that on the basis of the photon-neutrino weak-coupling theory, the neutrino sea may be the means of photon propagation.

To understand how the present "no-ether" mind fix became so prevalent, a short review of A. A. Michelson's contributions is here presented.

The book review of *The Master of Light,* a biography of A. A. Michelson, by Jane Wilson [15] outlines facets of the character of Michelson which are not discernible in the usual histories of physics. However, this review repeats as truisms some of the unfounded myths which have been so well watered and nurtured over the past 40 years. With the current rekindling of interest in Michelson, the man, it seems timely to reexamine some inaccuracies which are currently being accepted as established facts.

As the result of the challenge to prove the existence of "ether", Michelson (c. 1875-1880) conceived and constructed a most useful optical instrument; an interferometer, which divided a beam of light into two beams, then recombined these beams, such that the wave lengths of light could be used as rulers in measuring almost infinitely small distances and in determining almost infinitely great speeds (velocity of light).

A series of studies (1880-1890), which are known as the Michelson-Morley experiments, were performed utilizing the newly developed interferometer. These were designed to show that the Earth's orbital motion about the sun (30 kilometers per second) would be manifest as motion through a tenuous undefined ether, considered by nearly all scientists of that day to be necessary for the transmission of light. But the Michelson-Morley studies showed no such result, much to Michelson's surprise and chagrin.

Credit is now generally given to Michelson as the one who experimentally provided the basis for one of Einstein's important assumptions when developing the special theory of relativity (1905). This assumption was that there is no generalized frame of reference; that is, there is no means of experimentally demonstrating the motion of the Earth through space without referring to other celestial bodies. Thus Einstein formalized the opinion of Isaac Newton, who stated (c. 1700) that absolute motion could not be determined. From all this, it was concluded that an

ether did not exist.

It seems pertinent to emphasize that Michelson's well-deserved fame did not rest on his studies dealing with a possible ether. His Nobel Prize of 1907 (the first in science to an American) came as a result of his development of several high precision optical instruments and his determination of certain physical constants, most notably the velocity of light.

But a facet of history long unknown or ignored came to light shortly before Einstein's death. He stated that he probably had no knowledge in 1905 of the Michelson-Morley studies or, in any case, that these results did not influence the trend of his thinking.[16] His *ad hoc* assumption was a product of his theoretical methods, in which he concluded that absolute motion could not be demonstrated. But this has recently (1969) been disproved by determination of the Earth's intergalactic motion, using residual radiation left over from the primordial "big bang," which is believed to have ushered in our present cosmological epoch. This generalized electromagnetic radiation, having a wave length of 3.5 centimeters at a temperature of -270°C, provided the generalized frame of reference by which the Earth's motion through space was determined. Defined in local co-ordinates, the Earth is hurling through intergalactic space at a velocity of ~ 160 kilometers per second (5 times orbital velocity), along a line defined as declination 32 degrees, right ascension 13 hours.[17]

By study (since 1930) of the changes in the color of stars moving toward or away from the Earth (Doppler shift), and more recently by radio-waves emitted by intragalactic hydrogen, the Earth's velocity, with respect to our galactic center, is shown to be in the range of 200 to 220 kilometers per second.

Michelson and Morley centered their attention on the Earth's orbital velocity (30 kilometers per second). They had no knowledge of the existence of galaxies; of motions of galaxies in relation to each other; of the motion of our solar system in our galaxy. Orientation of their interferometers parallel to the Earth's surface insured that the angle of approach of an ether drift would be nearly perpendicular to the plane of the interferometer, and/or that rotation of the instrument in this plane would only slightly alter the effective velocity of the ether at the two arms of the interferometers.[18] Their negative results are explainable on the basis of pre-1900 classical mechanics, so provide no proof of the absence of the ether or Louis de Broglie's "subquantic medium." Thus the limited information available to Michelson and Einstein is emphasized by recent findings, particularly in astrophysics.

A study of the changing attitudes of physicists toward the concept of an ether makes interesting reading. A leading textbook of the era (1928), *Introduction to Modern Physics* by F. K. Richtmyer, contains four references to Michelson, nine references to ether but no mention of the Michelson-Morley studies of 1880-1890. In fact, 1929 saw Michelson still attempting to experimentally demonstrate the ether, which his intuition and reasoning told him *ought* to be present.[19]

The current climate of opinion, which now causes so many to refuse to even consider the possibility of an ether, was well established by 1940. For three decades the methods of teaching physics have led most physicists not to even consider this possibility. Today most persons are largely unaware that the ether concept began to be seriously reexamined by two of physics most notable theoreticians, Paul Dirac in 1951 and de Broglie in 1959, both Nobel Laureates.[20, 21] The ether is now being called the "neutrino sea" by astrophysicists, and has been characterized as an energy-rich particulate, subquantic medium. A rather voluminous literature on the subject is accumulating as indicated by a recent re-

view, "The Cosmic Neutrino," with 665 references covering only the period 1965-1972.[22]

The obvious question is: What is the practical significance of such an esoteric finding of an ether? As taught – and as utilized in attempting to solve the energy crisis through nuclear fusion reactors – current physical theory assumes (indeed requires) the absence of such levels of matter. It appears that an open-minded re-examination of this area of physics is long overdue in order to open up new avenues of approach to this pressing problem.

So, from the vantage point of 50 years, it appears that A. A. Michelson, experimentalist *par excellence,* was the towering giant of the 1900-1930 era. His hunch was right. Is it not time we built on this giant's experimental insight, intuition and genius?

Experimental Considerations

There were others who, over the years, have continued searching for evidence of an "ether," or the means of providing an absolute frame of reference. Some have recently questioned the doctrine of the constancy of the velocity of light, irrespective of the velocity of the observer.[23]

As indicated above, Conklin [17] did find a means of establishing absolute motion, which has sent reverberations throughout philosophical circles.

In an analysis of the many series of experimental studies designed to establish the presence or absence of a medium for the transmission of electromagnetic radiation, most are shown to have centered their attention on the Earth's orbital motion about the Sun (30 km/s), presuming the ether, if present, would flow over the Earth's surface. The exception to this general rule was Miller,[24] who, by a sophisticated method of multiple reflections extending over a rather large plane, obtained results which he judged indicative that the Earth has a component of motion, at a velocity of 208 km/s, in a direction parallel to what is now considered to be the galactic plane. The criticism (1955) of Miller's calculations and conclusions [25] notwithstanding, it appears that his predictions of 1934 are supported by presently accepted observations (Earth's galactic velocity 220 km/s), including Conklin's results.

Townes *et al.*[26] developed a method of detecting possible "ether drift" which has an inherent accuracy of three orders of magnitude greater than most interferometer techniques. This consisted of using flowing NH_3 masers ($2.4 \cdot 10^{10}$ Hz), measuring the beats of two of these units aligned such that the long axes of the opposing units were maintained in an E-W line, seeking ether drift due to the Earth's motion about the Sun. No ether drift was observed. Orientation of the masers only along an E-W line would ensure that no ether drift along a near N-S line would be detected.

Jaseja *et al.*[27] have studied the beats of two intersection He-Ne laser beams, oriented at 90°, in a horizontal plane (42.4° N lat.) (radiation $2.6 \cdot 10^{14}$ Hz). One arm was positioned in an E-W line. On rotation through 90° there was observed a rather constant (mean 275 kHz) frequency difference in the radiation generated by the two arms of the apparatus. These investigators suggested that this may be due to an effective optical path difference (EPD) resulting from magnetostriction of the mirror mountings. No effort was made to isolate the apparatus from the Earth's magnetic field.

It may be also assumed that the beat frequency shift (dv) represents an EPD due to motion of (or within) a medium. Then dv is a measure of the velocity V of

the medium with respect to the interferometer:

since	$d\nu$ is proportional to V^2/c^2,
assume	$2(d\nu)/\nu = V^2/c^2$, $2(275 \cdot 10^3/2.6 \cdot 10^{14}) = V^2/c^2$,
then	$V = 14$ km/s apparent velocity of medium in laboratory frame.

Because of the angle of flow of the neutrino sea into the Earth at 42.4° N lat., this apparent velocity is postulated to be a resultant, generating but a small fraction of the total EPD which may be produced if one arm of the interferometer is maintained parallel to the Earth's galactic motion, with the second arm at 90° thereto.

For the purpose of detecting the presence of a medium, a system which depends on V/c, and which determines the influence of emitter velocities on frequency, appears superior to most interferometer systems. The Michelson-type interferometer depends on $(V/c)^2$ and is very sensitive to purely structural stresses which may alter the geometrical path of the beams.

It is proposed that the spectra generated by high-velocity emitters be studied, determining the effect of motion of the emitters parallel to the Earth's galactic motion. Thus, it will be determined whether this motion will produce a difference in the observed frequencies.

Several other experimental approaches are indicated, due to their inherent sensitivity: a) flowing gas masers or lasers operating in the microwave or far infra-red range (after Townes [26]); b) canal ray emission (visible range) in which the emitters are accelerated by a high potential (after Ives and Stilwell).[28] In both cases, matched units having opposite directions of emitter flow are to be aligned such that the flow axis is maintained parallel to the Earth's galactic motion. The initial orientation of the flow axis will be N-S, at an angle with the horizontal plane equal to the latitude of the point of observation. Further angular adjustments will vary with time of day and year. This assumes that the orbital plane is perpendicular to the galactic plane.

Incorporation of the neutrino hypothesis into theories of electro-magnetic wave propagation began shortly after Pauli proposed what has become known as the neutrino. De Broglie [29] suggested a photon to be composed of a neutrino and an antineutrino. Jordan [30] proposed that the way in which neutrinos react with other particles leads to a simplified description of light. More recent approaches include that of Perkins [31], who proposes a four-component theory in which the basic particle is composed of two neutrinos and two antineutrinos.

Bandyopadhyay and Chauduri [32] assume a weak coupling of a neutrino and a photon as necessary for the propagation of electromagnetic radiation.

The writer has suggested that the neutrino family provides the basic units by which perturbations of inter- and intra-galactic electric and/or magnetic fields are propagated.

An important aspect of each of the mechanisms outlined above is that the propagation of light is dependent on the presence of a finite medium. From this it follows necessarily that the basic assumption of each theory is that there exists no "free space," and that the transmission of light is a resultant of a series of events, each time-dependent. Therefore, the velocity of light is not an independent "universal constant" but is dependent on the nature of the transmitting medium and mechanism.

Should experimental studies, as outlined above, indicate a medium which in-

fluences the transmission of electromagnetic radiation, the results will a) aid in defining the "subquantic medium" of de Broglie, b) provide further experimental elucidation of the mechanism by which photons, neutrinos and other particles interact.

Fitzgerald-Lorentz Contraction

Following the failure of Michelson (1880-1890) to find experimental evidence of an all-pervading "ether," it is interesting to note certain aspects of the scientific community's reaction to these unexpected findings. Several efforts were made to retain the old faith, this being the assumption, yea the absolute need for salvaging old ether concepts and theories. Remarkably similar to what is occurring today! Yes?

G. F. Fitzgerald and H. A. Lorentz (1889) independently introduced the *ad hoc* assumption that a body contracted along its direction of motion, and the Lorentz equation;

$$L = L_o \bullet \sqrt{1 - \frac{V^2}{c^2}}$$

served to explain the null results of the Michelson-Morley experiments (1870-1880). What is not pointed out in most modern texts is that this concept, then considered quite novel, was introduced to justify the retention of a generally held ether theory. Because of the lack of information, the ether had evolved into an undefined, generalized frame of reference (or "medium") which was considered necessary for the validity of classical models for propagation of electromagnetic radiation. These models resulted from Maxwell's mathematical analyses, for he assumed the necessity of such a medium.

As indicated above, recent developments indicate that a return to some type of "ether" concept may be now justified by experimental evidence.

The neutrino sea has been defined with reasonable accuracy as a generalized, near isotropic, particulate medium consisting of at least four types of uncharged particles, with rest mass at two widely different levels,

$$\nu_u, \bar{\nu}_u = \sim 0.6 \text{ Mev. and } \nu_e, \bar{\nu}_e = \sim 60 \text{ ev.}$$

The ν_u has been postulated to be the counterpart of the uncharged electron. A suitable name, *neuon,* is suggested as a contraction of neutral electron. Additional means of isolating the neutral particles resulting from muon decays have been outlined by Kalbfleisch.[33]

The inelastic scattering of particles of near equal mass, one being uncharged ("billiard ball effect"), is the mechanism which was postulated by Chadwick in his demonstration of the neutron (1932). The same mechanism is responsible for the effectiveness of light-water moderators in nuclear reactors.

It is proposed that a model be examined wherein there occurs inelastic scattering of uncharged electrons (e°) by orbital electrons.

Assume an isotropic flux of e°, with a continuum of velocities of near zero to c, with respect to laboratory frame. Let V_o = linear velocity of a hydrogen nucleus in laboratory frame, moving in a cloud of e°. Let V_e = velocity of an orbital electron

of hydrogen, in ground state ($\sim 10^8$cm/s).

When $V_o = 0$, the perturbations induced in the orbital electron will result from randomized impacts, equally on the inside and outside of the entire orbit. Total energy change = 0. This extends the treatment of de Broglie [9] in his development of the concept of a "subquantic medium."

As the nucleus moves with velocity (V_o) through the medium composed in part of e°, the summation of impacts will vary the energy input on the lead side of the orbit (ABC) and similarly on the inside of the following side of the orbit (CDA). Velocity of the orbital electron (e^-) will vary as follows:

$$V_{e1} > V_{e2}, \qquad V_{e1} = V_{e3}, \qquad V_{e4} > V_{e3},$$

where V_{e1} and V_{e3} are at points at 90° from the line of motion of the nucleus. V_{e2} is mid-point of the lead side of the orbit; V_{e4} is mid-point of the following side of the orbit;

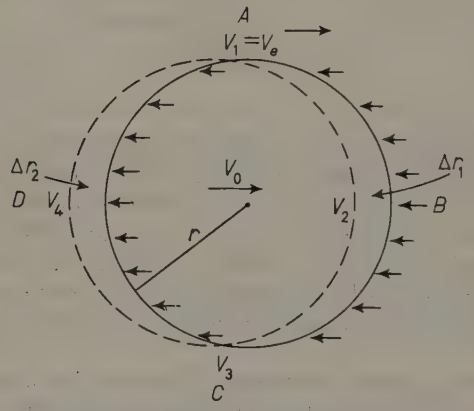

Fig. 1

This will result in a change in the orbital diameter, only along the line of motion as

$r - \Delta r_1$ on the lead side of the orbit,

$r + \Delta r_2$ on the inside of the following side of the orbit.

Since the Coulomb force varies as $1/r^2$,

$$\Delta r_1 > \Delta r_2,$$
$$(r - \Delta r_1) + (r + \Delta r_2) < 2r.$$

In the frame of a generalized e° flux, consider the total kinetic-energy components of the atom at linear nuclear velocity (V_o) to be

(1) $$(\text{KE})\ V_o = \tfrac{1}{2} M_{\text{nucl}}\, V_o^2 + \tfrac{1}{2} m_e\, V_e^2 + \tfrac{1}{2} m_e\, V_o^2,$$

where $(\frac{1}{2})m_e V_e^2$ = KE due to orbital velocity of e^-, $(\frac{1}{2})m_e V_o^2$ = KE due to effective lateral velocity of e^-, impacting with stationary e^o.

Assume no interaction of e^o with nucleus.

Then the total effective KE content of the atom *for the reaction* becomes the of the two components of motion of e^-;

$$(2) \qquad \overline{(KE)} = (\tfrac{1}{2})\, m_e\, V_e^2 + (\tfrac{1}{2})\, m_e\, V_o^2;$$

by vectoring V_e and V_o: let

$$(2) = (\tfrac{1}{2})\, m_e\, V_r^2$$

On impact, assume all of the KE of the lateral motion of e^- is transferred to e^o, thus the change in the kinetic-energy content of the atom *as a whole* becomes;

$$-\Delta\, \overline{KE} = \tfrac{1}{2}\, m_e\, V_r^2 - \tfrac{1}{2}\, m_e\, V_o^2.$$

By approximation:

When V_r is large, compared with V_o

$$V_r \pm V_o \to V_r, \qquad \frac{V_o}{V_r} \to 0, \qquad \left(1 - \frac{V_o^2}{V_r^2}\right) \to 1.$$

Since KE is proportional to V^2, $V = L/T$, m_e is constant and $L_o = 2r$.

When $V_o = 0$, V_r becomes V_e. Then as a first approximation, as $V_o \neq 0$,

$$L \text{ (observed)} \to L_o \cdot \sqrt{1 - \frac{V_o^2}{V_e^2}}.$$

and with $V_e = \sim 10^8$ cm/s this approaches the Lorentz equation.

This summation treatment assumes that when $V_o = 0$, e^o is also stationary. But since the e^o are postulated to be in random motion, the mean kinetic-energy exchange between e^- and e^o is proportional to the mean velocity of those e^o which impinge on the orbital e^-. This effective velocity becomes kV_o, where k is a proportionality constant, dependent on the distribution of velocities of the e^o, within the flux. Therefore, the effective velocity of e^- in the kinetic energy transfer between e^- and e^o becomes $V_r + kV_o$, and, as V_o increases, $V_r + kV_o \to c$.

This treatment is based only on Newtonian mechanics of free electrons and must be considered a first-order approximation. This approach suffers from the same limitations as Rutherford's original postulates. Atoms in motion, by interaction

with a particulate medium, should on the basis of classical mechanics disintegrate as the electrons spiral into the nucleus. Since this does not occur it is necessary to continue certain *ad hoc* assumptions of Bohr and others. It must be assumed that new states of equilibrium are established continuously as the velocity of the nucleus (V_o) increases in the e^o flux.

On the basis of classical mechanics a celestial body moving through a neutrino sea consisting of particles having finite mass must have its velocity reduced continuously. This, of course, is counter to observation. Because of the temporary lack of information, it is necessary now to advance an additional *ad hoc* assumption. Required is some mechanism as yet unknown, which establishes an energy input into each atomic and/or nuclear system, of a quantum of energy equal to that lost to the e^o flux. Eventually this will be further clarified and the necessity for this *ad hoc* assumption eliminated.

It is evident that this approach predicts that increased velocity of emitting nuclei will produce: (a) a change in frequency ($-\Delta\nu$), proportional to the velocity of the nucleus (V_o) in an e^o flux, (b) that characteristic Bohr quantized energy levels should not be observed since $-\Delta\nu$ is proportional only to ΔV_o, all other parameters remaining constant.

These predictions are supported by the classical investigations of Ives and Stilwell [28] on the "transverse Doppler effect." A study of the spectra of high-velocity H emitters showed that $-\Delta\nu$ is directly proportional to the velocity of the nuclei (in the laboratory frame) in the range 10^6 to 10^8 cm/s. These results also demonstrate a continuum of possible frequencies as velocity increases, indicating no characteristic or limiting Bohr orbits.

Previous to Ives' work these results had been predicted by others on the basis of special relativity. These data, within the limits of the accuracy of the experimental procedures, fitted the equation

$$\nu = \nu_o \bullet \sqrt{1 - \frac{V^2}{c^2}},$$

where V = velocity of emitters in laboratory frame.

Thus the present theoretical approach, which is purely mechanistic, may be considered an alternative hypothesis.

As determined by astronomic observation, the motion of the Earth in galactic coordinates is ~ 220km/s. As determined by Conklin [17], intergalactic motion, referred to the near-isotropic 3.5 cm radiation flux, is ~ 160 km/s (decl. 32°; Rt. Asc. 13 h). If this radiation flux is the residual from a primordial fireball, this motion of the Earth may reasonably be assumed to be absolute motion, within the limits of accuracy obtainable with the instrumentation now available. The philosophical significance of Conklin's findings have been outlined earlier.[34]

A means of study of the Earth's motion in galactic co-ordinates by means of high-velocity emitters has been proposed. This assumes that some particulate subquantic medium provides a mechanism for propagation of electromagnetic radiation.

High-velocity emitters, the direction of motion of which are equal and opposite to the Earth's motion through the neutrino sea, would provide the means of generating frequencies at true zero velocity. In this way an "absolute" frame of reference may be experimentally established. This would be an "absolute" frame

to the degree that all motion within the bounds of astronomic observation could be referred thereto. A test of this hypothesis would be the determination (after Ives) of the presence or absence of a transverse Doppler shift when observations were made perpendicular to the direction of motion, along the line of the Earth's motion in galactic coordinates.

From the postulates advanced here, frequencies of spectral emissions, estimates of stellar lifetimes and similar phenomena, dependent on electron orbital velocities and energy relationships, may require re-evaluation. It appears that what are termed "standard frequencies" have been determined on systems which have impressed on the emitters a component of motion which may significantly alter the energy relationship of the electronic shells.

Neo-Classical Model of Mass Increases as $V \rightarrow c$

Concepts of the neutrino sea as a particulate, essentially isotropic energy source and sink have been developing for more than a decade.(Review, Kuchowicz, 22) Certain cosmological models assume neutrinos to have non-zero rest mass, thus energy density of this flux may exceed *observable* mean mass-energy density. This neutrino flux may be treated as an energy-rich substrate, initiating and/or contributing energy to reactions occurring therein. Mass/energy density estimates range 10^8 to 10^{19} ev/cm^3; particle density $\sim 10^{12}$/cm^3.(de Graaf, 35)

The author considers this flux to be a common denominator in *all* particle interactions, while Volkov and Akulov (36) have pointed out that the hypothesis of the neutrino being a Goldstone particle leads to a definite type of neutrino interaction with all particles. This interaction is defined by a single phenomenological coupling constant; in this sense the reaction is universal. Such reactions may be considered to be through "neutral currents," a modification of the theory of weak interactions.(Reviews; Lubkin, 37 and Hammond, 38)

Extending the concepts which led to the causal models of radioactivity and Fitzgerald-Lorentz contraction (see above), the neutrino sea is herein treated as the causal basis for observed increases in mass as velocity of the particle approaches that of light, c. A phenomenological model for these phenomena is here developed within classical mechanics.

Based on Maxwell's postulates of the electromagnetic nature of matter, Thomson (39) showed that the mass of a charged body should increase with velocity. This was first verified qualitatively for β^- from natural radioactive materials. (Kaufmann, 40) Lorentz,(41) in extending the work of Einstein, developed the familiar equation for variation of mass of the *electron:*

$$m = \frac{m_e}{(1 - \frac{v^2}{c^2})^{1/2}}$$

This relationship was quantitatively demonstrated for β^- by Bucherer (42) in his studies of variations of charge/mass (e/m) assuming e to be constant. Further confirmation for p+ and more complex ions awaited development of particle accelerators.

A basic postulate of Special Relativity, on dual frames of reference, assumes that an observer in a moving system would not be aware of an increase in mass, as $v \rightarrow c$ since measuring instruments within the system would be similarly altered. This postulate requires:

a. that the moving system have no electric charge and be non-magnetic and/or
b. that the system if charged be moving in only a gravitational field and/or
c. that if there be a charge on the moving system, and there are present magnetic and/or electric fields, velocity must be constant, in rectilinear motion, parallel to the "lines of force" of unvarying fields.
d. similar restrictions as in (c) but for a moving system having a magnetic moment.

Unless the above restrictions are met, a charged system or one possessing a magnetic moment, initially within a space of low electric and/or magnetic flux, on movement into a space possessing a higher flux of either or both of these fields, will be caused to change course. *Inertial*, electric and magnetic effects on instruments within the moving system will indicate (a) field strength; (b) direction of action of forces; (c) v and dv of the system with respect to the three force fields. Since there will occur angular acceleration, v and dv with respect to center of curvature may be determined from within the moving system. Thus the *true* mass may be calculated from these three field effects. Forces which perturb the moving system will produce simultaneous, equal and opposite forces, manifest as perturbations of the apparatus which generate the fields.

Because of the proven existence of vast magnetic and electric fields, which were not recognized in 1905-1915, when Einstein developed Special and General Relativity, it is now necessary to reorient our approach to moving bodies, at all levels of mass. As with gravity, there are no spaces which can be isolated from the influence of magnetism or electro-statics. Therefore, postulates (a) and (b) above cannot be met. A body moving may only go from a low field strength region to one of higher field strength, or vice versa.

From these considerations it is concluded that observed increases in mass, now termed "relativistic," do not require the use of dual frames of reference for elucidation. Mass increases as $v \to c$ are considered to be phenomena of classical mechanics.

It is here proposed to develop an alternative hypothesis, postulating that any observed increase in mass results from incorporation, into the mass of the moving system, increments of *uncharged* mass derived from the subquantic medium ("neutrino sea") through which all bodies move; this process resulting from action of "neutral currents" (see 37, 38), analogous to increase of mass as neutrons are adsorbed by nuclei.

Recent developments indicate that the neutrino sea may be described with reasonable accuracy as a generalized near-isotropic, particulate continuum of velocities from near zero to near c; rest masses at two widely different levels, ν_u, $\bar{\nu}_u \sim 0.6$ Mev, and ν_e, $\bar{\nu}_e \sim 60$ ev. The muon neutrino ν_u has been postulated to be the counterpart of the uncharged electron and the name "neuon" suggested as a contraction of neutral electron, with notation e°, $\bar{e}^\circ$.(42)

It is proposed to extend these concepts by extrapolating the well-known properties of a *neutron flux*, to a flux made up of uncharged particles of less mass, e.g., e° (neutrino sea).

Experimental studies of neutron scatter and adsorption show that the probability of capture (σ_c) of a neutron by a nucleus is dependent on the velocity of the stream of mono-energetic neutrons. The target nuclei are essentially at rest (thermal

energies). Values of σ_c often vary widely with different target nuclei as well as being quite irregularly dependent on the velocity of the impinging neutron. To emphasize the point again – the velocity of the impinging neutron may be varied at will, while the target atoms may be considered stationary.

In a Fission reactor there are generated neutrons possessing high velocities. As the result of inelastic scattering processes with the moderator, neutrons are brought to "thermal energies." Therefore there is established and maintained fixed concentrations of neutrons with those velocities which have been shown by other studies to exhibit high σ_c values. The σ_c for a sample exposed in activation analysis is, however, a composite or average of the entire spectrum of neutron energies which exist in the reactor flux, at a particular power level.

Assuming that a large fraction of the particles ($e^\circ + \nu_e$) which constitute the neutrino flux are at low velocities, the reverse of the neutron studies may exist; high velocity particles impinging on essentially stationary particles of the neutrino flux. Correspondingly, as a particle is accelerated in a neutrino flux the number of interactions between the particle and the flux will be increased and the probabilities of establishing "resonant energy" relationships between the flux and the particle will be also increased.

Extrapolating the accepted theories of neutron interactions to other uncharged units of matter, but of lower mass, it is postulated that by varying the velocity of nuclei with respect to the neutrino sea, variations of σ_c for the e° and ν_e will occur. It is probable that the values of σ for e°, $\bar{e}^\circ$, ν_e, $\bar{\nu}_e$ will not be identical and will vary independently with effective velocity of the charged particle through the flux. Therefore, the observed mass increases of high velocity particles would be a resultant, producing a composite plot, approaching the Lorentz curve.

Assuming that e° and ν_e react similarly to neutrons, this theoretical approach predicts that, at certain velocities of accelerated ions, marked variations of σ_c will occur (i.e., resonance energies) producing corresponding anomalies in the plot, when compared with the theoretical Lorentz plot. Such a mechanism would also provide a causal basis for the observed variation of the decay rate of mesons when they are decelerated.

Grebe (1958) in formal discussions following the presentation of a paper [39] announced that he had observed anomalies in the mass of cyclotron accelerated particles. When the mass of these particles were plotted against velocity, discontinuities in the Lorentz plot were noted. Grebe offered no causal basis for his findings; however, he did not consider the anomalies to be instrumental errors. Confirmation of these results have not been reported, in so far as is known to this author.

It is suggested that unusual variations of mass of high velocity particles have been observed by others who utilize accelerators. These findings, if observed, were probably ignored or ascribed to instrumental errors or spurious results. The hypothesis that high velocity particles exhibit "mass increase resonance" at certain velocities can be tested with existing apparatus, by several experimental procedures.

Extending this line of reasoning, it is predicted that each charged particle at constant velocity in a "storage ring" forms a stable system, having incorporated a number of uncharged units of matter [$e^\circ + \nu^e$]. On deceleration, the system should become unstable, emitting uncharged increments of mass, and/or quanta of electromagnetic radiation. Such a process would re-establish equilibrium, forming a new stable system, with reduced mass. Maximum rate of emission of mass and/or energy should occur at those velocities corresponding to the "mass increase

resonance" points predicted above. Tests of these hypotheses may be carried out by determining the rates of x– and gamma ray production and uncharged particle emission that occur as high velocity particles are slowly decelerated by electromagnetic means.

As suggested earlier (1962),[6] observed net energy of nuclear events may be due to the exchange of mass and kinetic energy between these two classes of particulate matter, e.g., interaction as at the interface of a two-phase system:

$$\frac{(M_a) + (E_a)}{(M_b) + (E_b)} \rightleftharpoons \frac{w(M_a) + x(E_a) + (1-y)(M_b) + (1-z)(E_b)}{y(M_b) + z(E_b) + (1-w)(M_a) + (1-x)(E_a)},$$

where (M_a) = total mass of the neutrinos entering into the reaction; (E_a) = total energy of these neutrinos; (M_b) = total initial mass of the nucleons; and (E_b) = total energy of the nucleons entering into the reaction. Mass and energy would then be exchanged by the two systems, momentum being conserved, with no interconversion of mass and energy.

REFERENCES

Chapter VII

1. H. C. Dudley, *Theory of Relativity: A reexamination* (G. Andree. Publ.: New York, 1958).
2. H. C. Dudley, *New Principles in Quantum Mechanics* (Exposition-University Press: New York, 1959).
3. H. C. Dudley, *NUOVO CIMENTO*, 4B, 68 (1971).
4. S. Weinberg, *PHYS. REV.*, 128, 1457 (1962).
5. H. Y. Chiu, *BULL. AMER. PHYS. SOC.*, 7, 33 (1962).
6. H. C. Dudley, *BULL. AMER. PHYS. SOC.*, 7, 568, 609 (1962); 8, 599 (1963).
7. H. C. Dudley, *BULL. AMER. PHYS. SOC.*, 9, 738 (1964); 14, 88, (1969); 15, 93 (1970).
8. D. Bohm and J. P. Vigier, *PHYS. REV.*, 85, 146, 189 (1952); 86, 208 (1954).
9. L. de Broglie: *Non linear Quantum Mechanics* (English Translation), (New York, 1960).
10. J. A. de Silva and G. Lochak, *QUANTA* (English Translation), (New York, 1969).
11. J. Royer, *PHYS. REV.*, 174, 1719 (1968).
12. R. B. Stothers, *PHYS. REV. Lett.*, 24, 538 (1970).
13. L. Desrosiers and P. J. O'Donnell, *PHYS. REV.* D, 2, 403 (1970).
14. P. R. Bandyopadhyay, P. A. Chuduri and S. K. Saha, *PHYS. REV.* D, 1, 377 (1970).
15. J. Wilson, *BULL. ATOMIC SCIENTISTS* (May, 1974).
16. A. Einstein, *Letter Quoted., AMER. JOUR. PHYSICS,* 37, 969 (1969).
17. E. K. Conklin, *NATURE,* 222, 971 (1969).
18. H. C. Dudley, *BULL. ATOMIC SCIENTISTS* (Jan., 1975), p. 47; *PHYSICS TODAY* (Feb., 1975), p. 73.
19. R. S. Shankland, *PHYSICS TODAY* (Feb., 1975), p. 73.
20. P. M. Dirac, *NATURE,* 162, 906 (1951).
21. L. deBroglie, *JOUR. PHYS. ET RADIUM,* 20, 963 (1959).
22. B. Kuchowicz, *Cosmic Neutrino* (Nuclear Info. Center No. RR47 – Warsaw, Poland, 1972).
23. J. M. Kingsley, *Foundations of Physics* (Plenum Publ.: New York, 1975).
24. D. C. Miller, *NATURE,* 133, 162 (1934).
25. R. S. Shankland, et al., *REV. MOD. PHYS.*, 27, 167 (1955).
26. J. P. Cederholm, et al., *PHYS. REV. Lett.* 1, 342 (1958); *NATURE,* 104, 1350 (1959).
27. R. S. Jaseja, A. Javan and C. H. Townes, *PHYS. REV. Lett.*, 10, 165 (1963); *PHYS. REV.*, 133, A 1221 (1964).
28. H. E. Ives and G. R. Stilwell, *JOURN. OPT. SOC. AMER.*, 28, 15 (1938).
29. L. de Broglie, *COMPT. REND.*, 195, 536, 862 (1932).
30. P. Jordan, *ANN. DER PHYS.*, 93, 464 (1935).
31. W. A. Perkins, *PHYS. REV.*, 137, B 1291 (1965).
32. P. Bandyopadhyay and P. R. Chauduri, *NUOVO CIMENTO,* 38, 1912 (1965); 66 A, 238 (1969).

33. G. R. Kalbfleisch, *NUCL. PHYS.*, B25, 197 (1970).
34. H. C. Dudley, *BULL. AMER. PHYSICAL SOC.*, 15, 93, 1641 (1970); 17, 122 (1972).
35. T. de Graaf, *ASTRONOMY AND ASTROPHY.*, 5, 335 (1970).
36. D. V. Volkov and V. P. Akulov, *JEPT* (USSR) English Trans. 16, 438 (1972).
37. G. B. Lubkin, *PHYSICS TODAY*, 26, 17 Nov., 1973.
38. A. L. Hammond, *SCIENCE*, 182, 372 (1973).
39. J. J. Thomson, *PHIL. MAG.* 11, 229, 1230 (1881).
40. W. Kaufmann, *GOTT. NACHRICHTEN*, p. 143, Nov. 8 (1901).
41. H. A. Lorentz, *Theory of Electrons* (1909) – Reprint. Dover: New York (1952).
42. A. H. Bucherer, *BERL. PHYS. GESELL.*, 6, 668 (1908).
43. H. C. Dudley, *Lett. NUOVO CIMENTO*, 5, 231, 641 (1972).
44. J. J. Grebe, *ANNALS, N. Y. ACDY. SCI.*, 76, 1 (Sept., 1958).

IN CONCLUSION

We look on helpless while our material civilization carries us at breakneck speed to an end which no man can foresee or even conjecture, and the speed forever increases. The last hundred years have seen more change than a thousand years of the Roman Empire, more than a hundred thousand years of the stone age.

—Sir James Jeans
Growth of Physical Science (1947)

This thought-provoking quotation sets forth the general atmosphere of change which characterizes the twentieth century. This eminent scientist and philosopher wrote at a time when today's pressing problems were just beginning to gestate, at a time when but a few had some vague inkling of what the next decades would bring. Now it is high time that we all face up to the nuclear problems generated by man's unwitting stirring of the glue that sticks the nucleus together.

A wise man once observed that men will love you if you make them think that they think, but will hate you if you make them think. This volume, if it is to accomplish its purpose, must make you think. It must make you question. If you are timid, or proud of the extent of your knowledge, this volume may well be unacceptable.

To those of enquiring mind, who are humble in the face of our vast store of ignorance, who can exhibit the intellectual fortitude of question the scientific dogma of our times, who can dare to wonder if the knowledge we have is but a small part of that which we are destined to hold – to you this work is offered as a challenge.

The quite evident purpose of the very extensive PR campaign which was begun about the first of the year 1975 is to promote the public's acceptance of near unlimited, worldwide expansion of fission electric power-generating capacity.

In view of the unsettled nature of the very basics of nuclear science, it is suggested that we make haste, slowly.

Instead of revising, remodeling, repairing existing fission power units, which developed out of concepts acceptable 30 years ago, continuing to construct more and more of such units, industry and government would be well advised to evaluate and focus attention on the information which has become available since then.

In a field where emotion and politicing now tend to crowd out clear-headed evaluation of all options, let's not get caught up in a contest of wills (or pocketbooks). Let's be really innovative scientists and engineers again. Our children – and their children – have too much at stake.

IN APPRECIATION

As the result of the expansion of scientific research into a multibillion dollar business, there has inadvertently evolved over the past 30 years efficient methods of scientific censorship, including control of large segments of the scientific press. This, by methods, which would not be tolerated by the lay press, nor the U. S. Courts.

This author would like to publicly thank the following for breaking this circle of confusion by practicing the highest levels of journalistic ethics:

Tim Burkholder, Publisher and R. R. Jones, Editor of **INDUSTRIAL RESEARCH.**

Samuel H. Day Jr., Editor of **THE BULLETIN OF ATOMIC SCIENTISTS.**

Alfred F. Plant, Editor of **CHEMICAL & ENGINEERING NEWS** (American Chemical Society).

Dick Teresi, Managing Editor, **SCIENCE DIGEST** (Hearst Corp.).

Warner B. Sizemore and Lewis M. Greenberg, Editors of **KRONOS** (Jour. of Interdisciplinary Synthesis – Glassboro, N. J. 08028).

Lynn E. Rose, Editor of **KRONOS** (Jour. of Interdisciplinary Synthesis).

APPENDIX I

In which there are reproduced *in toto* "Conclusions" and "Appendices" from *Gravity Versus Relativity* by Charles L. Poor (Putnam's, 1922), detailing the manner in which data was culled and selected to support the Theory of Relativity, by those who believed implicitly in the validity of this theory and were impelled at all cost to bolster their views.

Charles Lane Poor, Ph.D., was professor of celestial mechanics at Columbia University, New York, 1910-44.

CONCLUSIONS

The astronomical evidence, cited by Einstein as complete and satisfactory proof of the relativity theory, fails to support his hypothesis. His hypothesis and formulas are neither necessary nor sufficient to explain the observed phenomena. They are not sufficient, as they account for only one of the numerous discordances in planetary motions, for only a portion of the supposed light deflections: they are not necessary, for all the discordances in the motions of the planets, including that of Mercury, can readily be accounted for by simple gravitational methods, and the light deflections, if real, can be equally well explained on other grounds.

A motion of the perihelion of Mercury, similar and approximately equal to that actually observed, can be explained by the Einstein hypothesis. But this hypothesis fails completely to explain other motions of Mercury and similar motions in other planets; it causes new and inexplicable discordances in the motion of Venus. On the other hand, all the observed motions of both Mercury and Venus can be readily explained by the action, under the Newtonian law of gravitation, of masses of matter, known to exist. And such explanation is based upon formulas and methods known and used for well over a century to account for similar motions in other portions of the solar system.

Deflections of light rays, similar to those reported at Sobral, can be explained by the relativity theory. This hypothesis can account, very approximately, for the amount of the supposed deflections, but it fails completely to account for the directions in which such deflections occurred. Refraction by the cosmic matter, through which the rays are known to have passed, will account fairly well for the observed directions, but encounters very serious difficulties, in accounting for the amounts of the deflections, as reported.

But for the true relativitist the pathway through all the difficulties of conflicting evidence is smooth and clear: for does not everything depend upon the observer? Nothing is absolute, everything is relative; the statute is golden for one observer and silver to the other. To the relativist the motion of the perihelion of Mercury, of course, is real and is exactly the 43" required by the Einstein hypothesis, but the other motions do not exist, they are mere accidental errors. It makes no difference that all these various motions result from the same investigations, that both Leverrier and Newcomb show that the motion of the perihelion is not independent, that it must be accompanied by and depend upon other motions. These other motions cannot be explained by relativity, and, therefore, they do not exist; they have not been "sufficiently attested." Thirty-three photographic plates, taken during the eclipse of 1919, show star images; of these thirty-three, seven only give

results even approximating towards the Einstein predictions. And to make even these seven fit the hypothesis, the relativitist is forced to invoke the aid of the sun to distort the camera in a particular way and by just the right amount!

The explanation of the old-fashioned astronomer, that the motion of Mercury may be due to masses of matter, which have been seen and photographed many times, is dismissed by the relativitist as having little probability and as having been devised solely for the purpose. The corona of the sun has been known from prehistoric times, the zodiacal light for many years, and meteors have fallen to the earth in all ages. That an elliptical-shaped central body would cause a perihelial motion (Note: This is particularly significant in view of the very recent work of Dicke!), was shown by Walmsley in 1785, and used by him to explain the motions of Jupiter's satellites. Was this devised solely to explain the motion of Mercury? Did Walmsley devise a method for the sole purpose of explaining something of which he was entirely ignorant, and which was not discovered until nearly a century after his death? The corona, the zodiacal light, meteors—are these fictions of the imagination? Were these devised by the deluded followers of Newton solely to explain the motions of Mercury?

The relativity theory may be true, but no substantial experimental proofs have yet been submitted by any of its adherents.

THE MICHELSON-MORLEY EXPERIMENT ON ETHER-DRIFT

The Michelson-Morley experiment forms the basis of the relativity theory: Einstein calls it decisive. If it should be shown that this experiment is not decisive, that the negative results obtained were due to instrumental errors or to some peculiar conditions under which the experiments were conducted; if it should develop that there is a measurable ether-drift, then the entire fabric of the relativity theory would collapse like a house of cards. For this reason the repetitions of the Michelson-Morley experiment recently made at Cleveland and at Mount Wilson are of especial importance; they indicate that the original experiment was not decisive, and that there may be a measurable ether-drift.

Many years ago it was suggested that the negative result of the Michelson-Morley experiment might be due to the earth dragging the ether, in its immediate vicinity, along with it: that the ether in the room, in which the experiment was made, was entrapped and moved with the room. A motor-boat, a steamship, moving through still water drags the particles of water in immediate contact with its sides along with it. If one looks directly down from the deck of a moving vessel, one will see the particles of water apparently cling to the sides of the boat and move forward with the boat; particles an inch or two from the surface cling less tenaciously and are slowly passed; particles a foot or two from the sides show no frictional effect and are left at rest by the passing vessel. To measure the true speed of the vessel through the water, one would have to consider the motion of the hull relative to water particles some considerable distance away from the boat. This effect of dragging water is the well known phenomenon of "skin friction," which plays such an important part in the design of all vessels.

The attempts of Michelson and Morley to measure, in the basement of buildings and at low altitudes, the motion of the earth through the ether might not inaptly be compared to the attempts of some minute beings, living in a small rust-pit on the side of the *Leviathan,* to measure the speed of that immense vessel through the waters by experiments in the thin film of water, contained entirely within the hollow in which they lived.

In the years 1891-1897, Sir Oliver Lodge tested this idea of skin friction between moving bodies and the ether, and attempted to measure the amount of such friction, if any there be. He devised an elaborate apparatus, by which he could test whether the ether contained between two parallel steel plates was dragged along by the plates, when they were whirled at high speed. His experiments showed that the ether between such discs, or plates was not dragged sufficiently to change the velocity of light by so much as the 1/1000th part of the velocity of the plates. And he concluded from this experiment that the viscosity, or fluid friction of the ether is zero. In considering this result it must be remembered that the discs, or plates were only some three feet in diameter, and were placed about one inch apart. The earth is some forty-two million feet in diameter. Thus this attempt of Sir Oliver Lodge to detect possible skin friction of the earth is not radically different from an attempt of a naval architect to find the skin friction of the *Leviathan,* after several months in service, from tests made on a plate of highly polished metal one inch in diameter.

Now the possibility of skin friction between the earth and the ether can be tested by repeating the Michelson-Morley experiment at different distances above the earth's surface. An accurate test, of course, can only be made in the higher regions of the atmosphere, clear above the tops of the highest mountains. This is impossible, but it is possible to utilize high-altitude stations and compare the results with those obtained at ordinary levels. This has been done by Professor Dayton C. Miller at the Mount Wilson Observatory, at an altitude of some 6,000 feet. He there made the experiment with the original apparatus used by Morley and Miller, and repeated it with improved instruments. Miller summarized his findings in the following words: (1)

> The suggestion was then made that the earth drags the ether, and while there is no "drift" at the surface of the earth, it might be perceptible at an elevation above the general surface. The experiment was again performed by the present author at the Mount Wilson observatory in March and April, 1921, where the elevation is nearly 6,000 feet. The results indicated an effect such as would be produced by a true ether-drift, of about one tenth of the expected amount, but there was also present a periodic effect of half the frequency which could not be explained. The interferometer had been mounted on a steel base and in order to eliminate the possibility of magnetic disturbance, a new apparatus with concrete base and with aluminum supports for the mirror was constructed. Observations were made in November and December, 1921, the results being substantially the same as in April. Before any conclusions can be drawn, it is necessary to determine the cause of the unexplained disturbance.

These experiments of Professor Miller are not conclusive, but they appear to indicate that the ether is dragged along by the rough earth, and the true drift might be measured if one could attain a sufficient height above the surface of the earth. If there be an ether-drift, as these experiments indicate, then the entire structure of the relativity theory is rendered worthless. But, whether there ultimately prove to be a measurable ether-drift at high altitudes or not, this cautious statement of Professor Miller embodies the true scientific spirit, and is in marked contrast to the statements and assertions of the relativitists.

EINSTEIN AND THE FIZEAU EXPERIMENT

The treatment of the Fizeau experiment by Einstein requires a few words of explanation. He gives two equations as follows:

$$W = v + w \qquad \text{(A)}$$

$$W = \frac{v + w}{L + \frac{vw}{c^2}} \qquad \text{(B)}$$

in which v is the velocity of the water in the tube, w the velocity of light in a motionless fluid, and **W** the velocity of light relative to the tube.

He states that equations **A** and **B** represent the relations between these quantities, **A** according to the ordinary theories of classical mechanics, and **B** according to the relativity theory. He then shows that the relativity equation **B** more nearly represents the results of Fizeau's observations: "Experiment decides in favour of equation **(B)** derived from the theory of relativity, and the agreement is, indeed, very exact."

Equation **A**, however, is not an equation of classical optics; it is found nowhere except in Einstein; it has nothing whatsoever to do with Fizeau's experiment. As it stands, it is a mere statement that the velocity of light in the moving water is equal to the sum of the velocities of light in air and of the water in the tube. This has never been claimed. Every formula, heretofore used, has involved a quantity that Einstein omits, namely, the index of refraction of water.

Further, the results obtained from equation **B** are not identical with the observational results of Fizeau. In order to bring equation **B** into accord with the results of Fizeau, Einstein is obliged to make approximations, or to neglect certain terms of his own formula. By means of such approximations, he finally puts his equation **B** in the form:

$$W = w + v\left(1 - \frac{1}{n^2}\right)$$

where n is the index of refraction of water, equal to the ratio c/w. And this equation is identical with Fizeau's.

Thus, in applying his "crucial test," Einstein sets up and knocks down an equation never before heard of, an equation having no relevancy to the observations discussed, and then adjusts his own equation, by a system of approximations, to fit the observations.

THE MATHEMATICS OF RELATIVITY

The entire relativity theory is based upon certain assumptions, or postulates, from which were derived mathematically all the complicated formulas and conclusions of Einstein. It has always been taken for granted that the mathematics of relativity were correct; that the conclusions followed logically and inevitably from the fundamental premises or assumptions. Now, this very point has lately been investigated by eminent French mathematicians, especially by Painlevé,[2] who has shown that a number of different and inconsistent conclusions can be drawn from the fundamental premises of relativity.

From his formulas, Einstein drew certain conclusions regarding the behavior of clocks and of measuring rods, when in motion. Painlevé has shown that the Einstein

formulas are not the only formulas to be derived from the premises, that there is an infinity of other possible formulas. One of these other possible formulas leads to the ordinary results of Euclidean space and to the constancy of rigid bodies. Other possible formulas lead to the conclusion that bodies expand instead of contracting, still others that they expand at right angles to the direction of motion.

The conclusions of Einstein appear to Painlevé to be audacious conjectures and not the *inevitable* consequences of the premises; he concludes that it is pure imagination to pretend to draw conclusions such as Einstein does. Painlevé believes that a number of Einstein's formulas will blend with classical science, but that some of the more startling consequences of the theory will not finally survive.

THE DISPLACEMENT OF SOLAR LINES AND RELATIVITY

Einstein has claimed that the observations of Grebe and Bachem at Bonn, on the cyanogen lines in the solar spectrum, place the reality of the relativity displacement almost beyond doubt, and in these observations he sees clear experimental confirmation of his entire theory. It has been noted, however, in *Chapter II,* that the bands or lines of the solar spectrum are subject to displacements due to other causes, to motions of the earth and sun, to motions of the solar atmosphere, and to differences of pressure. These displacements may be much larger than the predicted Einstein effect. Thus, the relativity, or Einstein, shift is not a clear-cut effect which can be directly measured; it must be disentangled, if it exists, from several similar, overlapping and even larger effects.

In the Annual Report of the Director of the Mount Wilson Observatory of California, there is to be found a summary of the observations upon the cyanogen lines, made by various observers, each of whom claims to have proved the existence of the Einstein effect. From this summary the following facts appear:

PEROT applied corrections for *downward* movement of the solar atmosphere and for *negative* pressure shift (approximately equal to the Einstein shift), and when thus corrected, his results agreed with the Einstein prediction.

BIRGE applied a correction for an *upward* movement of the atmosphere, but no pressure shift, and when thus corrected, his results agreed with the Einstein prediction.

GREBE and **BACHEM** assumed neither *upward nor downward* movement of the atmosphere and *no* pressure shift, but applied a correction for a supposed *asymmetry* of the arc-lines, and, when thus corrected, their results agreed with the Einstein prediction.

Had these three observers applied the same corrections, in the same way, it is perfectly clear that their final results would have been very discordant, and that two sets of results, at least, would have differed radically from the predicted Einstein effect. As a matter of fact, these three sets of observations, taken together, do not show the slightest trace of the relativity effect; they are radically discordant and can only be made to show the desired result by arbitrary and contradictory corrections.

Mr. St. John, of the Mount Wilson Observatory, sums up the various observations, in the Annual Report of the Director, in the following words: [3]

> Owing to the different and even inconsistent corrections applied to the observed sun-arc displacements, the resulting approximate agreement with the deductions from the Einstein theory fails to carry conviction.

This statement is certainly conservative!

REFERENCES

Appendix I

1. *SCIENCE,* No. 1427: May 5, 1922.
2. *Classical Mechanics and the Theory of Relativity,* by P. Painlevé. Science abstracts: Section A-Physics: Vol. 25, Part 3, page 170. March 31, 1922.
3. Carnegie Institution of Washington. Annual Report of the Director of the Mount Wilson Observatory. *Year Book,* No. 20, for the year 1921, p. 244.

APPENDIX II

EINSTEIN ACCEPTS CORRECTIONS ON ERROR IN THEORY

Concept "Must be Revised," Relativity Calculator Says Philosophically After Talk

Eclipse Photographs Seen

Sun "Shots" Taken in Sumatra Reveal His Discrepancies

[*From the Herald Tribune Bureau*--Copyright, 1931, New York Tribune Inc.]

BERLIN, JUNE 13. – Professor Albert Einstein was on record today as accepting the correction by a fellow scientist of a 25 per cent margin of error in his calculations concerning the deflection of the light from stars in connection with his theory of relativity.

"The theory must be revised," Professor Einstein admitted philosophically. "It must conform to the facts."

This development surprising Berlin scientific circles came when Professor Erwin Freundlich, director of the Einstein Observatory at Potsdam, reported to the Physics Association of Berlin on his expedition to North Sumatra two years ago to observe an eclipse of the sun.

Professor Einstein had estimated that a ray of light coming from one of the more distant stars and passing near the edge of the sun on its journey ought to be bent in its passage by an angle which should be 1.745 sec. if the ray just grazes the edge of the sun. Professor Freundlich, however, in his lecture last night, stated that the observations made by his party in Sumatra during the eclipse of the sun of May 9, 1929, showed that this deflection on the edge of the sun amounted to 2.2 sec.

Professor Einstein, who himself listened attentively to the lecture, made a short speech subsequently, in which he declared that it was his duty as a physicist to bow to the facts and stated that his theory would have to be modified to fit them.

Professor Freundlich's findings do not correspond with those of the expedition sent out by the Lick Observatory, California, to view the eclipse of 1922. That expedition obtained for displacement of star rays at the sun's limb a value of 1.72 sec., a figure which approximates the Einstein estimate.

Professor Freundlich asserted last night, however, that the American astronomers had committed an error of prime importance by leaving out of consideration observations that did not fit in with the results they wanted to obtain. On the other hand, he told his learned audience that his observations confirmed beyond doubt one of the major premises of the Einstein theory, namely, that a ray of light from a star was deflected outward by the sun's field of gravity.

But the pleasure that the German scientists derived from this partial confirmation of the theory of relativity was marred by the discrepancy between the angle of displacement as estimated by Professor Einstein and as established by the expedition. The latter found the deflection to be 25 per cent greater than the displacement to rectilinearity caused by the sun as asserted by the relativity theory.

In the discussion which followed, Professor Einstein, who was making his first appearance in Berlin scientific circles since his return from the United States, said he considered the data collected by Professor Freundlich to be the most reliable

which yet had been made concerning the deflection of the light of stars.

The author of the theory of relativity then stated that he thought it was highly improbable that differences between actual observation and theory would be removed by more accurate measurements in the future. He expressed the belief, on the contrary, that an improvement of the theory by the extension and adoption of a uniform field theory was possible.

"The foundations of the relativity system must be subjected to a revision which will fit its teachings to these new observations," he said.

The German expedition to Sumatra, headed by Professor Freundlich, took with it two telescopes, from one of which four, and from the other three photographic plates were developed. The eclipse, Professor Freundlich said, took place under exceptionally favorable conditions and lasted five minutes – *New York Herald Tribune,* Sunday, June 14, 1931, page 11.

EINSTEIN TO MODIFY THEORY OF RELATIVITY AS LIGHT STUDY SHOWS CALCULATIONS WRONG

[Special Cable to *The New York Times*]

BERLIN, JUNE 12. – Professor Albert Einstein said today that his theory of relativity would have to be modified in view of the observations of Professor Erwin Finlay Freundlich, head of the Einstein Institute in Potsdam, who announced today the results of the Sumatra expedition of the institute.

The expedition took pictures of the sun during the total eclipse of May 9, 1919, in order to ascertain whether the light of stars deviated in the gravitational field of the sun as predicted by Dr. Einstein. The observations of British and American scientists during previous eclipses had confirmed Professor Einstein's forecast.

Professor Freundlich asserted that the pictures taken by his expedition showed that the calculations of the theory of relativity were wrong and that the deviation of light rays were considerably greater than had been assumed heretofore. He made the announcement at the annual meeting of the German Physicists' Society before an assembly of Germany's most distinguished physicists, including Dr. Einstein and Professor Max Planck.

Dr. Einstein rose after Professor Freundlich had spoken and said there was no doubt that Dr. Freundlich's observations were the most accurate made so far and that consequently a certain modification of the theory of relativity would be necessary.

"The theory of relativity took account only of the influence of gravitation," Dr. Einstein said. "On this basis its calculations were correct. But I have always felt that gravitational and electro-magnetic fields cannot be considered separately but must be combined. A theory combining them does not exist yet, but must be evolved."

Professor Einstein himself presented the results of the Freundlich expedition last night to the Prussian Academy of Science. The deviation of light by the sun, as observed by Professor Freundlich, is 2.22 seconds, while the theory of relativity placed it at 1.75.

The reason for the fact that British and American scientists obtained the same result as Dr. Einstein is, according to Professor Freundlich, that they failed to calculate correctly certain imperfections of their photographing equipment. If his method had been applied in the American observations, he said, different results would have been obtained.

To measure the deviation of the light rays, pictures of the sun were taken during the eclipse when the surrounding stars were visible. Several months later the same stars in the same constellation were photographed again and their position in both sets of pictures compared. Professor Freundlich said the greatest source of errors was climatic influences on the lens of the camera.

Photographic Method Explained

An American scientist tried to calculate these changes mathematically, he explained, while he himself had excluded errors from the same source mechanically. Immediately after the pictures had been taken, he explained, a screen was projected upon the plates with a separate camera. This camera was kept isolated from all climatic influences, he continued, and the same screen was projected upon the second set of pictures several months later, thereby determining the purely mechanical deviation.

Four pictures were taken during the eclipse lasting five minutes. They showed, respectively, deviations of 2.25, 2.17, 2.61, and 1.82, Professor Freundlich announced. The results of the expedition could not be announced earlier, he said, because more than 100,000 microscopical observations had been necessary besides mathematical calculations. Another set of pictures was taken during the same eclipse with a different camera, he said, and the results of those pictures will be published soon.

At the same meeting Professor Arnold Sommerfeld of the University of Munich received the Planck medal for 1931. He will depart soon for the United States to lecture there. – *The New York Times,* June 13, 1931, p. 1.

The above news reports were taken from the *New York Herald Tribune* and the *New York Times* of June 13-14, 1931. These show that Albert Einstein admitted a significant error in his calculations involving deflection of light by the sun's gravitational field.

These findings by Professor Erwin Freundlich have subsequently been overlooked or ignored by most scientists, even by Einstein himself: "The chief attraction of the theory lies in its logical completeness. If a single one of the conclusions drawn from it proves wrong, it must be given up: to modify it without destroying the whole structure seems to be impossible." (Albert Einstein, "What is the Theory of Relativity?" *Mein Waldbild* [1933]; English trans. by Alan Harris, *The World as I See It* [1934].)

Einstein continued in his attempts to modify his theories in order to integrate gravity-magnetism-electrostatic forces into a "unified field theory." He and several others failed to develop such a generalized treatment for what are still the most intriguing mysteries of the physical sciences.

H. C. D.

APPENDIX III

In which are given excerpts from a most unusual volume which will be found in few libraries: *THE CASE AGAINST EINSTEIN* by Arthur Lynch (Dodd, Mead and Co., New York, 1933).

This material is presented here in order that today's thinking persons may know that earlier there were certain men who could not accept the postulates and methods of reasoning which were then beginning to become the fads and fashions which have come down to us via the scientific and philosophical textbooks of the past four decades.

H. C. D.

PREFACE

Brave men find fascination in voyages of discovery; few joys can be compared to the thrill and excitement when first the eye discerns on the horizon a faint cloudy strip that surges up, wonder on wonder, as a new land, full of untold possibilities of riches and delight. Yet greater still are the voyages of the mind, when trembling along the subtle lines of our thought, a new idea, a new discovery, reveals itself, that tells of a secret of Nature; for secrets of Nature are never single nor barren, and once the source has been reached the way is won to a very continent of power, and the subtle speculations of a solitary thinker come to reality in the possessions that for ever afterwards enlarge the spiritual domain of man.

Is Relativity such a domain of new intellectual enlargement and strength? There is something enlivening in the bold fresh adventure of thought, and to me, perhaps more than to most; there is a deep satisfaction in the break away from whatever is false or unwholesome in mere orthodox conventions. The way of scientific development is to be daring in thought, even audaciously speculative; always with this proviso, however, that the speculations be tested with a courage, a desire for truth, no less inspired than the impulse of the first setting-out.

There are three domains of science of special interest in this theory of Relativity: that of psychology, of which Einstein rightly insists on the importance; that of physics, in which he indulges in tentative speculations; and that of mathematics, in which he disregards the essentials of clearness of vision and rigour of argument.

In the following pages I place his theory in its setting in each of these domains; in none of them, to my surprise, did I find originality of thought. His psychology is simply imitative, being derived from Kant as the fountainhead, without discrimination or surety of comprehension, for Kant himself lacked that.

In the domain of physics, there is nothing new except the bizarre notions, the disconcerting conclusions. In the field of mathematics, I have traced out successively from Descartes onward the source of his ideas – for here, too, there is nothing original – and I have shown that the magic, or the paradox, of his theory consists in giving to mathematical expressions which occur in the writings of others, notably of Riemann, and later of the exponents of Absolute Geometry, strained meanings, and

the setting down as *realities* what are conventional *modes* of representing (mathematical) operations.

All this, however, has a dry, abstract appearance, and may produce that distaste which most men feel for the merely academic; but so far we have not touched on the real, even if already legendary, and divinely impossible, Einstein; that is to say, the Einstein of popular imagination; the man who has changed the qualities of the Universe by an intellectual turn of the hand; the man who has decreed the limits of velocity; the man who can curve our space from Euclidean to Lobatchewskian or Riemannian, from flat to spherical or saddle-backed, simply by fiddling with cryptic symbols; the man who tells us that bounded and infinite are just one, and that time is indistinguishable from space; the man who sees enveloping our world a finer transcendental world of which the freedom of the city is vouchsafed to the Relativitist disciples, and even – such is the power of this tremendous wave of thought – a few men of science.

Even during my own lifetime I have known many theories, famous in their day, overthrown. In the following pages I will show that Relativity may also be numbered among these ephemeral doctrines.

INTRODUCTION

Relativity has become a sort of new religion with Einstein as its prophet. It has the hall-mark of many religions that have swayed the minds of men in being founded on premises which at first sight seem dubious, and on examination by the profane – that is to say those who have not received a sort of mystical baptism – untenable, if not absurd. It also resembles a religion in the respect that, when the truth of this statement is proved, the faith of the believers remains unshaken. This book, therefore, is addressed mainly to those whose minds are still free and capable of separating the grain of real science from the chaff of impossible, even if delightfully mysterious, conceptions. The introduction is devoted to the consideration of those intangible but powerful influences, which, though completely unscientific, may determine reputations in science; and if I repeat myself, as I may do even to tedium, it is because I have continually run afoul of the same falsities.

When I first began to look into the theory of Relativity and to criticise the arguments by which it was established, I was told that I must have "great courage" to undertake such a task. I reflected. It is true that in every campaign of this nature I have provided myself with but one instrument – reason.

On a certain evening when, by gracious favour, I was admitted to hear Einstein lecture on his principle of Relativity at King's College in London. He was the Maupertuis of his day, appearing there with a doctrine still more alluring, still more recondite, and, at the base of things, still more fantastic than that of the Gallic geometer. Frederick was represented by the professors sitting in their robes, those wonderful garments that might have proved rivals more serious than Solomon's to the lilies of the field.

I mention these details because I am dealing for the moment not with science, but with public impressiveness, and in this hierophantic display of the professors I have indicated the main source of their attraction for the public.

The whole affair was well stage-managed, just as I used to note in the House of Commons when Mr. Asquith rose to speak. Einstein appeared in modest guise, and

I conceived a liking for the man, a liking since confirmed by M. Paul Painlevé – a man of genius, that – who lately spoke to me of Einstein's courtesy, equal indeed to his seriousness of purpose. Looking like a musician, as he is, with his crown of unruly, but now well-ordered, hair, his easy stance, his modest manner, and his short-sighted wondering eyes, Einstein spoke well. His exposition had an air, quite a deceptive air, of lucidity, while now and then a lightness of manner and a witty expression reminded me that the learned professor was of the race of Heine, rather than that of Heine's professor Saalfeld.

But he spoke in German, of which language not ten per cent of his audience knew enough to follow him; not ten per cent of these knew anything of physics or mathematics; and of these again how many could understand the psychological assumptions that lay deep at the base of the doctrine? I hesitate to answer because I do not wish to discourage anyone. At the University of Berlin, it had fallen to my lot to study these three subjects; and it had been an essential part of my original work on psychology to free myself from the shackles of that Kantean psychology that, I perceived, still marked the limits of Einstein in that domain. Therefore, I knew at least what he was saying.

The discourse was divided into three sections that had no visible connection with each other; one dealt with psychological, or metaphysical conceptions, the second with physical hypotheses, such as came within the Galilean scope of things, and the third with Einstein's tenuous theories and his tentative explanations, for example, of such phenomena as gravitation.

I listened in absorbed attention, sometimes delighted with his philosophical detachment, at other times disconcerted by the want of cogency of his argument. In this, I was reminded of a spectacle of a few years earlier, when I had listened to Bergson speaking to a similar audience. His exposition had at times an appearance of great clarity, at other times it astonished me by a sudden flash of intellect, and again left me in stupefaction at the futility of the reasoning.

Why do I lay stress on the popular reputation of Einstein instead of the position of authority he holds among the body of scientific men?

My answer is that I would be pleased to deal with the theory of Relativity on the sole ground of its scientific value, but the main part of its strength does not lie in its acceptance by men of science, but in its popular fame; and, further, many scientific men, even some on the councils of the universities, and certain journals and magazines of science, are far more susceptible to current popularity, or even "boosting" of press agencies, than they would care to acknowledge. This is as conspicuous in the case of Einstein, as in instances of men, of far inferior intellectual quality, who have by sheer force of popular "boosting," stampeded the learned bodies. It is necessary to overcome, in the first place, the presumption created in the minds, even of thoughtful people, that there must be something of exceptional depth, or luminosity, in Einstein's paradoxes; for he is cited by learned men all over the world, and was invited to lecture with authority at the great universities which close their doors so jealously on any kind of philosophy that runs counter to their own accepted teachings.

There is another reason for the popular appreciation of such a theory as Einstein's. The public delights in wonders, and the press, which offers a fair reflex of the public

mind, encourages them in that predilection. It is difficult, as a rule, to obtain the insertion in a newspaper of a scientific article, and even when, on State occasions, the papers give some space to science they either invest the news with something that enhances it – the patronage of science by a titled person – or they add something astonishing, or fantastic, to eke out the news. The same difficulty arises with any reasoned form of philosophy. If it reaches sane conclusions it passes into the light of common day, and ceases to be of interest; but if it asserts that a young man in Cambridge has created life in a test tube, whereas he has simply mistaken objects under his microscope, then a wave of enthusiasm traverses the world; and devout people, whose chief beliefs would be jeopardised by this discovery, are loudest in their hymns at the wonder.

And so with Einstein. It was not merely that he had improved on Newton; for when Henri Poincaré published his *Nouvel les Méthodes dans la Mécanique célèste,* which added refinements to Laplace's system, the man in the street remained indifferent to the scientific achievement. But Einstein! Ah, there we have the real journalistic tang, the marvel, assured of popularity. The man who can dispense with the ether itself, who can enable us to talk of space that is both bounded and limitless, and who can assure us that the relative motion of two objects has no effect on their relative velocity; that is no ordinary man! The attractiveness of these doctrines was also enhanced by the fact that they could be imbibed without the fatigue of study. I have heard everywhere, at Labour meetings, in theatrical circles, in the halls of the great, the chatter of Relativity among men and women, who had become "advanced" and emancipated from the tyranny of coherent thought.

The American physicists and mathematicians are, in general, the most critical of Relativity and this is true also of the framers of the case which is the cornerstone of the theory, the Michelson-Morley experiment; Michelson rejected the Relativitist theory.

All this explanation is, I know, laborious, for a child of three knows perfectly well what is meant by time, though he might be puzzled about the relativistic interval, and moreover the child knows inevitably and clearly what is meant by "before" and "after." But I am answering the thesis of the Einsteinians who are continually bringing forward, in new guises, the same old misconceptions.

> Sir Arthur (Eddington) breaks through the cold beauty of his academic style to ridicule the naive simplicity of such ideas as I put forth here. I am not displeased; these little razzias of wit alleviate the pain of trying to follow him, but what he gains in genial levity he loses in weight of judgment. We are far from done with the "interval" yet; it has some choice surprises in store. While on the subject I would cite the hankering of the Relativists for seeking to make time run backwards. Dean Inge, when President of the Aristotelian Society, illustrated their idea. He imagined a diver plunging into the water, and then described the cinematograph film moving in the reverse order. This was not a case of time moving backward, but simply of one set of (visual) images being noted, and then, still in sequence of time, another series. A small boy

counting the buttons of his waistcoat first down and then up is not a great philosopher, but he does not commit the error of the Dean.

What can the more recondite speculations of Einstein mean to the average man? The remark, sometimes made, that the popularity of Einstein is a hopeful sign of the interest of the people in the high feats of intellect is sheer humbug, if the use of so vulgar a word be permitted. What interest has the average man shown in the works of Cayley in this country, or of Hamilton in Ireland; or of Cauchy, or Poincaré, or Hermite; in the marvellous deep thrusts of insight of the young genius, Evariste Galois, or in the delightful elegence of the expositions of Hesse, or the profound searchings of Sophus Lie? Sophus Lie, by the way, hailed from Norway, but when I once mentioned his name in admiration to a Norwegian, he thought that I had meant to allude to Jonas Lie, a popular novelist. Yet, Norway is one of the few countries I know that has erected a statue, and a fine one, to a man who was a mathematician pure and simple. Not far from the University of Oslo, stands a remarkable monument destined to glorify to the world the intellectual prowess of the Keats of mathematicians, Niels Abel. But does the man in the street read Abel? Would it please a London music-hall audience to hear an allusion, by way even of an appreciative gag, to the study of hyperelliptic functions? No. Then, let us clear our minds of cant, recognise what "balderdash" is the current admiration of Einstein, even though heralded by Lord Haldane and trumpeted by Bernard Shaw.

FINIS

Yet, as I cast my eye over the whole course of science, I behold instances of false science, even more pretentious and popular than that of Einstein, gradually fading into ineptitude under the searchlight; and I have no doubt that there will arise a new generation who will look with a wonder and amazement, deeper than now accompany Einstein, at our galaxy of thinkers, men of science, popular critics, authoritative professors, and witty dramatists, who have been satisfied to waive their common sense in view of Einstein's absurdities. Then to these will succeed another generation, whose interest will be that of a detached and half-amused contemplation; and in the limbo of forgotten philosophies they may search for the cenotaph of Relativity.

INDEX

Absolute, The, 21
Absolute Motion, 77, 82
Academic Market Place, 22
Acausality, 64
Airliners, 89
Alice in Wonderland, 1
American Association Advancement of Science, 38
American Association of Physics Teachers, 43
American Chemical Society, 42
American Journal of Physics, 43
American Physical Society, 42, 43
American Rocket Society, 5
American Society Mechanical Engineers, 5
Argentina, 29
Army-Navy-Air Force Journal, 5
Astrophysics, 74
Atomic Clocks, 66
Atomic Bombs, 29, 58
Atomic Energy, 33

Berlin, 20
Beta Decay, 56, 64
Beta particles, 56, 64
Big Bang, 55
Bikini, 33
Brazil, 29
Brownian Movement, 16, 18
Bulletin Atomic Scientists, 91
Budget, R. and D., 32, 37, 41

^{12}C, 66
^{14}C, 63, 67, 68
Carnegie Institution, 98
Catastrophe, Ultimate, 30
Censorship, 38, 41, 90
Celestial Mechanics, 51, 93
Clocks, 8, 10
Chemical & Engineering News, 39, 40, 41, 91
Chile, 29
China Syndrome, 33
Classical Physics, 4, 22, 82, 83
Climate of Opinion, 37, 51, 54
Columbia University, 19, 93
Common Denominator, 83
Congress, U. S., 34
^{60}Co, 53, 63, 68
^{133}Cs, 9, 10, 11, 66
^{137}Cs, 54, 63, 68
Cosmic Matter, 83
Current, Electrical, 15
Current, Neutral, 58
Cyanogen lines, 97
Cyclotron, 85
Decay rates, 63, 66
Decay rates, Induced changes in, 54, 63, 64, 65
Disintegration constant, 63, 64, 66
Dogma, 56
Doppler Shift, 76, 83
Duquesne University, 20

e° (Heuon), 55, 56, 57, 58, 59, 65, 79, 81, 82, 85
Earth's velocity, 10, 55
Earth, velocity in galaxy, 10, 55, 76
Eclipse, 100, 101
Einstein, Albert, 13, 16, 24, 25, 59, 96, 101, 103, 104, 105, 106, 107
Electrons, 66, 81, 83
Electron, uncharged, See e°
Electric Field, 51, 52, 71, 74
Electric power, 89
Electromagnetic radiation (3.5 cm), 55, 76, 82
Electromagnetic Fields, 15, 73, 84
Electroscope, 53, 63
Electrostatics, 52
$E = Mc^2$, 18, 41, 58
Energy density, 55
Environmental blight, 33
Ether, 18, 24, 32, 42, 49, 54, 59, 73, 76, 77, 79, 94, 95
Ether drift, 54, 74, 95
Ethics, 43, 91

Fads, 1
Fashions, 1
Feynman Mechanisms, 54
Fire Ball, 33
Fission, 33, 63
Fission, Bombs, 24
Fission Power, 89
Fission Products, 63
Fission Reactors, 43, 63, 85, 89
Flying clocks, 8, 11
Fitzgerald-Lorentz Contraction, 79, 83
Frame of Reference, 10, 31, 84
Fusion, 32, 58, 64

Galactic Center, 55, 76
Galactic coordinates, 76, 82
Galactic motion, 10, 77, 78, 82
Games, 11, 42
Geometries, Non Euclidean, 11, 18, 19, 104
GNP, 41, 51
Goldstone particle, 83
Gravity, 84, 100, 101, 105
Gregorian University, 20

^2H, 57
Half life, 31, 32, 53
Hidden variables, 75
Hoaxes, 21
Increase in Mass, 23
Information Explosion, 34, 39, 51, 59
Industrial Research, 39, 41, 91
Inertia, 84
Intellectial inertia, 59
Interferometer, 75, 76, 78
Italian Physics Society, 42

Japan, 24
Johns Hopkins University, 19

Lasers, 11, 77
Le Chatelier Principle, 55
Leptons, 49, 55
Light, velocity of, 57, 21
Linear resonant systems, 54, 63
Lorentz Transformation, 8

Macrocosmos, 4
Magnetic Fields, 52, 74
Magnetism, 84
Malaise of Crisis, 59
Manhattan Project, 24, 29, 30, 32
Mass, 86
Mass increase, 74, 83, 84, 85
Mass-Energy, Interconvertability (See $E = Mc^2$)
Masers, 77
Mathematical games, 15, 16
Mathematics, 15, 16
Mathematics, Metaphysical, 15, 16, 17
Maxwell's Equations, 3, 73, 79
McCarthyism, 38
Medium, Finite, 79
Melt Down, 33
Mercury, 94
Meson, 8, 11, 64, 66
Metaphysics, (See Philosophy and Mathematics)
Metaphysical Mathematics, 17, 42
Microcosmos, 4
Michelson-Morley experiments, 20, 22, 54, 75, 76, 79, 95, 106
Minkowski, space-time, 20
MIRVA, 43
Models, conceptual, 51, 63, 73, 74
Moderators, 85
Morality, Scientific, 25, 33, 41
Mt. Wilson Observatory, 94, 97, 98
Murphy's Law, 32

N A S A, 9
Nazi Axis, 29
Neuon, See e°
Neutral currents, 71
Neutron, 56, 79, 84, 85
Neutrino, electron, 49, 57, 58, 65, 78, 79, 85
Neutrino flux, 68, 74, 84
Neutrino, Muon (e°) See e°
Neutrino sea, 10, 11, 29, 42, 55, 66, 74, 76, 77, 78, 84
Neutrinos, solar, 66
New York Herald Tribune, 99, 101
New York Times, 100, 101
Nobel Prize, 3, 17, 25, 39, 40, 75, 76
Nuclear Accident, 29, 30, 33
Nuclear "club", 29

Nuclear disasters, 11, 32, 34
Nuclear explosion, 30, 34, 43
Nuclear safety, 34
Nuclear power, 33, 56, 63
Nuclear reactors, 42
Nuclear weaponry, 32, 34

Oak Ridge Laboratories, 25
Optiks, (Newton), 23
Overkill, 32, 33
Ozone, 33

Pakistan, 29
Paradigms, 35, 59
Parametric excitation, 55, 63
Particle density, 55
Peer Review, 16, 35, 37, 38, 39, 41
Perihelion of Mercury, 93
Periodic table, 3
Philosophy, 16, 17
Photoelectric effect, 17
Plutonium (^{239}Pu), VIII
Positron (e^+), 3
Potsdam, 99, 100
Princeton University, 20
Prussian Academy Science, 100
Psychology, 100

Quasi-religious faith, 17, 25, 53
Quantum Mechanics, 43

Radioactivity, 52, 61, 63, 65, 66, 68
Relativity, 3, 4, 17, 18, 20, 22, 73, 84, 100, 103, 104, 107
Religion, 104
Resonance, 85, 86
Review Processes, 35, 40, 43
Ridicule, 44
Riemann (Geometry), 104
Roman Empire, 89

Sacred Cow, 21
Safety Limits, VII
Satellite, 9
Science, 35, 37
Science Digest, 91
Science, a Sacred Cow, 21
Scientific American, 58
Scientific Method, 16, 37, 41
Scientific Revolutions, 59
Set-Mouse Trap Syndrome, 55, 63
Sobral, 93
Solar Lines, 97
Solvay Congress, 24
Space-Ship Earth, 33
Spintrascope, 53, 63
Spontaneous disintegration, 52, 53, 54, 56, 61, 63, 64
Spontaneous generation, 52, 54, 56
Space-Time (See Minkowski)
^{90}Sr, VII
Stability index, 54, 55, 63
State of the Union, 34
Status quo, 44
Subquantic Medium, 4, 18, 24, 32, 42, 49, 55, 59, 63, 71, 75, 76, 80
Sumatra, 99, 100
Supernova, 27, 33

Thermodynamics, 43
Thermal energies, 85
Thought control, 35, 38, 39
Time, 5, 9, 100
Time's Arrow, 7
Time, Astronomic, 9
Time Bombs, 8, 51, 52
Time Machine, 7
Time Dilation, 7, 8
Time Reversal, 5, 7, 18, 42
Trinity, Camp, 30, 106
Twin Paradox, 8, 9, 11, 42

Ultimate Catastrophe, 29, 30
United Nations, 34
Uranium, 38, 43

Velikovsky Affair, 38, 43
Velocity of Light, 75, 76
Venus, 93

Wall of Knowledge, 51
Wall Street, 21
Washington, D. C., 11
Western Europe, 29
World War II, 51

ABOUT THE AUTHOR

DUDLEY, HORACE C (HESTER), b. St. Louis, Mo. June 28, 09; m. 35, 54; c. 4. PHYSICS, RADIOBIOLOGY. A.B., Mo. State Teachers Col. 31; Maryland, 31-34; Hopkins, 35-36; Ph.D. Georgetown, 41. Lab. asst. U. S. Bur. Standards, 31-32; jr. chemist, bur. chem. U. S. Dept. Agr. 33-34; med. res. div. Chem. Warfare Serv. 34-36; biochemist, U. S. Pub. Health Serv. 36-42; head allied sci. sect. Med. Serv. Corp. U. S. Navy, 49-52, in charge biochem. div. Naval Med. Res. Inst. 47-52, head radioisotope lab. Naval Hosp. St. Albans, N. Y. 52-62; prof. physics & chem. dept. Southern Mississippi, 62-69; PROF. RADIATION PHYSICS, UNIV. ILL. MED. Ctr. 69- Res. collab. Brookhaven Nat. Labs. 52-57; consult. Oak Ridge Inst. Nuclear Studies, 48-57; L. I. Jewish Hosp. 57-61. Dipl. Am. Bd. Health Physics, 60. U.S.A.R., 31-42; U.S.N., 42-62, Capt.; Bronze Star, 45, Navy Commendation Medal, 46. Fel. AAAS; Health Physics. Soc.; Am. Phys. Soc.; Am. Asn. Physics Teachers; Am. Asn. Physicists Med. Biochemistry; radioactive isotopes; nuclear theory; theory of neutrinoflux as generalized sub-quantic medium; radio biology. Address: Dept. of Radiology, University of Illinois at the Medical Center, Box 6998, Chicago, IL 60680.

—*American Men and Women of Science.*, 12th ed., p. 1544.
(R. R. Bowker, Co.: N. Y., 1972)

For further information, to pass on comments, or to order additional copies at $5.00 (US), Postpaid – Address:

RADSAFETY ASSOCIATES
PUBLICATIONS AND CONSULTING ON
ALL ASPECTS OF RADIATION SAFETY
P. O. BOX 452
HINSDALE, ILLINOIS 60521