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FOIA MARKER

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Record Group/Collection: George H.W. Bush Presidential Records
Collection/Office of Origin: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: General Science Files

OA/ID Number: 62040
Folder ID Number: 62040-008

Folder Title:
Life Sciences: Radiation/Electro-Magnetic Fields [2 of 2] [1991]

Stack:	Row:	Section:	Shelf:	Position:
	0	0	0	0

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION

DOCUMENT NUMBER: 9120986

FROM: GUTOWSKI, M/M Roy

TO: DR. BROMLEY

DATE OF
CORRESPONDENCE: 03/29/91

SUBJECT: CONCERN ABOUT THE FEDERAL GOVERNMENT'S LACK OF
ACTIVITY ON THE ISSUE OF ELF EMISSIONS FROM
PERSONAL COMPUTER MONITORS.

ASSIGNED TO:

ACTION REQUIRED:

SENDER'S DUE DATE:

OSTP DUE DATE:

DATE COMPLETED:

COPIES TO: Life Sciences

WHITE HOUSE TRACKING #:

CONTACT PERSON:

REMARKS:

DATE RECEIVED: 04/03/91

FILE: 9- LIFE SCIENCES: ~~ELF~~ - RADIATION / EMP



9120980
RECEIVED

4032 Inglewood Blvd.
Mar Vista, CA 90066
March 29, 1991

OFFICE OF THE
DIRECTOR

Dr. D. Allan Bromley
Science Advisor To The President
Office of Science and Technology Policy
Old Executive Office Building #358
Washington, D.C. 20506

Dear Dr. D. Allan Bromley,

I am writing to you to express my concern about the federal government's lack of activity on the issue of ELF (extremely low frequency) emissions from personal computer monitors. I urge you to direct the appropriate groups within the Food and Drug Administration, the Environmental Protection Agency, OSHA, NIOSH, and the Department of Energy to develop an interim standard that will limit the exposure of users of personal computers to ELF emissions.

Sincerely,

Roy Gutowski

Mr. & Mrs. Roy Gutowski

"LIFE SCIENCES (CORRESPONDENCE TRACKING)"

TYPE: INFORMATION DOCUMENT NUMBER: 9120724
ORIGINATOR: 02 STATUS C DIRECTORATE STATUS C

FROM: DARBY, Richard

TO: DR. BROMLEY

DATE OF
CORRESPONDENCE:

SUBJECT: RESEARCH FINDINGS RELATED TO EMF AND DISEASE.

DIRECTORATE STAFF
ASSIGNED: LIFE SCIENCES ASSIGNED: LIFE SCIENCES

ACTION STAFF
REQUIRED: REQUESTS REVIEW ACTION:
OF FINDINGS

SENDER'S DUE DATE:
OSTP DUE DATE: STAFF DUE DATE
DATE COMPLETED: DATE COMPLETED/DEPT:08/08/91

COPIES TO: D. Allan Bromley

WHITE HOUSE TRACKING #: CONTACT PERSON:
PHONE: EXT:
REMARKS: Personal letter attached to DAB's copy; Bromley then asked
Henderson and Wong to see and discuss -- DAB said no answer was
necessary and to close record out.

OSTP RECEIVED: 03/12/91
DEPT RECEIVED:

FILE: P-LIFE SCIENCES-RADIATION/EMF

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION

DOCUMENT NUMBER: 9120724

FROM: DARBY, Richard

TO: DR. BROMLEY

DATE OF
CORRESPONDENCE:

SUBJECT: RESEARCH FINDINGS RELATED TO EMF AND DISEASE.

ASSIGNED TO: Life Sciences

ACTION REQUIRED: REQUESTS REVIEW
OF FINDINGS

SENDER'S DUE DATE:

OSTP DUE DATE:

DATE COMPLETED:

COPIES TO: D. Allan Bromley

WHITE HOUSE TRACKING #:

CONTACT PERSON:

REMARKS: Personal letter attached to DAB's copy.

DATE RECEIVED: 03/12/91

FILE: P- LIFE SCIENCES ~~EMF~~ - RADIATION/EMF

Withdrawal/Redaction Sheet

(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
01. Letter	To: Allan Bromley From: Richard Darby Re: Research Findings related to EMF and disease [personal information redacted] (3 pp.)	3/12/91	(b)(6)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: General Science Files
WHORM Cat.:
File Location: Life Sciences: Radiation/Electro-Magnetic Fields [2 of 2] [1991]

Date Closed:	3/17/2010	OA/ID Number:	62040-008
FOIA/SYS Case #:	2005-0336-F	Appeal Case #:	
Re-review Case #:		Appeal Disposition:	
P-2/P-5 Review Case #:		Disposition Date:	
AR Case #:		MR Case #:	
AR Disposition:		MR Disposition:	
AR Disposition Date:		MR Disposition Date:	

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P-1 National Security Classified Information [(a)(1) of the PRA]
P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
P-3 Release would violate a Federal statute [(a)(3) of the PRA]
P-4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
P-5 Release would disclose confidential advice between the President and his advisors, or between such advisors [(a)(5) of the PRA]
P-6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Removed as a personal record misfile.

Freedom of Information Act - [5 U.S.C. 552(b)]

(b)(1) National security classified information [(b)(1) of the FOIA]
(b)(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
(b)(3) Release would violate a Federal statute [(b)(3) of the FOIA]
(b)(4) Release would disclose trade secrets or confidential or financial information [(b)(4) of the FOIA]
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(b)(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION

DOCUMENT NUMBER: 9120748

FROM: ADAIR, Robert K.: YALE UNIVERSITY ;

TO: DR. BROMLEY

DATE OF
CORRESPONDENCE: 03/10/91

SUBJECT: THE EFFECTS OF ELF FIELDS

*EMF file
Scalled to h
March 31/91*

ASSIGNED TO:

ACTION REQUIRED:

SENDER'S DUE DATE:

OSTP DUE DATE:

DATE COMPLETED:

COPIES TO: D. Allan Bromley
Life Sciences

GENE WONG

WHITE HOUSE TRACKING #:

CONTACT PERSON:

REMARKS:

DATE RECEIVED: 03/15/91

FILE: P-LIFE SCIENCES-RADIATION/EMF

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION

DOCUMENT NUMBER: 9120748

FROM: ADAIR, Robert K.: YALE UNIVERSITY

TO: DR. BROMLEY

DATE OF
CORRESPONDENCE: 03/10/91

SUBJECT: THE EFFECTS OF ELF FIELDS

ASSIGNED TO:

ACTION REQUIRED:

SENDER'S DUE DATE:

OSTP DUE DATE:

DATE COMPLETED:

COPIES TO: D. Allan Bromley
Life Sciences

WHITE HOUSE TRACKING #:

CONTACT PERSON:

REMARKS:

DATE RECEIVED: 03/15/91

FILE: LIFE SCIENCES

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION

DOCUMENT NUMBER: 9120748

FROM: ADAIR, Robert K.: YALE UNIVERSITY

TO: DR. BROMLEY

DATE OF
CORRESPONDENCE: 03/10/91

SUBJECT: THE EFFECTS OF ELF FIELDS

ASSIGNED TO:

ACTION REQUIRED:

SENDER'S DUE DATE:

OSTP DUE DATE:

DATE COMPLETED:

COPIES TO: D. Allan Bromley
Life Sciences
Dr. Wong

WHITE HOUSE TRACKING #:

CONTACT PERSON:

REMARKS:

DATE RECEIVED: 03/15/91

FILE: LIFE SCIENCES

Withdrawal/Redaction Sheet

(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
02a. Letter w/attachments	To: Allan Bromley From: Robert Adair Re: Richard Wilson's proposal to DOE [DOE Proposal Evaluation forms attached] (9 pp.)	3/10/91	(b)(6)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: General Science Files
WHORM Cat.:
File Location: Life Sciences: Radiation/Electro-Magnetic Fields [2 of 2] [1991]

Date Closed:	3/17/2010	OA/ID Number:	62040-008
FOIA/SYS Case #:	2005-0336-F	Appeal Case #:	
Re-review Case #:		Appeal Disposition:	
P-2/P-5 Review Case #:		Disposition Date:	
AR Case #:		MR Case #:	
AR Disposition:		MR Disposition:	
AR Disposition Date:		MR Disposition Date:	

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personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of
gift.

PRM. Removed as a personal record misfile.

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(b)(4) Release would disclose trade secrets or confidential or financial
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purposes [(b)(7) of the FOIA]
(b)(8) Release would disclose information concerning the regulation of
financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

Withdrawal/Redaction Sheet

(George Bush Library)

Document No. and Type	Subject/Title of Document	Date	Restriction	Class.
02b. Letter	To: Nathaniel Barr From: Richard Wilson Re: Reviews of proposal to DOE [personal information redacted] (7 pp.)	2/14/91	(b)(6)	

Collection:

Record Group: Bush Presidential Records
Office: Science and Technology Policy, Office of (OSTP)
Series: Bromley, D. Allan, Files
Subseries: General Science Files
WHORM Cat.:
File Location: Life Sciences: Radiation/Electro-Magnetic Fields [2 of 2] [1991]

Date Closed:	3/17/2010	OA/ID Number:	62040-008
FOIA/SYS Case #:	2005-0336-F	Appeal Case #:	
Re-review Case #:		Appeal Disposition:	
P-2/P-5 Review Case #:		Disposition Date:	
AR Case #:		MR Case #:	
AR Disposition:		MR Disposition:	
AR Disposition Date:		MR Disposition Date:	

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

P-1 National Security Classified Information [(a)(1) of the PRA]
P-2 Relating to the appointment to Federal office [(a)(2) of the PRA]
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(b)(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
(b)(9) Release would disclose geological or geophysical information

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION

DOCUMENT NUMBER: 9120131

FROM: KORN, DAVID

TO: DR. BROMLEY

DATE OF
CORRESPONDENCE: 01/17/91

SUBJECT: ASPECTS OF THE EMF CONTROVERSY DEALING WITH PUTATIVE
CARCINOGENICITY

ASSIGNED TO: D. Allan Bromley

ACTION REQUIRED:

SENDER'S DUE DATE:

OSTP DUE DATE:

DATE COMPLETED:

COPIES TO: Nancy Maynard
Alicia Dustira

WHITE HOUSE TRACKING #:

CONTACT PERSON:

REMARKS:

DATE RECEIVED: 01/19/91

FILE: ~~CANCELLED DRAFT RPT~~

P- LIFE SCIENCES/RADIATION/EMF

D- LIFE SCIENCES - EMF

[REDACTED]



STANFORD UNIVERSITY MEDICAL CENTER

STANFORD, CALIFORNIA 94305-5302

David Korn, M.D.

Carl and Elizabeth Naumann Professor
Vice President and Dean

Stanford University School of Medicine
Room M 121
(415) 723-6436

January 17, 1991

Dr. D. Allan Bromley
Science Advisor to the President and
Director, Office of Science and Technology Policy
Old Executive Office Building, Room 360
17th and Pennsylvania Avenue, N.W.
Washington, D.C. 20506

Dear Allan:

Sometime last spring, Bob Charrow, whom I had gotten to know rather well while he was Deputy General Counsel for the Department of HHS, asked me whether I might have any interest in reviewing the data base on power frequency EMFs and expressing an opinion about the issues of putative health hazards. From my own areas of professional interest, and from the experiences I have had as Chairman of the National Cancer Advisory Board, especially with the Environmental Carcinogenesis Subcommittee of that Board, I was somewhat familiar with the EMF issues, but little did I know what a political thicket I was about to enter! I am enclosing for your interest copies of two brief pieces that I have prepared, which express my views on those aspects of the EMF controversy that deal with putative carcinogenicity. The first piece, entitled "Cancer Science and Cancer Policy" was part of a collection of essays prepared by experts that were offered last June to the EPA in a hearing that I did not attend. The second piece represents the testimony that I delivered at the more recent EPA hearing on January 14, which was concerned with a discussion of the EPA Draft Report. In preparation for the latter hearing, I spent a good deal of time reading the Draft Report in detail and looking, in addition, at some of the major source materials.

The enclosures accurately represent my views about this matter, but they really cannot begin to express the indignation I felt during the many hours I sat and listened to the presentations at the January 14 event. Most of that day was devoted to EPA staff review of the several chapters of the Draft Report, and most of the critical comment was scheduled to be delivered on January 15 and 16, during sessions that I could not attend. I was dismayed by the extraordinary efforts exhibited by many of the EPA staff commentators to strengthen an extraordinarily weak data base in an attempt to derive biological plausibility and causal inferences where none, to my mind, existed. As I stated at the hearing, I do not purport to be an epidemiologist; but I do not think one has to be an

Dr. D. Allan Bromley
January 17, 1991
Page 2.

epidemiologist to recognize how weak and "noisy" the available epidemiological data are in fact. As far as the biological data are concerned, they represent, in my view, an assortment of entirely descriptive, phenomenological observations, almost none of which has yet been reproduced, and most of which have been carried out under conditions of physical stimulation that almost defy efforts at reproducibility. Clearly, the issue of biological plausibility is important here, not only as a general consideration with respect to the interpretability of epidemiological data, but in this instance in particular, given the inherent weaknesses in those epidemiological data themselves.

I realize that you have earlier expressed your own concerns about the form and substance of these EPA studies, and it is for that reason that I thought you might be interested in reviewing the materials I have enclosed. As I indicated, I was not able to stay for the second and third days of the EPA hearing, but based on what I did endure during the first day of the event, I would suggest that the matter merits your close attention.

Sincerely,

A handwritten signature in cursive script that reads "David Korn". The signature is fluid and elegant, with a large initial "D" and a long, sweeping underline.

David Korn, M.D.

DK/sp

Enclosures

EPA Hearing on ELF (Power Frequency) EMF'S

January 14, 1991
David Korn

Introduction

I'd like to thank you for the opportunity to appear today at this meeting to offer some comments on the EPA Draft Report and the difficult question of power frequency EMF's and their putative effects on biological systems -- especially, on the issue of whether such fields may be potentially carcinogenic.

I wish to make clear that although I am the Dean of the Stanford University School of Medicine and have been serving as chair of the NCAB since March 1984, my opinions and comments are my own and do not represent the views of Stanford University, the NCI or the NCAB. Nor do they represent the views of the Health Sciences Group, which originally asked me whether I would be willing to review this matter and express an opinion on the underlying scientific and policy issues.

I know that you have received a copy of an essay I prepared last summer entitled "CA Science and CA Policy"; and although that paper was written before I had the chance to study the latest (October 1990) draft of the EPA Report, I believe now, having reviewed the EPA Draft, that the major points I attempted to make in my brief paper remain valid and continue to reflect my views.

In my paper, I attempted first to summarize some of the remarkable progress that has been made in basic biomedical research during the past two decades, which has dramatically opened and illuminated the mysterious "black

box" that represented our knowledge of the neoplastic processes prior to 1990. We have indeed been able to make enormous advances in probing the most intimate details of the genetic regulation of cell growth and differentiation, and in beginning to unravel the incredibly complicated intracellular and intercellular communications networks that accomplish cellular and tissue homeostasis. From this wealth of scientific advancement we have been able to reorganize two major types of genetic abnormalities that appear to be fundamental to the initiation and progression of neoplastic changes:

1. The abnormal activation and expression of oncogenes (or CA genes) due to one or another form of mutational change -- i.e., due to some form of injury to the DNA -- that by itself, or in concert with further derangements introduced by the activation of cellular repair processes -- results in a heritable alteration of the cell's genome. These changes, in every case studied to date, can be said to lead to the turning on of some key process in a regulatory chain of events and to the loss of the normal modulation of that process that is essential to normal cellular behavior.

2. The second form of genetic damage leads to the abnormal inactivation of genes that are normally turned on and function to suppress or restrain critical cell processes that, to date, all appear to be involved in triggering the entry of a cell into the mitotic cycle; most of these processes seem directly to be involved in the initiation of DNA synthesis. This second family of genes have been dubbed "CA Suppressor Genes" -- and progress in identifying them and elucidating their molecular bases of activity is advancing rapidly.

The unfolding of our knowledge of CA genetics has importantly clarified previously obscure processes of CA "initiation" and CA "promotion": Agents that initiate CA invariably do so by causing damage to DNA -- e.g., ionizing radiation, UV radiation, genotoxic chemicals like polyaromatic hydrocarbons; certain classes of viruses; etc. Similarly, CA promoting agents are a diverse variety of agents that lead to cellular proliferation and provide the opportunity both for the expression of the initiating genetic damage and for the accumulation and outgrowth of subsequent genetic abnormalities that seem to occur in progressive and sequential patterns. From this conceptual framework, it is clear that many promoting agents are in fact agents that cause cell and tissue injury, thereby leading to cell proliferation and repair efforts. Accordingly, with respect to such agents, as it is now becoming quite clear, issues of "toxicity" confound assessments of "carcinogenicity" and raise vexing and presently unresolved problems of "thresholds" -- a matter of substantial controversy in the present public policy arena.

I believe from all of the documents of which I am aware that there is no evidence whatsoever that 60 Hz EMF cause genetic damage; none of the cited biological experiments noted either in the OTA or in the Draft EPA Reports supports the interpretation that such EMFs are CA initiating agents; nor do they provide any support for the hypothesis that such EMFs may be CA promoting agents. To be fair, it should be acknowledged that both reports recognize the absence of evidence for CA initiation processes. But in their rather encyclopedic reviews of the potpourri of published biological data, single and

non-reproduced phenomenological observations, that have no mechanistic context of any kind that I can recognize, are from time to time interpreted with excessive generosity in attempting to reach possible relevance with known CA initiating and promotional events and to thereby infer "biological plausibility." I think these efforts are extraordinarily speculative; they badly strain credulity, and they weaken the quality of what is otherwise a commendable effort of data accumulation and evaluation.

In reviewing these materials, I continue to be troubled by the remarkable lack of specificity or reproducibility of the applied physical stimuli, and distressed by the absence of any interpretable dose-response relationships. Although the postulated "window phenomenon" is an interesting a posteriori construct to try to get around this perplexity, it really does not help much in trying to understand either a physical or a biological basis for the several modest and entirely descriptive biological effects that have been observed.

Accordingly, I believe that no biologically plausible mechanism has been articulated -- or demonstrated -- by which 60 Hz EMF might initiate or promote CA. The existence of such plausible mechanisms, based on sound biological and pathological principles, is always important in evaluating potentially injurious agents -- including potential carcinogens; and the absence of such mechanisms is of especial concern and calls for especial caution in attempting to evaluate complex epidemiological studies.

As I noted in my earlier essay, epidemiology is an important area in the biomedical sciences in that it deals with human populations in "the real world," and as such, may generate important clues for further study and development. On the other hand, however, epidemiology is fundamentally an observational science, and the topics of interest are often complex and multifactorial, thus leading to a high intrinsic susceptibility to misinterpretation, confounding, bias and frank error. I believe that the credibility of epidemiologic data depends importantly on their consistency, their coherence, their reproducibility -- and to the extent to which suggested associations and correlations conform with established biological and pathological principles of relevance to the disease state of interest. Absent such conformance, it becomes more difficult to distinguish bona fide relationships from spurious statistical associations.

The literature presents many controversial studies of this kind, some of them of many-years duration, in which disagreement and inconclusiveness remain -- e.g., caffeine (coffee) studies; studies of effects of fiber on cardiovascular or CA end-points (the recent controversy over bran); arguments about the potential costs and benefits of replacement hormone therapy in post-menopausal women -- and this, by the way, is one of the reasons that the FDA has been so extremely chary about using such data to endorse the advertising of alleged health-benefits on packaged foodstuffs.

On the basis of my review of the data assembled in the EPA Report, and in earlier reviews, I do not believe that the case for the potential carcinogenicity of 60 Hz EMF has yet been made in any kind of convincing fashion. I believe the

available data are extremely "soft" and "noisy"; that bias, confounding and chance have not been adequately ruled out; that the reported studies are highly inconsistent -- a fact, by the way, that may directly result from the lack of clear definitions of "exposure" and the remarkable absence of measurement in many of the published studies. The absence of quantitative definition; the retrospective nature of most of the studies (perhaps all of them); the relatively small numbers of cases and low statistical power; the marginally significant and low Relative Risk Ratios -- where the 95% confidence intervals in so many instances include a boundary term <1.0 -- all of these factors, to my mind, can only lead to the conclusion that no inference of 60 Hz EMF causation of CA can presently be supported.

Others in this hearing will be far more expert than I about the design and interpretation of such epidemiological studies, and in their ability specifically to address the shortcomings in the diverse group of papers that have been cited in the EPA Draft Report.

Clearly, it must be recognized that although the evidence to date does not support the conclusion of causal relationship between 60 Hz EMFs and human neoplasia, neither does that evidence permit one conclusively to rule the possibility out. The problem is scientifically intriguing -- and what is needed is additional, high-quality research. For example, in my earlier paper, I noted the large prospective study of childhood ALL that has recently been launched by the NCI and the CCSG, a study that will focus on incidence, not on mortality,

and one that proposes strong measurement components. Surely, other such studies would be most welcome.

Beyond these, however, it seems to me important that more rigorous basic research ought to be initiated as well. To my mind, there is still no plausible biological model to explain how ELF EMFs might interact with biological systems. For example, what might be a plausible mechanistic basis for a "window-phenomenon"? What, if any, mechanisms might exist that could result in energy transfer between ELF EMFs and biological systems? If purported membrane interactions might be of interest, there are powerful model systems and new technologies that could be used to design some novel experimental approaches that might ask specific questions and even provide some definitive answers. What I think we do not need, however, are more poorly designed descriptive studies, which, in the absence of plausible mechanistic hypotheses, will result in little more than additional "stamp-collecting" of dubious value.

I offer two concluding comments:

1. The EPA Draft Report should be modified to make its conclusions fit more closely the data and its own textual evaluations of that data -- which are often quite thoughtful. In its present form, it supports interpretations about a potential CA link that I believe are unwarranted and unsupported by the research to date -- or by our present framework of knowledge about CA causation.

2. One must clearly be especially cautious when evidence derived principally or solely from epidemiological studies provides the basis of proposals for important decisions in the area of health policy -- in the present instance, of cancer regulatory policy. It is certainly incumbent upon us to take appropriate steps to protect the public health and well-being; but the consequences of inappropriate or premature action based on speculation, on inadequate analysis, or on non-validated hypotheses can be enormous with respect to the expenditure of public funds and the magnitude of disruptive interposition into widespread and well-established patterns of social and economic behavior.

The potential linkage of power frequency EMF and CA has neither been demonstrated nor conclusively eliminated from possibility. More study is needed, and of a much more focussed, rigorously designed and higher scientific quality than characterizes the bulk of the work reported to date.

Cancer Science and Cancer Policy

David Korn, M.D.
Vice President and Dean
Stanford University School of Medicine

Since the enactment of the National Cancer Act and the launching of the National Cancer Program in 1972, we have made remarkable advancements in illuminating fundamental aspects of cell growth and differentiation and in beginning to unravel the complex abnormalities that lead to the spectrum of human diseases that we call "cancer." These advancements have been reflected through striking accomplishments in the fundamental biomedical sciences -- in biochemistry, molecular biology, molecular genetics, immunology, virology, and others -- which, taken together, have revealed an enormous wealth of detail about the most intricate workings of the highly interdigitated subcellular systems that function ordinarily to accomplish normal cell growth and differentiation.

Perhaps the most noteworthy of these achievements relates to the area of cancer genetics, where, during the past decade, beginning with seminal experiments with a few retroviruses known to cause malignancies in animals, it has become clear that a major underlying phenomenon in all cancer is a set of genetic abnormalities that have led to the recognition of "cancer genes" (oncogenes) and "cancer suppressor genes." Cancer genes may develop in cells through a number of different mechanisms: many cancer genes arise from alteration of normal genes essential to the life process by the phenomenon of mutation. Such mutations may be recessive and transmissible by inheritance, in which case they are present in every cell of the body, or they may arise as a result of postnatal insult caused by an agent, chemical or physical, known to

damage the genetic material, DNA. In the latter instance, the damage leads to the production of a dominant mutation and tends to be localized to particular cells and particular tissues, depending both on the nature of the inciting agent and what, if any, mechanisms the exposed individual may possess for metabolizing the inciting agent. Other mechanisms that are now recognized commonly to lead to the formation of "cancer genes" involve kinds of chromosomal damage that lead to the deletion, the rearrangement or the translocation of portions of DNA from a normal site of residence within a particular chromosome to some abnormal site where that particular piece of DNA is not normally found. As a consequence of the latter class of changes, delicate systems of genetic control, that may be thought of as switches regulating the turning on and the turning off of particular genes, become deranged; and as a consequence, specific genes may be turned on inappropriately, and often maintained in a permanent "on" state that leads to unrestrained cell multiplication.

The behavior of "cancer suppressing genes," although less completely described, can be thought of in the opposite sense: cancer suppressing genes are genes that are normally present in our cells, which function as part of master regulatory circuits to maintain in the "off" position specific genes or sets of genes that would otherwise drive the cell into inappropriate and uncontrollable multiplication.

The identification of oncogenes led naturally to a search for the abnormal products of those genes, and that search has in turn revealed the existence of an incredible array of protein molecules and structures that comprise an

elaborate communications system, within and between cells, that is essential for normal cell and tissue growth and differentiation. Some of these molecules function as "messenger elements," acting either locally, regionally or over relatively large distances; other molecules constitute links in intricate cascades of amplifying or dampening regulatory signals that are involved in stimulating or stopping cell division or in modulating cell maturation; while still other molecules are situated in or adjacent to cell membranes, where they serve as receptor elements (or transducers) for the transmissible messenger molecules. The pace of the science has been such that examples of almost every element of these complex regulatory schemes have been demonstrated as abnormal products resulting from a genetic aberration that leads to the activation of one or another cancer gene.

I emphasize these scientific principles to make the point that with this remarkable wealth of scientific clarification, many facets of the mystery of the "cancer black box" have become substantially illuminated during these past two decades. As a consequence, our understanding of many aspects of cancer causation ~~have~~^{has} become similarly more clarified, and, in particular, the established phenomena of cancer initiation and cancer promotion can now be understood far more clearly than before in terms of specific events that lead to particular changes that drive a cell into the malignant state.

In general, it is clear that "initiating agents" are invariably agents that cause permanent damage to the genetic material of a cell -- that is, to DNA. Such agents may be chemical or physical, and among the physical agents, the best established are either ionizing radiation or other forms of high energy

electromagnetic radiation (e.g., ultraviolet light) which, in every instance, can be shown to cause specific chemical or physical changes in target DNA.

"Promoting agents" seem to cause the accumulation of additional kinds of changes in DNA by a variety of routes; or they may act more directly on other discrete steps of the complex cellular regulatory system to perturb cellular homeostasis and lead to abnormalities in cell growth and cell differentiation. Numerous examples of these phenomena have now been identified both experimentally and in naturally occurring human cancers, where, for example, a progressive sequence of genetic changes can be correlated with progressive stages of cellular atypia, culminating ultimately in premalignant growths and frankly malignant cancers. The latter correlations, by the way, constitute one of the great validating triumphs of cancer genetics and represent a scientific breakthrough of fundamental importance.

Given this impressive record of scientific accomplishment, it is possible now to be far more precise and rigorous in designing protocols for studies in experimental carcinogenesis in general and in designing and interpreting epidemiological studies in particular, i.e., studies that aim to identify environmental factors and agents that may be involved in cancer causation. With the new insights into molecular mechanisms of carcinogenesis, it becomes possible to develop plausible biological hypotheses by which to explore the role of putative environmental factors in oncogenesis, both in prospective studies and in retrospective analyses. Epidemiology is, of course, an important area of the biomedical sciences in that it deals with human populations "in the real world," and as such, may generate important clues which, upon further

study and careful elaboration, may point to new directions for research or yield previously unsuspected insights about disease causation.

On the other hand epidemiology by its nature is largely a non-experimental science, that is, an observational one; and it is in the nature of epidemiological observation that the topic of interest is often highly complex and multifactorial, thus leading to a very high intrinsic susceptibility of misinterpretation or frank error. Accordingly, leading epidemiologists pursue their investigations with extraordinary care and rigor in order to minimize the probabilities of being misled by a host of factors indigenous to the structure of the study itself and to the resulting statistical manipulations of the collected data. Aside from such methodological concerns, the credibility of epidemiological data depends importantly on their consistency, their reproducibility, their coherence and the degree to which the suggested findings conform with established biological and pathological principles of relevance to the disease state under inquiry. Thus, an epidemiological study, however well designed, will not be convincing absent reasonable biological or pathological principles which can help to distinguish bona fide relationships from spurious statistical associations.

Such need for care in study design and execution, in data handling and interpretation, and in the drawing of inferences and conclusions is certainly not unique to epidemiology: indeed it is the fundamental stuff of the sound scientific method. But with respect to epidemiological studies, the need for such care is particularly compelling in light of the nature of the questions asked, the inherent limitations of study designs and the very significant probabilities of confounding, of bias or of irreproducibility. The biomedical literature is full of reports of intriguing, putatively causal relationships of factors to diseases, deduced from

carefully conducted epidemiological studies, that have simply proved to be irreproducible and ultimately, unsubstantiable.

These points must be given particularly weighty consideration when evidence derived principally or solely from epidemiological studies provides the basis of proposals for important decisions in the area of health policy in general, of cancer regulatory policy in the present instance. It is certainly incumbent upon us that we take appropriate steps to protect the public health and well being; but the consequences of inappropriate or premature action based on speculation, on non-validated hypotheses or inadequate analyses can be enormous with respect to the expenditure of public funds and the magnitude of disruptive interposition into patterns of common social and economic behavior. This admonition is particularly pertinent to the present evaluation being conducted by the EPA of the putative carcinogenicity of power frequency (50-60 Hertz) electric and magnetic fields (EMF). I offer this caution because this is an area of research that has not yet been examined sufficiently and validated by the research community and is certainly far from mature; an area that has nonetheless received wide-spread attention and is certainly capable of prompting wide-spread public concern; and an area in which an inappropriate or premature decision by the EPA could have profoundly adverse consequences for modern societies world-wide.

In forming this opinion, I have reviewed the papers of Wertheimer and Leeper, and of Savitz et al.; the background paper prepared by OTA and entitled "Biological Effects of Power Frequency Electric and Magnetic Fields"; the paper entitled "Evaluation of the Potential Carcinogenicity of

Electromagnetic Fields," prepared for the Office of Radiation Programs, EPA; and critical reviews prepared by Drs. Boutwell, Cole, and Labarthe, the latter two, respected cancer epidemiologists. I have also made additional independent inquiries of other experts.

On the basis of these readings and inquiries, I believe that the case for the potential carcinogenicity of power frequency EMFs is not convincing. The cited epidemiological studies, as Drs. Cole and Labarthe convincingly point out, are so subject to procedural and methodological challenge as to be essentially uninterpretable. Similarly, the scattered experimental studies that are cited in the OTA paper are predominantly single efforts that have not been replicated or systematically pursued to plausible or convincing conclusion. With respect to underlying pathobiological principles, it is clear that 60 Hz fields are non-ionizing and have not been shown to have any effects whatever on chromosome structure or DNA metabolism; certainly, therefore, they cannot be interpreted according to our current understandings of mutagenic or carcinogenic mechanisms. Neither is there evidence that such EMFs are capable of behaving as cancer initiators or cancer promoters. Perhaps most disturbing is the fact that there is no evidence in any of these studies of interpretable dose-response relationships, nor is it even clear that exposures can be defined or measured -- or even estimated -- with any kind of specificity or precision. Such problems of dosimetry are bad enough in the controlled laboratory environment; they totally confound efforts to attribute significant correlations, to say nothing of causal relationships, in epidemiological field studies conducted retrospectively.

In the absence of usual dose-response relationships, the concept of a "window phenomenon" has been proposed; and yet at our current state of knowledge of biology and biophysics, it is very hard to intuit the sorts of plausible biological or biochemical mechanisms might be at risk to such perturbations by "window effects." The OTA background paper, on page 67, summarizes the reviewed biological studies very well: "Current scientific understanding does not yet allow us to interpret the evidence in a single coherent framework. Even more frustrating, it does not yet allow us to draw definite conclusions about questions of possible risk or to offer clear science-based advice on strategies to minimize or avoid potential risks."

Earlier in that paper, on page 25, the text states: "Although a number of high-quality experiments have been performed in the last decade, we still do not have enough robust, replicated results to build a coherent scientific or phenomenological picture of the spectrum of effects and we are far from having a good theoretical model . . . in the field of biological effects of ELF fields, there are not yet theories to make firm hypotheses and test them. Therefore, some of the experiments described in this paper are attempts to see if there are any effects at all. Other experiments examine if there are simple hypothetical connections between experimental observations and possible health effects. We are not at the stage where experiments can be designed to test hypotheses based on a coherent framework."

In light of those appropriately conservative reflections, it is disappointing and surprising, again in the OTA background paper on page 67, to review the summary points regarding the putative relationship of ELF fields to cancer

promotion. These summary points are remarkably insubstantial and excessively speculative; for example, to reach from the exceedingly tentative suggestion that ELF fields may somehow affect cell membranes to the conclusion that these fields may cause cancer by disrupting cellular communication systems, or to try to correlate such speculation with known facts about messenger molecules and membrane-based messenger receptors is certainly unacceptable scientifically and is of dubious logic.

It is my opinion that the question of the possible roles of power frequency EMFs in human health and disease remains open, but it is certainly not one in which there is anything approaching convincing evidence in support of positive conclusions of disease causality. That is especially true with respect to the relationships of such EMFs to carcinogenicity. Speculations about these matters do abound, and further careful testing of plausible theories ought certainly to be encouraged. In this respect, I note that the National Cancer Institute is proposing, in collaboration with the Children's Cancer Study Group, a large scale collaborative investigation to determine if low frequency EMF exposure contributes to the development of acute lymphocytic leukemia (ALL), which comprises about 85% of all childhood leukemias in the United States. The proposed study will involve about 1,000 ALL cases and 1,000 matched controls, it will be prospective, it will look at incident cases and it will have a strong measurement component. This NCI-supported investigation appears to be precisely what this perplexing question requires -- sound further investigation, both epidemiological and biological, to obtain a stronger database from which to form testable hypotheses and judgments that might eventually lead to sound policy recommendations. Absent that database,

absent sound biological or pathological underlying principles, and given the fragmentary and insubstantial state of the body of evidence that has been adduced to date, I believe that the evidence of the possible carcinogenicity of EMFs is vastly insufficient to support any kind of sound decision-making with respect to new cancer regulatory policy.

/sp

**EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506**

January 23, 1991

D.A. Henderson:

Please review the attached material and advise as to whether it would be worth Dr. Bromley's time to review it and respond, or whether Alicia or someone could respond to the letter. Perhaps you could verbally brief Dr. Bromley at some point, and have Alicia send a thank you note to Dr. Korn.

Thank you.

Ken Yale

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

January 31, 1991

Dear David,

Thank you for your thoughtful letter regarding the scientific evidence pertaining to EMF and risk. Your paper on "Cancer Science and Cancer Policy" clearly documents the problem. Sound policy, especially that which has far-reaching consequences, demands sound science.

I was glad to hear from you on this issue and I look forward to keeping in touch.

Sincerely yours,

A handwritten signature in dark ink, appearing to read 'D. Bromley', with a stylized flourish at the end.

D. Allan Bromley
Director

Dr. David Korn
Carl and Elizabeth Naumann Professor
Vice President and Dean
Stanford University Medical Center
Stanford, California 94305-5302

"CORRESPONDENCE TRACKING"

TYPE: INFORMATION

DOCUMENT NUMBER: 9120253

FROM: HASELTINE, MICHAEL

TO: DR. BROMLEY

DATE OF
CORRESPONDENCE: 01/15/91

SUBJECT: ELF EMISSIONS

ASSIGNED TO:

ACTION REQUIRED:

SENDER'S DUE DATE:

OSTP DUE DATE:

DATE COMPLETED: -----

COPIES TO: Life Sciences

WHITE HOUSE TRACKING #:

CONTACT PERSON:

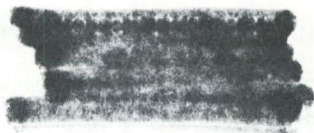
REMARKS:

DATE RECEIVED: 01/19/91

FILE: ELF EMISSIONS

P- LIEESCIENCES-RADIATION/EMF

Life Sci



9120153
January 15, 1991

Dr. D. Allan Bromley
Science Advisor to the President
Office of Science and Technology Policy
Old Executive Office Building #358
Washington, D.C. 20506

Dear Dr. Bromley,

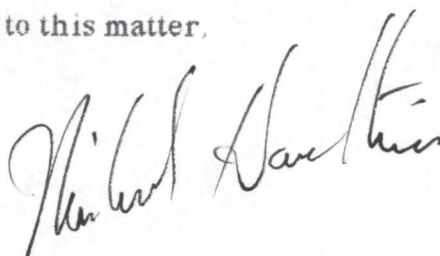
I am writing to express my concern about extremely low frequency (ELF) emissions, and particularly those from personal computer monitors. I use a computer quite regularly, have done a fair amount of reading regarding this type of emissions, and am greatly concerned.

I believe that it is of vital importance to those of use who are constantly exposed to ELF emissions through the use of personal computers that the U.S. government require manufacturers to meet some basic standards that will limit that exposure.

You should be ashamed for trying to bias the EPA panel of experts toward the electric power industry! You are in a privileged position and have mistaken it as a lobby for a small, but powerful segment of society. Frankly, I believe individuals are more important than industry, and you owe it to us to be more balanced in your actions.

Please, I urge you in the strongest possible terms to direct the appropriate groups within the Food and Drug Administration, the Environmental Protection Agency, OSHA, NIOSH, and the Department of Energy to develop interim standards that will offer maximum protection until current research proves the level of protection required.

Thank you for your attention to this matter.



Michael Haseltine
710 N. Alamo Ave.
Tucson, AZ 85711

"CORRESPONDENCE TRACKING"

TYPE: ACTION

DOCUMENT NUMBER: 9120180

FROM: YOUNG, ALVIN, L.

TO: DR. BROMLEY

DATE OF
CORRESPONDENCE: 01/14/91

SUBJECT: PLANNED CIRRPC EM FIELD ACTIVITIES

ASSIGNED TO: Rachel Levinson

ACTION REQUIRED: DAB SIGN

SENDER'S DUE DATE: OSTP DUE DATE: 02/01/91

DATE COMPLETED: -----

COPIES TO: Dr. Wong
D. Allan Bromley
Michelle Van Cleave
Ken Yale

WHITE HOUSE TRACKING #:

CONTACT PERSON:

REMARKS:

DATE RECEIVED: 01/22/91

FILE: P- LIFE SCIENCES-RADIATION /EMF

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

February 20, 1991

Jim.
MEMORANDUM FOR JAMES O. MASON

FROM: D. ALLAN BROMLEY *Dan*
SUBJECT: CIRRPC EMF ACTIVITIES

This is in response to Alvin Young's January 14, 1991, memorandum concerning CIRRPC's planned activities related to the alleged health effects attributable to electric and magnetic fields (EMF) at low frequencies.

First, I agree that CIRRPC should respond to EPA's request to review the EPA draft report entitled, "Evaluation of the Potential Carcinogenicity of Electromagnetic Fields." I had suggested this possibility to representatives from EPA when they briefed me on the draft report in November 1990.

Second, I also agree that CIRRPC should proceed with addressing the Department of Labor request for CIRRPC to review the scientific literature on health effects of electric and magnetic fields associated with electric power lines, home appliances, and video display terminals. Earlier, I requested that CIRRPC examine the literature on the health effects of EMF to identify additional research needs, recommend agency research roles, and suggest policy alternatives where appropriate. Dr. Young had responded that the study requested by the Department of Labor should provide the information necessary to enable CIRRPC to respond to my request.

I see no need for the third initiative. A National Academy of Sciences study of the possible health effects associated with use of video display terminals would duplicate work done under the second initiative. In addition, I expect that the cost and duration of this proposed project would far outweigh its utility to FCCSET member agencies.

bcc: Ms. Bach

80

COMMITTEE ON INTERAGENCY RADIATION RESEARCH
AND POLICY COORDINATION
1019 Nineteenth Street, NW, Suite 700
Washington, D.C. 20036

MEMORANDUM

TO: D. Allan Bromley
Assistant to the President
for Science and Technology

FROM: Alvin L. Young *Alvin L. Young*
Chairman, CIRRPC

THROUGH: James O. Mason *James O. Mason* JAN 17 1991
Assistant Secretary for Health

DATE: January 14, 1991

SUBJECT: Planned CIRRPC EM Field Activities

In response to concerns within the Office of Science and Technology Policy (OSTP) and the Federal agencies regarding the alleged health effects attributable to electric and magnetic (EM) fields at low frequencies, the Executive Committee of the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC) at its January 3, 1991 meeting proposed the following plan of action in addressing the EM field initiatives brought to CIRRPC's attention.

INITIATIVE I. Accept an Environmental Protection Agency (EPA) request for CIRRPC to review the EPA draft report entitled "Evaluation of the Potential Carcinogenicity of Electromagnetic Fields."

Plan: Upon receipt of an official request from EPA, CIRRPC will coordinate a review of the draft document by all CIRRPC member agencies and any other agencies or individuals identified by an individual agency. Thus, the review may include non-Federal scientists or scientific organizations. CIRRPC will serve as the focal point of this review; if necessary, conduct meetings of agencies for discussion of comments; and coordinate a draft integrated response to EPA. The final response will be submitted from CIRRPC through the Committee on Life Sciences and Health (CLSH) to OSTP for transmittal to EPA.

OFFICE OF THE
DIRECTOR

JAN 22 1991

RECEIVED

Time: Three months from receipt of request by CIRRPC.

INITIATIVE II. Proceed with the Department of Labor (DOL) request to CIRRPC to review the scientific literature on health effects of electric and magnetic fields associated with electric power lines, electric home appliances, and video display terminals (i.e., power frequencies, 15 to 180 Hz; and video display terminal frequencies, 10 to 30 kHz).

Plan: A multidisciplinary review of the scientific literature on potential adverse effects from EM fields will be made by non-Federal scientists with individual expertise in one or more scientific disciplines that are needed to evaluate reported findings of carcinogenesis, reproductive effects, and neurophysiological effects. The review will address:

- a. Is there a clear health hazard from exposures to EM fields emitted from these sources?
- b. Are there sufficient data available upon which to base quantitative risk assessments? If not, what additional information would be required to develop such estimates?

The Federal Advisory Committee Act is inapplicable because these scientists will provide independent input which will be used to achieve a comprehensive document. These individual contributions will be acknowledged as such and be summarized in a draft report by a member of the CIRRPC Science Panel. Peer reviews will be performed by Science Panel member agency scientists and external reviewers as designated by the Science Panel. The report will be subsequently reviewed by CIRRPC and submitted through the CLSH to OSTP for final approval and transmittal to DOL and other Federal agencies. As outlined in my July 24, 1990 memorandum to you, CIRRPC will use the output from the review of the scientific literature in responding to your July 20, 1990 request for CIRRPC "to identify additional research needs, recommend agency research roles, and suggest policy alternatives where appropriate."

Time: CIRRPC draft completed six months after initiation of consultant efforts.

INITIATIVE III. Evaluate the anticipated National Academy of Sciences/National Research Council (NAS/NRC) proposal for "An Assessment of the Possible Health Effects Associated with the Operation of Video Display Terminals, " when submitted by NAS/NRC.

Plan: An option for CIRRPC as a third initiative would be to co-sponsor a National Academy of Sciences report. The Academy Board on Radiation Research has not given final approval for this project, nor has CIRRPC allocated resources (estimated at \$200,000) for the project in the FY 1991 budget. CIRRPC would evaluate the merits of such a study in supplementing the previous two CIRRPC activities noted above, in the context of Federal agencies' needs. If approved, CIRRPC would arrange for Federal financial support for the NAS/NRC study and contract their services through its technical support function at Oak Ridge Associated Universities.

Time: NAS/NRC estimates the project will take eighteen months.

I seek concurrence to proceed with these plans.

JAMES O. MASON

D. ALLAN BROMLEY

Concur ☒
 Nonconcur ☐

Concur ☐
 Nonconcur ☐

"CORRESPONDENCE TRACKING"

TYPE: ACTION

DOCUMENT NUMBER: 9120174

FROM: HUBBELL, JOHN H.

TO: DR. BROMLEY

DATE OF
CORRESPONDENCE: 01/10/91

SUBJECT: CHERENKOV "CITATION CLASSICS" FOR YOUR INTEREST AND
COMMENTS.

ASSIGNED TO: D. Allan Bromley

ACTION REQUIRED: AS NECESSARY

NAN per DAB 2/1/91

SENDER'S DUE DATE: OSTP DUE DATE:

DATE COMPLETED: -----

COPIES TO:

WHITE HOUSE TRACKING #:

CONTACT PERSON:

REMARKS:

DATE RECEIVED: 01/19/91

P- Life Sciences - RADIATION/EMF
FILE: RADIATION-IRPS

44

1914-1915

1914-1915

THE WHITE HOUSE
WASHINGTON

January 4, 1991

Dear John:

Many thanks for sending me the preliminary program for the 5th International Symposium on Radiation Physics to be held in Dubrovnik, June 10-14, 1991. If you have not previously visited Dubrovnik it is truly a beautiful city and I recall with great pleasure taking time off during a conference I attended there a number of years ago to walk around the entire city on top of the ancient walls. It was a fascinating trip and the city itself is an absolute jewel.

Many thanks too for giving me the information on Cherenkov's death. He was one of the great men of physics and someone who richly deserved his Nobel Prize. I am glad that you have taken the initiative to get his obituary into the appropriate places.

I have read the WHO report on high energy x-ray surveillance of cargo containers with particular interest in as much as an old student of mine, Mario Ruscev, spent several years developing a wire chamber detector which made it possible to image the contents of the standard container used in international shipment in the a single x-ray exposure and then process that information electronically by taking appropriate signals from the wires. This was done as part of the Schlumberger Company but I think that being as large a company as it is, the decision has probably been made that the market for such devices is not sufficiently large to make it worthwhile for them to produce them commercially. This would be a great pity because from the data that my former student has shown me, the resolution attainable was nothing short of spectacular.

Finally, let me thank you for your note of sympathy concerning Pat's death. As I am sure you can understand this has been a very bleak Christmas season. But fortunately my children and grand-children were here for most of the vacation period.

With all best wishes for a happy, healthy and rewarding New Year,

Sincerely yours,

A handwritten signature in dark ink, appearing to read "D. Allan Bromley", with a long, sweeping horizontal stroke extending to the right.

D. Allan Bromley
Assistant to the President
for
Science and Technology

Dr. John H. Hubbell
National Institute of Standards and Technology
Building 245, Room C311
Gaithersburg, Maryland 20899

Applied Radiation and Isotopes

International Journal of Radiation Applications and Instrumentation

Part A

January 10, 1991

Prof. Dr. D. Allan Bromley
Assistant to the President for
Science and Technology
The White House
1600 Pennsylvania Ave., NW
Washington, DC 20500

From the Editor:

John H. Hubbell
National Institute of Standards and Technology
(Formerly National Bureau of Standards)
Building 245, Room C311
Gaithersburg
MD 20899
U.S.A.

Dear Dr. Bromley (Allan):

Thank you for your letter of January 4 and your glowing description of Dubrovnik with respect to the 5th International Symposium on Radiation Physics June 10-14, 1991, your comments on Cherenkov, and your interest in the WHO report on high energy x-ray surveillance of cargo containers with reference to a wire chamber detector development by your former student Mario Ruscev. I must admit it always gives me a lift and a thrill to hear from you, to attune to your perspective from the "Eagle's Nest."

Enclosed, for your interest (and comments), is the Cherenkov "Citation Classic" I had mentioned ISI (Institute for Scientific Information, Phila.) had invited me to write, adapted from the obituary I sent you. I hope you like the title "Faster than a Speeding Photon," with apologies to Superman. I sent a copy also off to Boris Govorkov (Lebedev Inst., Moscow) to make sure the story sticks to the facts.

At our IRPS (International Radiation Physics Society) Executive Council Meeting in Rabat, Morocco November 21-23, 1990 we settled on Rabat for our venue for ISRP-6 (1994), and hope the world will be back in one piece by that time. Looking further ahead, ISRP-7 (1997) will perhaps be in Chengdu, China (see enclosed IRPS Council Meeting Solicitation) where I visited Prof. Luo Zhengming in 1987. Besides the global society-building strategy benefits, the food (Sichuan cuisine) would be good in any case.

With best regards and thanks again for your interest in the IRPS and other matters.

Sincerely,



John H. Hubbell
Executive Councillor, International Radiation Physics Society (IRPS)
Ionizing Radiation Division
Center for Radiation Research, NIST



Allen:

For your further interest.

1/10/81

INVITED COMMENTARY FOR "CITATION CLASSIC" IN CURRENT CONTENTS

Cited Paper: Cherenkov, P. A., Visible light from clear liquids under the action of gamma radiation, Doklady Akademii Nauk SSSR (Comptes Rendus de l'Academie des Sciences de l'URSS) 2 (8), 451-454 (1934). [Physico-Mathematical Institute V. A. Steklova, Academy of Science, Leningrad, USSR]

Abstract: This paper reports observations of previously unknown properties of visible radiation produced in clear liquids under the action of fast electrons such as beta-particles from radioactive elements or Compton electrons liberated in liquids in the process of scattering of gamma rays. These properties include the polarization of the radiation, and the marked asymmetry of its emission directionality. [According to a manual citation count by the author of this commentary, SCI indicates 104 citations 1945-1989, in addition to citations 1934-1944.]

Commentary Title: Faster than a Speeding Photon

Commentary Author: John H. Hubbell, National Institute of Standards and Technology, Gaithersburg, Md. 20899

Commentary: It is an undue honor, but a pleasure nonetheless, that Drs. Garfield and Mears of ISI would invite me to write this commentary, which came about because I sent them an obituary I had concocted, for possible use in The Scientist, but which they convinced me could be adapted into an interesting commentary. This material is based on (a) a delightful surprise visit (I thought he was already long deceased) with Prof. Cherenkov in his laboratory in

produced when energetic particles, such as Compton electrons, exceed the velocity of light which is slowed in the clear liquid (or glass, or plastic, etc.) in proportion to the reciprocal of the refractive index.

A sound theoretical basis for the new radiation, as an electrodynamical analog to the Mach waves of hydrodynamics, was provided by I. M. Frank and I. E. Tamm [2] and quantitatively verified by Cherenkov's further experiments [3,4].

However, although the work was greeted enthusiastically by physics luminary Niels Bohr, Cherenkov's English-language manuscript "Visible Radiation Produced by Electrons in a Medium with Velocities Exceeding that of Light" was rejected by Nature, whose editors did not take the work seriously. The Physical Review was somewhat more open minded, and accepted the paper, which underwent only a change of mailing envelope, as a Letter to the Editor [5].

In 1958 Cherenkov, Frank, and Tamm shared the Nobel Prize in Physics "for the discovery and explanation of the Cherenkov effect." Cherenkov's numerous other awards and honors include the Order of Lenin (twice) and the State Prize of the Soviet Union (three times). Although he was not of great physical stature, Pavel Alekseevich Cherenkov casts a long shadow (or light, actually) across both the history and future of radiation physics.

References:

- [1] Cherenkov, P. A., At the threshold of discovery, Nuclear Instruments and Methods in Physics Research A248, 1-4 (1986), Proceedings of the Seminar Held on the Occasion of the 50th Anniversary of the Discovery of Vavilov-Cherenkov Radiation, P. N. Lebedev Physical Institute, Academy of Sciences of the USSR, July 11-17, 1984, Moscow.

Allen:

Concerning ISRP-7 (1997):

ISRP-6, 1999, now set to be in Rabat.

SOLICITATION OF HOST FOR EAST-ASIA IRPS COUNCIL MEETING; POSSIBLE ISRP

At the IRPS Council Meeting in Rabat, Morocco November 21-23, 1990, interest was expressed, for the long-range health and growth-strategy of the IRPS, in holding a near-future Symposium (ISRP-7, 1997, or ISRP-8, 2000) in the East-Asia/Pacific area, in particular the possibility of holding an ISRP in PRC China. One site which has been mentioned earlier is Chengdu, Sichuan Province, at the Institute of Nuclear Science and Technology at Sichuan University, where Prof. Dr. Luo Zheng-ming, who participated in the IRPS Founding Meeting at ISRP-3 (1985) in Ferrara, Italy, has already received some preliminary approvals and support for hosting an ISRP in connection with his establishment, in progress, of a Center for Radiation Physics at Sichuan University.

Prior to making any specific plans or soliciting a serious commitment, it would be useful to hold an IRPS Executive Council Meeting (attendance typically 6 to 10) at the site, to get some feeling for the conference facilities, local accommodations, transportation (accessibility) situation, and to become personally acquainted with local governmental and scientific authorities from whom final approvals and/or support for the Conference would eventually be required. Alternative desirable sites, if transportation accessibility would be a major consideration, would be Beijing or Shanghai, or perhaps you will have an alternative suggestion/offer. (?)

The IRPS Council would appreciate your sending your comments, suggestions, and expressions of support, if you agree, to

?

Prof. Dr. Luo Zheng-ming
Institute of Nuclear Science and Technology of Sichuan University
Chengdu, Sichuan, People's Republic of China,

with a copy to

Prof. Dr. Richard H. Pratt, Secretary, IRPS
Dept. of Physics and Astronomy
University of Pittsburgh
Pittsburgh, Pa. 15260, U.S.A.

Many thanks for your important help in laying this foundation for eventually holding an International Symposium on Radiation Physics (ISRP) in the PRC or nearby site, thus stimulating greater participation of East-Asian/Pacific Radiation Physics researchers in the global communication network of the International Radiation Physics Society (IRPS).

Sincerely,

John

John H. Hubbell, IRPS Council Member
Ionizing Radiation Division ("Emeritus")
National Institute of Standards and Technology
Gaithersburg, MD 20899, U.S.A.

Allen: In my mind,
like Teilhard de Chardin's
"noosphere."

John

Allen:
+ his now published.

This Week's Citation Classic

CC/NUMBER 51
DECEMBER 17, 1990

Hubbell J H. Photon mass attenuation and energy-absorption coefficients from 1 keV to 20 MeV. *Int. J. Appl. Radiat. Isot.* 33:1269-90, 1982.

[Center for Radiation Research, National Bureau of Standards, Washington, DC]

The penetration and energy-deposition properties of X-ray or gamma-ray photons traversing materials are expressible as mass attenuation and mass energy-absorption coefficients, respectively. These coefficients are here described and tabulated for 40 elements over the range $Z = 1$ to 92, also for 45 multielement materials, for photon energies 1 keV to 20 MeV. [The *SC*[®] indicates that this paper has been cited in more than 200 publications.]

X-Ray Cross Sections and Crossroads

John H. Hubbell
National Institute of Standards and Technology
US Department of Commerce
Gaithersburg, MD 20899*

Some papers become highly cited due to the creativity, genius, and vision of the authors, presenting seminal work stimulating and opening up new and multiplicative lines of research. Another, more pedestrian class of papers is "house-by-the-side-of-the-road" works, highly cited simply because these papers provide tools required by a substantial number of researchers in a single discipline or perhaps in several diverse disciplines, as is here the case.

This paper, an invited contribution to editor Bill McLaughlin's *International Journal of Applied Radiation and Isotopes* special issue "Trends in Radiation Dosimetry," is clearly in the latter class, I think. The citation time profiles of such side-of-the-road papers have been the subject of a study¹ by Katharine (Kay) Way (former editor, *Atomic Data and Nuclear Data Tables*), who concludes, "The moral is easily seen to be that if you want your name to make a splash in the Citation Index, publish a table." Kay's study included as one of her examples an earlier NBS/NIST tabulation of photon mass attenuation and energy-absorption coefficients,² and another NBS/NIST review and tabulation, of X-ray scattering data,³ has also subsequently made its splash in a *Citation Classic* commentary.

There is a further and profoundly career-satisfying dimension to this supportive-role table-making work. This process of collecting measured and theoretical data, evaluation, filling gaps by hook or by crook, and publishing tables has developed into a

kind of international crossroads of such information, funneling and synthesizing the intellectual productivity of an army of globally distributed scientists, including many talented Third World researchers, into tables fanning back out to similarly geographically and discipline-distributed user communities.

This data crossroads has sometimes been a dynamic, rather than passive, enterprise. For example, I instigated an International Union of Crystallography (IUCr) X-Ray Attenuation Project,⁴ graciously chaired by Dudley Creagh of the University of New South Wales, Australia, to resolve some serious discrepancies in the existing data. In this project, Dudley fabricates and distributes well-characterized absorber samples to a dozen or so globally distributed participating laboratories, where the measurements are made using diverse but well-described techniques and reported back to Dudley. This IUCr project will contribute some additional reliability to the X-ray attenuation coefficient tables⁵ in the latest *International Tables for Crystallography*.

The spawning of a global "radiation physics family" with strong personal and apolitical friendships from this crossroads enterprise has also led in part to the founding of a new International Radiation Physics Society, which will hold its Fifth International Symposium on Radiation Physics in Dubrovnik, Yugoslavia, June 10-14, 1991, following the earlier symposia in India, Malaysia, Italy, and Brazil.

Recognition of this X-ray data compilation work, performed under the guidance and vision of Martin J. Berger, long-time NBS/NIST Radiation Theory group leader, has been given by the American Nuclear Society in the form of its Radiation Industry (1985) and Professional Excellence (1990) Awards, and also by the Society of Nuclear Medicine by its Paul C. Aebersold Award (1985).

For more recent compilations in this topical area, the interested reader is directed to the 100 eV to 100 keV work with Saloman and Scofield⁶ and to the 10 eV to 100 GeV collaborative effort with D.E. ("Red") Cullen and others at the Lawrence Livermore National Laboratory.⁷

IRPS plus.

1. Way K. Citation counts for tables. (Nolen J A & Benenson W, eds.) *Atomic masses and fundamental constants*. New York: Plenum Press, 1980. Vol. 6, p. 541-6.
2. Hubbell J H. *Photon cross sections, attenuation coefficients, and energy absorption coefficients from 10 keV to 100 GeV*. Washington, DC: US Government Printing Office, August 1969. NSRDS-NBS Report No. 29. 80 p. (Cited 490 times.) [See also: Hubbell J H. *Citation Classic*. (Thackray A, comp.) *Contemporary classics in physical, chemical, and earth sciences*. Philadelphia: ISI Press, 1986. p. 54.]
3. Hubbell J H, Veigele W J, Briggs E A, Brown R T, Cromer D T & Howerton R J. Atomic form factors, incoherent scattering functions, and photon scattering cross sections. *J. Phys. Chem. Ref. Data* 4:471-538, 1975; and Erratum. *J. Phys. Chem. Ref. Data* 6:615-6, 1977. (Cited 350 times.) [See also: Hubbell J H. X-ray scattering data for atoms. *Citation Classic, Current Contents/Physical, Chemical & Earth Sciences* and *CC/Engineering, Technology & Applied Sciences* 9 January 1989, p. 14.]
4. Creagh D C & Hubbell J H. Problems associated with the measurement of x-ray attenuation coefficients. I. Silicon. Report on the International Union of Crystallography X-Ray Attenuation Project. *Acta Crystallogr. A-Found. Cryst.* 43:102-12, 1987. (Cited 10 times.)
5. ----- X-ray absorption (or attenuation) coefficients, section 4.2.4. (Wilson A J C, ed.) *International tables for crystallography, Volume C. Mathematical, physical, and chemical tables*. International Union of Crystallography/Reidel. (In press.)
6. Saloman E B, Hubbell J H & Scofield J H. X-ray attenuation cross sections for energies 100 eV to 100 keV and elements $Z=1$ to $Z=92$. *At. Data Nucl. Data Tables* 38:1-197, 1988. (Cited 20 times.)
7. Cullen D E, Chen M H, Hubbell J H, Perkins S T, Plechaty E F, Rathkopf J A & Scofield J H. *Tables and graphs of photon-interaction cross sections from 10 eV to 100 GeV derived from the LLNL Evaluated Photon Data Library (EPDL)*. Part A: $Z=1$ to 50, and Part B: $Z=51$ to 100. Livermore, CA: Lawrence Livermore National Laboratory, 1989. UCRL-50400. Vol. 6. Rev. 4.

*Received June 1, 1990

"CORRESPONDENCE TRACKING"

TYPE: ACTION

DOCUMENT NUMBER: 9120174

FROM: HUBBELL, JOHN H.

TO: DR. BROMLEY

DATE OF
CORRESPONDENCE: 01/10/91

SUBJECT: CHERENKOV "CITATION CLASSICS" FOR YOUR INTEREST AND
COMMENTS.

ASSIGNED TO: D. Allan Bromley

ACTION REQUIRED: AS NECESSARY

SENDER'S DUE DATE:

OSTP DUE DATE:

DATE COMPLETED:

COPIES TO:

WHITE HOUSE TRACKING #:

CONTACT PERSON:

REMARKS:

LIFE SCIENCES

DATE RECEIVED: 01/19/91

FILE: RADIATION-IRPS

9120174

Applied Radiation and Isotopes

International Journal of Radiation
Applications and Instrumentation

Part A

January 10, 1991

Prof. Dr. D. Allan Bromley
Assistant to the President for
Science and Technology
The White House
1600 Pennsylvania Ave., NW
Washington, DC 20500

From the Editor:

John H. Hubbell
National Institute of Standards and Technology
(Formerly National Bureau of Standards)
Building 245, Room C311
Gaithersburg
MD 20899
U.S.A.

Dear Dr. Bromley (Allan):

Thank you for your letter of January 4 and your glowing description of Dubrovnik with respect to the 5th International Symposium on Radiation Physics June 10-14, 1991, your comments on Cherenkov, and your interest in the WHO report on high energy x-ray surveillance of cargo containers with reference to a wire chamber detector development by your former student Mario Ruscev. I must admit it always gives me a lift and a thrill to hear from you, to attune to your perspective from the "Eagle's Nest."

Enclosed, for your interest (and comments), is the Cherenkov "Citation Classic" I had mentioned ISI (Institute for Scientific Information, Phila.) had invited me to write, adapted from the obituary I sent you. I hope you like the title "Faster than a Speeding Photon," with apologies to Superman. I sent a copy also off to Boris Govorkov (Lebedev Inst., Moscow) to make sure the story sticks to the facts.

At our IRPS (International Radiation Physics Society) Executive Council Meeting in Rabat, Morocco November 21-23, 1990 we settled on Rabat for our venue for ISRP-6 (1994), and hope the world will be back in one piece by that time. Looking further ahead, ISRP-7 (1997) will perhaps be in Chengdu, China (see enclosed IRPS Council Meeting Solicitation) where I visited Prof. Luo Zhengming in 1987. Besides the global society-building strategy benefits, the food (Sichuan cuisine) would be good in any case.

With best regards and thanks again for your interest in the IRPS and other matters.

Sincerely,



John H. Hubbell
Executive Councillor, International Radiation Physics Society (IRPS)
Ionizing Radiation Division
Center for Radiation Research, NIST



Allan:

For your further interest.

John

1/10/81

INVITED COMMENTARY FOR "CITATION CLASSIC" IN CURRENT CONTENTS

Cited Paper: Cherenkov, P. A., Visible light from clear liquids under the action of gamma radiation, Doklady Akademii Nauk SSSR (Comptes Rendus de l'Academie des Sciences de l'URSS) 2 (8), 451-454 (1934). [Physico-Mathematical Institute V. A. Steklova, Academy of Science, Leningrad, USSR]

Abstract: This paper reports observations of previously unknown properties of visible radiation produced in clear liquids under the action of fast electrons such as beta-particles from radioactive elements or Compton electrons liberated in liquids in the process of scattering of gamma rays. These properties include the polarization of the radiation, and the marked asymmetry of its emission directionality. [According to a manual citation count by the author of this commentary, SCI indicates 104 citations 1945-1989, in addition to citations 1934-1944.]

Commentary Title: Faster than a Speeding Photon

Commentary Author: John H. Hubbell, National Institute of Standards and Technology, Gaithersburg, Md. 20899

Commentary: It is an undue honor, but a pleasure nonetheless, that Drs. Garfield and Mears of ISI would invite me to write this commentary, which came about because I sent them an obituary I had concocted, for possible use in The Scientist, but which they convinced me could be adapted into an interesting commentary. This material is based on (a) a delightful surprise visit (I thought he was already long deceased) with Prof. Cherenkov in his laboratory in

Troitsk (just south of Moscow) in 1979, (b) his personal reminiscences recounted in a historical review paper [1] he presented at a Seminar "Cherenkov Detectors and their Applications in Science and Technics" celebrating the 50th anniversary of the Vavilov-Cherenkov radiation discovery, and (c) additional information supplied to me by one of Cherenkov's colleagues Boris B. Govorkov (P. N. Lebedev Institute) who hosted me in Moscow in 1979.

Pavel Alekseevich Cherenkov (or Čerenkov), who died of yellow jaundice January 6, 1990 in Moscow, was born to a peasant family July 28, 1904 in Voronezh, a city midway between Moscow and Rostov, on the Voronezh River just before it flows into the Don. A graduate of Voronezh University, he did postgraduate work at the Physics Institute of the USSR Academy of Sciences, Moscow, 1930-1935, from which he was awarded a doctorate in natural science 1940.

During this period, under the guidance of S. I. Vavilov, Cherenkov investigated the luminescence of solutions of uranium salts under the action of gamma radiation. He observed, as reported in the above 1934 "discovery" paper, that the gamma radiation creates a weak luminescence of the solution, which differs sharply from normal luminescence. This observation stimulated his extensive further experiments eventually defining the Cherenkov (or Cherenkov-Vavilov) effect, and what we now know as Cherenkov radiation.

This radiation, seen but not explained by Marie Curie around the turn of the century, is the beautiful blue glow we see in the liquid surrounding strong gamma-ray or charged-particle emitters such as fuel rods in a swimming pool reactor. This 100% polarized light, emitted at an angle related by a simple formula to the particle velocity and the refractive index of the medium, is

produced when energetic particles, such as Compton electrons, exceed the velocity of light which is slowed in the clear liquid (or glass, or plastic, etc.) in proportion to the reciprocal of the refractive index.

A sound theoretical basis for the new radiation, as an electrodynamical analog to the Mach waves of hydrodynamics, was provided by I. M. Frank and I. E. Tamm [2] and quantitatively verified by Cherenkov's further experiments [3,4].

However, although the work was greeted enthusiastically by physics luminary Niels Bohr, Cherenkov's English-language manuscript "Visible Radiation Produced by Electrons in a Medium with Velocities Exceeding that of Light" was rejected by Nature, whose editors did not take the work seriously. The Physical Review was somewhat more open minded, and accepted the paper, which underwent only a change of mailing envelope, as a Letter to the Editor [5].

In 1958 Cherenkov, Frank, and Tamm shared the Nobel Prize in Physics "for the discovery and explanation of the Cherenkov effect." Cherenkov's numerous other awards and honors include the Order of Lenin (twice) and the State Prize of the Soviet Union (three times). Although he was not of great physical stature, Pavel Alekseevich Cherenkov casts a long shadow (or light, actually) across both the history and future of radiation physics.

References:

[1] Cherenkov, P. A., At the threshold of discovery, Nuclear Instruments and Methods in Physics Research A248, 1-4 (1986), Proceedings of the Seminar Held on the Occasion of the 50th Anniversary of the Discovery of Vavilov-Cherenkov Radiation, P. N. Lebedev Physical Institute, Academy of Sciences of the USSR, July 11-17, 1984, Moscow.

- [2] Frank, I. M., and Tamm, I. E., Coherent visible radiation of fast electrons passing through matter, Comptes Rendus (Doklady) de l'Academie des Sciences de l'URSS 14 (3), 109-114 (1937).
- [3] Cherenkov, P. A., Visible light of pure liquids under the action of hard beta-radiation, Comptes Rendus (Doklady) de l'Academie des Sciences de l'URSS 14 (3), 101-105 (1937).
- [4] Cherenkov, P. A., Angular dependence of the intensity of light emission, produced by gamma-radiation in pure liquids, Comptes Rendus (Doklady) de l'Academy des Sciences de l'URSS 14 (3), 105-108 (1937).
- [5] Cherenkov, P. A., Visible radiation produced by electrons moving in a medium with velocities exceeding that of light, Physical Review 52, 378-379 (1937).

Allan:

Concerning ISRP-7 (1997):
(ISRP-6, 1994, now set to be in Rabat.)

SOLICITATION OF HOST FOR EAST-ASIA IRPS COUNCIL MEETING; POSSIBLE ISRP

At the IRPS Council Meeting in Rabat, Morocco November 21-23, 1990, interest was expressed, for the long-range health and growth-strategy of the IRPS, in holding a near-future Symposium (ISRP-7, 1997, or ISRP-8, 2000) in the East-Asia/Pacific area, in particular the possibility of holding an ISRP in PRC China. One site which has been mentioned earlier is Chengdu, Sichuan Province, at the Institute of Nuclear Science and Technology at Sichuan University, where Prof. Dr. Luo Zheng-ming, who participated in the IRPS Founding Meeting at ISRP-3 (1985) in Ferrara, Italy, has already received some preliminary approvals and support for hosting an ISRP in connection with his establishment, in progress, of a Center for Radiation Physics at Sichuan University.

Prior to making any specific plans or soliciting a serious commitment, it would be useful to hold an IRPS Executive Council Meeting (attendance typically 6 to 10) at the site, to get some feeling for the conference facilities, local accommodations, transportation (accessibility) situation, and to become personally acquainted with local governmental and scientific authorities from whom final approvals and/or support for the Conference would eventually be required. Alternative desirable sites, if transportation accessibility would be a major consideration, would be Beijing or Shanghai, or perhaps you will have an alternative suggestion/offer. (?)

The IRPS Council would appreciate your sending your comments, suggestions, and expressions of support, if you agree, to

Prof. Dr. Luo Zheng-ming
Institute of Nuclear Science and Technology of Sichuan University
Chengdu, Sichuan, People's Republic of China,

with a copy to

Prof. Dr. Richard H. Pratt, Secretary, IRPS
Dept. of Physics and Astronomy
University of Pittsburgh
Pittsburgh, Pa. 15260, U.S.A.

Many thanks for your important help in laying this foundation for eventually holding an International Symposium on Radiation Physics (ISRP) in the PRC or nearby site, thus stimulating greater participation of East-Asian/Pacific Radiation Physics researchers in the global communication network of the International Radiation Physics Society (IRPS).

Sincerely,

John

John H. Hubbell, IRPS Council Member
Ionizing Radiation Division ("Emeritus")
National Institute of Standards and Technology
Gaithersburg, MD 20899, U.S.A.

↳ Allan: In my mind,
like Teilhard de Chardin's
"noosphere."
John

四川大学原子核科学技术研究所

中 国 · 成 都

Institute of Nuclear Science And Technology · Sichuan University

CHENGDU · P. R. C.

Dec. 16, 1989

Mr. and Mrs John Hubbell
11830 Rocking Horse Road
Rockville, Maryland 20852

Dear Dr. Hubbell,

While Christmas is approaching, allow me to extend to you and Mrs. John my greetings.

I apologize for the delayed letter. On Aug. 5 I left for Denmark for presenting at the 13th conference on atomic collision in solids, then I visited the institute of Radiation Physics of Karolinska Institutet and worked there for 3 months. During this period, my colleagues did not pass my letters to me.

There is a good news. having returned to Chengdu, I have passed your suggestion, namely Chengdu would be chosen as a candidate city for the 3rd ISRP, on to our university. The president of Sichuan University, Prof. Lin, shows her interest and would like to consider your suggestion further. Therefore I hope the ISRP could discuss this problem and give us some further information so as to consider the possibility further.

In connection with setting a center for Radiation Physics at Sichuan University, the university has agreed to our suggestion. Maybe, the center will be established at our campus in next year.

Thank you and Dr. Berger for your interest and help.

wishing you and Mrs. Hubbell joy at Christmas and happiness in the new year.

sincerely yours

Luo Zhengming

Luo Zhengming

Allen's
+ his now published.

John

This Week's Citation Classic®

CC/NUMBER 51
® DECEMBER 17, 1990

Hubbell J H. Photon mass attenuation and energy-absorption coefficients from 1 keV to 20 MeV. *Int. J. Appl. Radiat. Isot.* 33:1269-90, 1982.
[Center for Radiation Research, National Bureau of Standards, Washington, DC]

The penetration and energy-deposition properties of X-ray or gamma-ray photons traversing materials are expressible as mass attenuation and mass energy-absorption coefficients, respectively. These coefficients are here described and tabulated for 40 elements over the range $Z = 1$ to 92, also for 45 multielement materials, for photon energies 1 keV to 20 MeV. [The SCI® indicates that this paper has been cited in more than 200 publications.]

X-Ray Cross Sections and Crossroads

John H. Hubbell
National Institute of Standards and Technology
US Department of Commerce
Gaithersburg, MD 20899*

Some papers become highly cited due to the creativity, genius, and vision of the authors, presenting seminal work stimulating and opening up new and multiplicative lines of research. Another, more pedestrian class of papers is "house-by-the-side-of-the-road" works, highly cited simply because these papers provide tools required by a substantial number of researchers in a single discipline or perhaps in several diverse disciplines, as is here the case.

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kind of international crossroads of such information, funneling and synthesizing the intellectual productivity of an army of globally distributed scientists, including many talented Third World researchers, into tables fanning back out to similarly geographically and discipline-distributed user communities.

This data crossroads has sometimes been a dynamic, rather than passive, enterprise. For example, I instigated an International Union of Crystallography (IUCr) X-Ray Attenuation Project,⁴ graciously chaired by Dudley Creagh of the University of New South Wales, Australia, to resolve some serious discrepancies in the existing data. In this project, Dudley fabricates and distributes well-characterized absorber samples to a dozen or so globally distributed participating laboratories, where the measurements are made using diverse but well-described techniques and reported back to Dudley. This IUCr project will contribute some additional reliability to the X-ray attenuation coefficient tables⁵ in the latest *International Tables for Crystallography*.

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IRPS plus.

1. Way K. Citation counts for tables. (Nolen J A & Benenson W, eds.) *Atomic masses and fundamental constants*. New York: Plenum Press, 1980. Vol. 6. p. 541-6.
2. Hubbell J H. Photon cross sections, attenuation coefficients, and energy absorption coefficients from 10 keV to 100 GeV. Washington, DC: US Government Printing Office, August 1969. NSRDS-NBS Report No. 29. 80 p. (Cited 490 times.) [See also: Hubbell J H. *Citation Classic*. (Thackray A, comp.) *Contemporary classics in physical, chemical, and earth sciences*. Philadelphia: ISI Press, 1986. p. 54.]
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*Received June 1, 1990

"CORRESPONDENCE TRACKING"

TYPE: ACTION

DOCUMENT NUMBER: 9120076

FROM: BUDINGER, THOMAS F.

TO: DR. BROMLEY

DATE OF
CORRESPONDENCE: 01/08/91

SUBJECT: EPA ASSESSMENTS OF HEALTH EFFECTS & THE ELF RISK
PROBLEM

ASSIGNED TO: Dr. Wong

ACTION REQUIRED: DRAFT DAB SIGN

SENDER'S DUE DATE: OSTP DUE DATE: 01/28/91

DATE COMPLETED: 2/14/91 by EN/DAB

COPIES TO: D. Allan Bromley

WHITE HOUSE TRACKING #: CONTACT PERSON:

REMARKS: FILE - ELF

DATE RECEIVED: 01/14/91

FILE: *P-Life Sciences - Radiation/EMF*
SCIENCE & ENGINEERING



2025 RELEASE UNDER E.O. 14176

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

February 13, 1991

Dear Dr. Budinger:

I am writing to thank you for your letter of January 8 on the health risk issues associated with low frequency electromagnetic radiation.

The questions that you pose in your letter put into sharp focus the issues underlying the case. I am delighted that someone of your scientific standing is playing an important role in trying to resolve these issues. I wish you every success.

Once again, thank you for your help, and I hope that we can continue to call on you from time to time.

Sincerely yours,


D. Allan Bromley
Director

Thomas F. Budinger, M.D., Ph.D.
Director
Research Medicine and
Radiation Biophysics Division
Lawrence Berkeley Laboratory
Cyclotron Road
Berkeley, California 94720

THE WHITE HOUSE
WASHINGTON

January 18, 1991

Dear Professor Budinger:

Many thanks for your most useful and helpful letter of January 8. As it developed, the hearings about which Gene Wong had contacted you were cancelled but may well be scheduled again in the future.

The material in your letter is, in any event, very helpful to us and we will keep in close touch with you. I much appreciate your willingness to help.

With warmest best wishes for the New Year,

Sincerely ours,

A handwritten signature in dark ink, appearing to read "D. Allan Bromley", written in a cursive style.

D. Allan Bromley
Assistant to the President
for
Science and Technology

Professor Thomas F. Budinger
Lawrence Berkeley Laboratory
1 Cyclotron Road
Berkeley, California 94720



Lawrence Berkeley Laboratory

RECEIVED

1 Cyclotron Road Berkeley, California 94720

(415) 486-4000 • FTS 451-4000

91 JAN 14 All : 42

January 8, 1991

OFFICE OF THE
DIRECTOR

Refer to: 91RM05

Dr. D. Allan Bromley
Director, Office of
Science & Technology
Room 360, Old Executive Office Bldg.
Washington, D.C. 20506

Dear Doctor Bromley:

You encouraged me to keep you informed on national scientific and technical issues of mutual interest and responsibility. I am writing about the EPA assessments of health effects and the status of knowledge on nonionizing radiation in the low frequency ranges -- the ELF risk problem. I have discussed some of these issues with Professor Gene Wong of your office. Based on these discussions, I have attempted to anticipate questions which require an immediate, yet thoughtful answer. Allow me to pose these questions and attempt an answer:

1. Is there an urgency to resolve the issue of ELF risk based on public health evidence?

There is no evidence requiring immediate advisories or regulatory action for protection of the public. The urgency is in the need to finalize a plan for the thorough and rational assessment of risks, by research actions, not through a rehash of available data. The Public concerns have been kindled by power-line, right-of-way legal battles; radar installation environmental questions, and controversy among scientists engaged in either biophysical or retrospective epidemiological surveys. Thus, we must engage the research gears and encourage or, if necessary, manage a program of scientific study. But the present data do not support a policy of prudent avoidance or the promulgation of mitigating engineering procedures until research data warrant those activities.

2. In addition to the EPA, are there unbiased scientific consensus groups on whom we depend for determination of risks or, if necessary, standards?

Yes, we can expect both short and long term responsible actions can be taken by the following groups:

American Public Health Association
Bioelectromagnetism Society
IEEE Standards Board
Institute of Medicine

The national standards for high frequency (3KHz to 300 MHz) human exposures were developed by the American National Standards Institute (ANSI) initially and these activities are now under the aegis of the IEEE Standards Coordinating Committee 28, which consists of the

Neenah Bond

membership of the older ANSI committee. The IEEE SCC28 is now given responsibility for the ELF standards in that their purview from 300 MHz down to OHZ. This Committee has a subcommittee with an anticipated membership of 140 individuals which is being organized to not only evaluate the needs for ELF standards, but to detail the needed experimental data and, if necessary, extend their responsibilities to manage the conduct of experiments. The SCC28 intends to coordinate their activities with the American Public Health Association and the Bioelectromagnetism Society, who have a strong representation on the action subcommittee. In addition, SCC28 Chairman intends to establish close communication with the Institute of Medicine and the EPA.

3. What are the root causes of the controversy regarding evidence for ELF-related cancer induction and health effects?

The major problems are the lack of verifiable and repeatable epidemiological data and the absence of a biophysical mechanism to explain some reported data relevant to the magnitude of ELF to which the public are exposed. The fact that physical measurements within the homes of populations considered at greater risk than other populations are absent or not convincing leads in the argument that the epidemiological data do not show a cause-effect relationship between power line distribution and cancer induction.

Biophysical and biochemical data which show effects related to calcium ion transport need verification by independent laboratories, a close scrutiny of physical models proposed to explain these findings, and a diligent search for other experimental causes. Three examples illustrate this need. Small temperature changes rather than magnetic fields were found to account for measured changes in nerve conduction velocities. Environmental rather than magnetic field conditions were found to affect animal reproduction behavior. Microphonics associated with oscillating fields can explain small animal behavioral changes as well as cell ion transport changes.

In addition, the well known and physically understood current induction behavior of changing magnetic fields or creation of visual phosphenes, stimulation of sound, and neuromuscular stimulation are at ELF amplitudes many times greater than those of the environs. Indeed, even the substantial biophysical effects which are demonstratable at very high amplitudes are not necessarily related to cancer induction, in fact, ELF is being used for beneficial aid in difficult orthopedic problems.

4. What are reasonable action plans that the government can take in view of the controversy and contentions between the cognizant scientists and engineers?

Encourage the organizations such as IEEE's committees to pursue their charters with a policy and philosophy of consensus.

Conduct physical measurements in the environs thought to be at risk to establish a sound base for epidemiological surveys or measurements.

Evaluate the possibility of epidemiological studies whose results we can rely upon; e.g., a nation-wide unbiased cause of death vs occupational exposure retrospective survey seems to make sense, however, before embarking on this endeavor careful scrutiny is required from epidemiologists and biostatisticians unbiased by the present controversy.

January 8, 1991

My intent is to both express my ideas regarding actions we can take to avoid Public hysteria and by this letter to make myself available to assist you on this ELF problem.

Sincerely,



Thomas F. Budinger, M.D., Ph.D.
Henry Miller Professor of Medical Research
Professor, Department of Electrical Engineering
& Computing Science, UCB
Professor of Radiology, UCSF
Director, Research Medicine &
Radiation Biophysics Division, LBL

TFB:jb