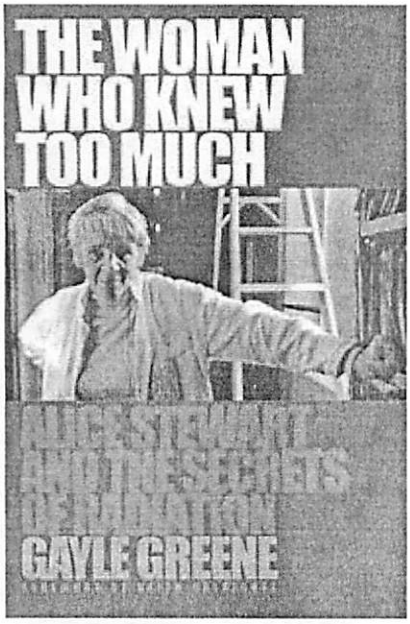

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The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation

Gayle Greene, Author University of Michigan Press $35 (360p) ISBN 978-0-472-11107-7

MORE BY AND ABOUT THIS AUTHOR

In 1956, British physician Alice Stewart discovered that exposing a fetus to a single diagnostic X-ray doubles the risk of an early death from cancer. As this spirited biography demonstrates, Stewart's subsequent dedication to investigating the effects of radiation turned her into a kind of guru to the antinuclear movement. In 1974-1977, her study of U.S. nuclear workers at the Hanford weapons complex in Washington State found that workers had a greater risk of developing cancer if exposed to radiation well below one-tenth of the ""safe"" level stipulated by international standards. According to Greene, the Atomic Energy Commission attempted to seize Stewart's data, and her funding was cut off. Yet her controversial findings, published in 1977, have momentous implications because, as Stewart explains, ""If we are correct, occupational safety standards will have to be changed and it will open the floodgates to claims from workers, veterans and downwinders."" Greene, a professor at Scripps College, also sets forth Stewart's provocative, still untested theory that sudden infant death syndrome masks myeloid leukemia. Stewart's varied personal life included conducting an affair with literary critic/poet William Empson, raising two children as a single parent and enduring her son's suicide. Greene calls this a ""collaborative memoir,"" because she lets Stewart, 93, speak for herself

whenever possible. Yet Greene also uses this blunt, feisty woman's career to mount a compelling critique of the nuclear industry and the medical establishment. 31 b&w photos. (Jan.)

DETAILS

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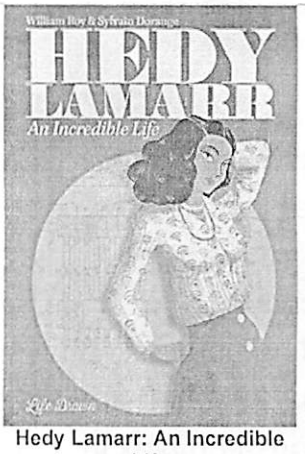

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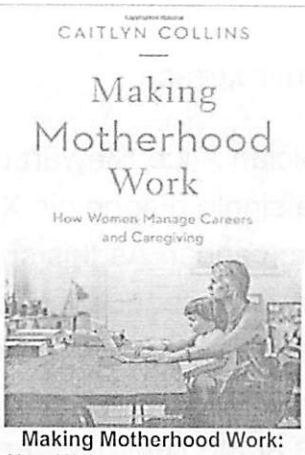

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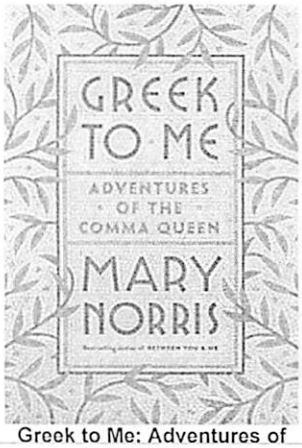

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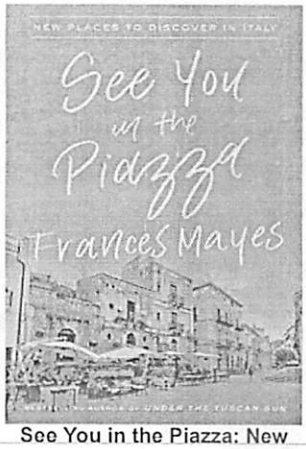

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terweight to the anatomists; it sold policies ensuring that workers with few assets would get a decent (ie, permanent) burial.

The second half of the book deals with outlying topics: popular lectures and textbooks, gothic novels, museums, and children's fiction. Sappol both confirms the importance of anatomy in 19th-century popular education and emphasizes how low the wall separating the dissecting room, the lyceum, and the licentious could be. Lecturing physicians not only displayed diagrams and wax models but, in at least one case, demonstrated "the body electric" with a cadaver hooked up to a galvanic battery. Private museum exhibitions of models of bodies and their variations were presented as educational but, then, when seen by purity crusader Anthony Comstock, were recategorized as sensationalist displays of prurience and monstrosity.

The dissectionist children's story was a small genre—five books that physician, sexual reformer, and rubber goods developer Edward Bliss Foote wrote in the early 1870s about boy anatomist Sammy Tubbs. They were remarkable, however, because they included, according to Sappol, the first explicit diagram of sexual anatomy in a book for preadolescents. Even more transgressively, Foote presented in Sammy an African American who mastered science, dissected his pet monkey, lectured on sexuality to mixed audiences, and succeeded romantically with an upper class white girl. Contradicting nearly every stereotype about American Victorian racism, Sammy Tubbs displayed the liberatory potential that anatomical knowledge could have.

Sappol maps this jumble of activity through the idea that anatomy was integral to the "creation of the bourgeois self." Class identity was certainly important in determining who stood at the dissecting table and, even more, who lay on it; and what Sappol calls "the anatomical body"—an emphasis on materiality and architecture as understood by a rational mind—formed part of the intellectual tool kit of educated people. But the explanatory power of the "bourgeois self" in cultural history is like "asthenia" in 19th-century medicine: reasonable and sometimes useful, but neither precise nor deeply predictive. In particular, it does not explain this story's end point: the sudden falloff of interest in gross anatomy after the 1870s. Introduction of bacteriological knowledge and physiological training methods, the rise of surgery as a specialty, the development of cold storage, and the separation of training and research from practice all played roles—but not the bourgeois self. Difficulties articulating the causes of historical change are minor, however, by comparison with the real achievement of this book: laying out the importance, scope, structure, and sloughs of the anatomical metropolis in which American medicine developed.

Philip J. Pauly, PhD
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Radiation Epidemiologist

The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation, by Gayle Green, 321 pp, with illus, paper $17.95, ISBN 0-472-08783-5, Ann Arbor, Mich, University of Michigan Press, 1999.

ALICE STEWART, MD, MRCP, IS INDEED a remarkable woman, and Gayle Green's book is both a nicely documented biography and a document of Dr Stewart's position on the hazards of radiation, especially low-level exposure to radiation. Whether or not you agree with Dr Stewart's position and thesis, you have to admire her dogged persistence in overcoming adversity and dismissal.

Born Alice Mary Naish in 1906 just after the Victorian era, when few women ventured to work outside the home and fewer still pursued careers in science or medicine, she proceeded to have a lifelong career in cancer and radiation epidemiology. She was a practicing physician, wife, mother, teacher, epidemiologist, author, world traveler, consultant, and defender of people whom she felt were damaged by radiation but ignored. Her parents, both physicians, assured that she was educated on a par with her brothers and sisters. Her early interests were less in medicine, the family business (five of eight siblings also became physicians), than in science. However, she found that she was very good at solving diagnostic problems and fascinated by bedside teaching. In 1933, after completing her residency at the Royal Free Hospital, she married Ludovick Stewart and moved to Manchester. She was pregnant and out of a job and felt her career was over. After her daughter was born in 1934, Ludovick accepted the job of French master at Harrow just outside London. This move gave Stewart the opportunity to work at the London School of Hygiene and Tropical Medicine. Other Harrow masters' wives envied her job; little did they know that she was basically a laboratory assistant, collecting blood samples, keeping records, and feeding the monkeys.

Stewart's career improved when she accepted the position of registrar at the Royal Free Hospital and then passed the Royal College of Physicians examination, which would place her in the rare position for a woman of consulting physician at a teaching hospital. In 1939, she also became consultant at the Elizabeth Garrett Anderson Hospital and for a time held two full-time consulting jobs. With the onset of World War II, she continued teaching. Ludovick became involved in code-breaking, and Stewart was asked to investigate her first occupational health problem, jaundice and aplastic anemia at a munitions plant. The experiment that she developed, using herself and students, demonstrated that trinitrotoluene was damaging workers' bone marrow. Stewart became a founding member of the *British Journal of Industrial Medicine*, which published the study in the inaugural volume.

As men went off to war, women were increasingly entering medicine, and Dr Stewart, while raising a family, was in demand for clinical practice, teaching, and industrial medicine. John Ryle, who started the Institute of Social Medicine at Oxford, selected Stewart as his first assistant. In her self-deprecating way, she felt that she had not been his first choice but, rather, the only person who would

take the job. She did have practical experience with surveys from her industrial studies during the war and was willing to learn what she needed to for this work. Ryle's main interest was the Child Health Survey, but Stewart was less enthused, so Ryle allowed her to continue industry-related studies. She used vital statistics records and Civilian Medical Board records to study tuberculosis, varicose veins, peptic ulcers, eczema, acne, hernia, and scoliosis in various industries.

When Ryle died in 1950, Stewart took over an institute that was an academic orphan, desired by neither the preclinical nor the clinical faculties of the university. She persisted in defending the programs, and, because dissolution would have embarrassed one of the university's major benefactors, the institute was allowed to continue as the Social Medicine Unit, with Stewart as head but with no staff and limited space. The unit became one of the first programs to depend on funds raised from outside sources. Stewart's first task was to organize its records, which she had to store in the library because there was no space for them at the unit.

Of the major health threats that might be amenable to epidemiological study with available data, only leukemia, which was increasing in 1951, was not already being studied. Stewart's godchild had recently died of leukemia, which gave impetus to her interest. After reviewing the data, Stewart and colleagues learned that children had lymphatic leukemia more frequently in counties with better medical care and lower childhood death rates. They proposed a project to interview the mothers of the children who had died, especially because Stewart was concerned about prenatal events. The Medical Research Council, the major source of research funding, rejected the proposal, but the researchers did receive a small grant (£1000) from the Lady Tata Memorial Fund to get started. Stewart sought the help of local public health departments in collecting data, ultimately visiting all 203 to gain their assistance.

The Oxford Survey of Childhood Cancer project included 500 leukemia deaths, 500 deaths from other cancers, and 1000 living children as controls. The first results were that children dying of leukemia and cancer had been x-rayed more often than living children. This finding, first published in 1956, was both applauded and condemned. The criticisms and attempts to refute or confirm it and Stewart's defense and extension of her ideas about the hazards of radiation have consumed her professional career. She has constantly defended her work, helped others, and battled the nuclear establishment throughout the world, garnering supporters and critics alike. Before the Oxford Survey of Childhood Cancer was over, the mothers of more than 22000 pairs of children were interviewed. The survey remains a model of the retrospective epidemiological study.

The biographer quotes frequently from interviews with her subject and others and from Stewart's notes and published work. She has done an excellent job of summing up the long and controversial life of Alice Stewart. I recommend this book to anyone interested in the low-level radiation controversy, the history of epidemiology, and the lives of remarkable women. The book should appeal to students, historians, and the general reader as an excellent biography of an outstanding women of medicine and epidemiology.

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School of Public Health
University of Kentucky
Lexington

Journalism

Medical Journalism: Exposing Fact, Fiction, Fraud, by Ragnar Levi, 151 pp, paper, $34.95, ISBN 0-8138-0303-9, Ames, Iowa State University Press, 2001.

NO SELF-RESPECTING MEDICAL REporter sets out to purposely distort the facts of a story. But the path to crafting an accurate and engaging article can be strewn with landmines that foil a writer's best intentions. In *Medical Journalism: Exposing Fact, Fiction, Fraud*, author Ragnar Levi, MD, provides a roadmap to help journalists avoid these difficulties and navigate a safe passage to the truth of a story.

Dr Levi draws lessons not only from his background in medicine and journalism but from numerous interviews with experienced medical journalists. Bringing a critical eye to bear on a story is the cardinal rule he sets down. The overall message is that, rather than accept information at face value, journalists must scrutinize data and ask relevant questions. To do this, reporters need a basic understanding of research methodology and of common errors in clinical research. The author stresses that it does not take a scholar to question the experts; however, it does take guts, common sense, and "an interest in the implications of scientific findings for people's health problems."

But what exactly does the term "critical journalism" mean? According to Dr Levi the critical journalist can separate fact from fiction in a story by asking whether the claims seem credible, verifying that the claims are supported by scientific evidence, and determining whether the evidence is strong or weak. Deciding on the best way to tell the story is also integral to its quality and accuracy. As Deborah Blum, one of many medical and science writers interviewed for the book, points out, giving a story the right emphasis, putting it into perspective without understating the risks or exaggerating the hopes is part of good medical reporting.

Medical Journalism provides a useful overview of general questions to consider when evaluating a research report. For example, a reporter can begin by asking how the hypothesis for a study was framed and what methods were used to test the hypothesis. To help distinguish between strong and weak evidence, Dr Levi describes the different types of clinical studies—from randomized controlled trials to case reports. While the studies are well described, I do think the author might have included examples of each study to further clarify them for inexperienced journalists.

Detailing all the pitfalls a medical reporter may face would be virtually im-

■**Greene, Gayle.** The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation. Jan. 2000. 344p. index. illus. Univ. of Michigan, $35 (0-472-11107-8). DDC: 610. **XX**

British epidemiologist Stewart has been issuing warnings about the serious health threats associated with low doses of radiation for 40 years. Her investigation began in 1956, when she traced childhood cancers to prenatal Xrays. That discovery led to her even more controversial findings regarding nuclear workers and the inaccuracies of the so-called A-bomb data used to calculate safe radiation dosages. Greene calls her riveting portrait a "collaborative memoir," and, indeed, Stewart's voice is heard almost as frequently as her biographer's as she recounts her unusual life with verve and humor. Greene enthusiastically chronicles Stewart's fascinating family history (her mother was one of England's first women doctors) and demanding private life, and perspicaciously examines the "visions and doggedness" that characterized Stewart's pioneering and invaluable work. Now in her nineties, Stewart combated sexism throughout her career and conducted her labor-intensive research without the support of a university or a research facility. Stewart's story is one of perseverance, ingenuity, compassion, independence, and integrity, a noble tale in the checkered history of science. —*Donna Seaman*

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February 2001 Vol. 38 No. 3

SCIENCE & TECHNOLOGY
Health Sciences

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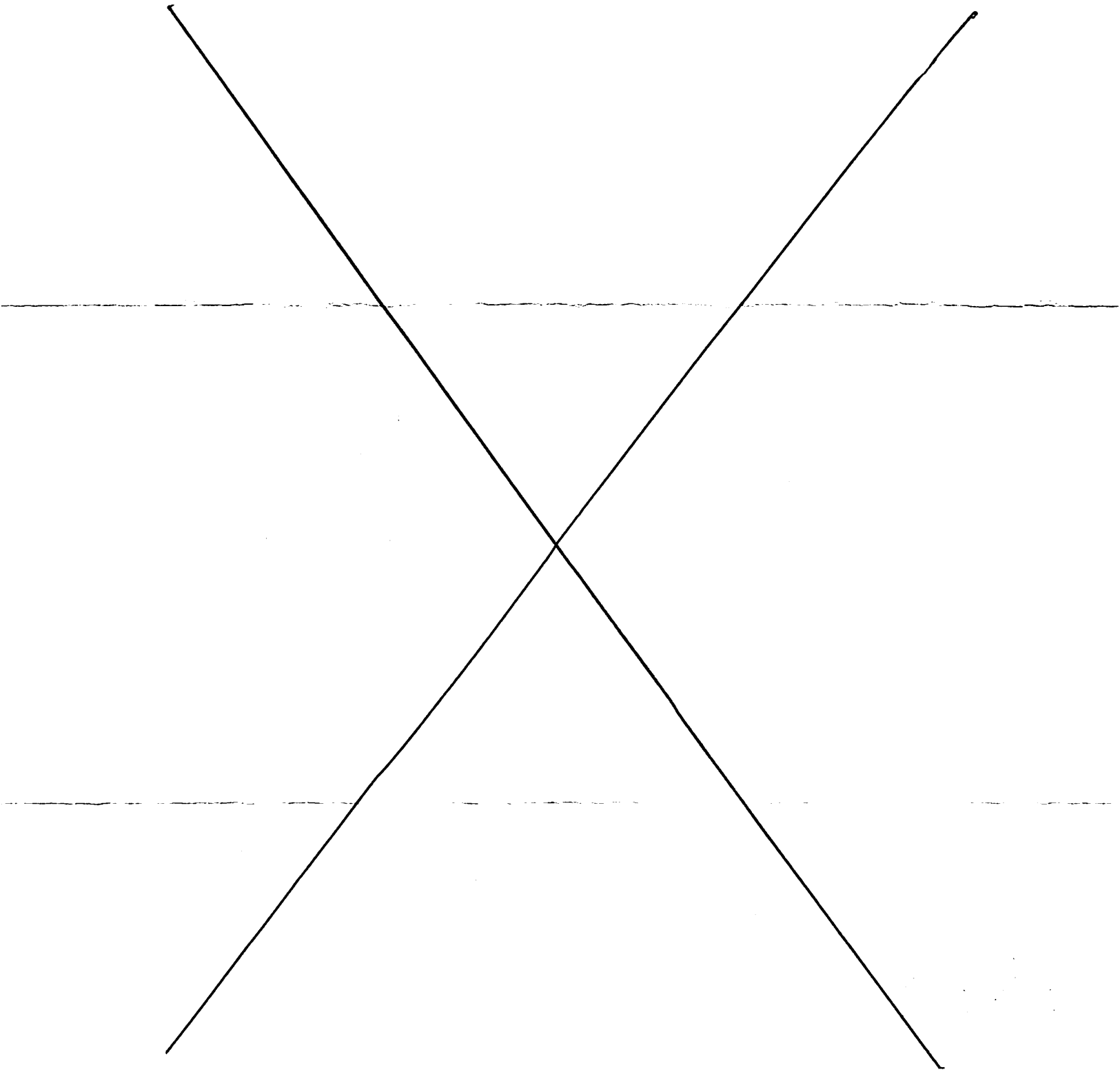
The following review appeared in the February 2001 issue of CHOICE:

38-3359 R489 99-51898 MARC
Greene, Gayle. **The woman who knew too much: Alice Stewart and the secrets of radiation.** Michigan, 1999. 321p bibl index afp ISBN 0-472-11107-8, $35.00

Claiming radiation to be "unsafe at any dose," Alice Stewart, MD epidemiologist, found exposure to low-level radiation far more serious than most scientists do. She took on the establishment by challenging its long-held belief in the "linear hypothesis." The latter, as its title implies, is an unproven but scientifically accepted theory stating that radiation damage to tissue is directly proportional to the magnitude of the dose received. Universally accepted for extremely high exposures, such as experienced at Hiroshima and Nagasaki, the hypothesis forecasts linearly decreasing damage as radiation doses become less. "Perhaps [she is] the Energy Department's most influential and feared critic," asserted the *New York Times* in May, 1990. This noncritical memoir by Greene (Scripps College) describes Stewart's lifelong dedication to proving her own hypothesis, one enthusiastically endorsed by those strongly opposed to further development of nuclear energy. Her views also run counter to decades of investigations performed by the National Academy of Sciences and federal regulatory agencies, and to conclusions from research performed under the auspices of the United Nations, World Health Organization, and other such organizations. All levels.
-- *J. G. Morse, Colorado School of Mines*



Go Ask Alice

BY ANNA MAYO

The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation
by Gayle Greene
University of Michigan Press
360 pages, $17.95.

Once, when the world and I were a great deal younger, it was my journalistic prerogative to be seated next to the British physician Alice Stewart at an anti-nuke fundraising breakfast where she was the honored guest. Awestruck, I hazarded a question: "Dr. Stewart, what do you consider your most important scientific accomplishment?" to which she replied, between bites of toast, "I invented epidemiology." I didn't dare ask her what that meant, but Gayle Greene, bless her, did. What might be called "basic epidemiology" was invented by Dr. John Snow, who traced an outbreak of cholera to a contaminated well. What Stewart meant was that she had refined, enlarged—one could say transformed—the science. Along the way she revolutionized medical practice. And in the words of *The New York Times* she also became the nuclear establishment's "most influential and feared scientific critic."

Most books that treat of atomic catastrophe are a hard sell, the reason being, of course, that scarcely anybody can bear to read them. But *The Woman Who Knew Too Much* is something of an exception; a lot of it is grim beyond belief, but a lot of it isn't. Once word gets around about the un-grim part, it should have a new audience, one outside Dr. Stewart's disciples in the anti-nuclear movement. That new audience will be made up of (of all things) English majors! Also, English teachers, English lit profs, fans of Merchant Ivory/E.M. Forster movies, reciters of Ezra Pound, W.H. Auden and "the Oracle" (critic William Empson's irreverent nickname for T.S. Eliot), and on and on—the whole band of nostalgic Anglophiles who still pine for that golden phase between the two wars when Empson, at the hub of it all, was making and breaking reputations and writing his own difficult poetry.

But, you ask, what's all this stuff about Empson doing in a review of a book on the life of Alice Stewart? What was he to Stewart or she to Empson? Greene deliciously reveals—to the amazement of many of Stewart's admirers in the anti-nuclear movement—that all the while their heroine was carrying out her world-shaking studies, all that long while when she was establishing that even very low levels of radiation kill, that there is no threshold for radiation effects, she was simultaneously carrying on a sizzling love affair with the dashing, iconoclastic, and married poet/critic. The two had met as undergraduates at Cambridge where Stewart, at once ostracized and bored by the male medical students, chose to run exclusively with the literati. But Empson soon scooted off to adventures in the Far East accompanied by his recent bride—not Stewart, who later drifted desultorily into a less than happy marriage to a master at an elite private school. Many years later, when Empson came home, he ran into her at a party, and asked her to dance. After that, she told Greene, "we went right on dancing, as it were."

"The years between the wars," he once wrote, "were like a circus with a thrill in every turn. But the post-war scene turned flat and dull." Perhaps, he added, striking a note of uncharacteristic pessimism, "the atomic bombs have rabbitted our heads." When he died of a cancer–which, like all post-World War II malignancies may well have been caused by atomic radiation–Stewart's closest companions became fellow researcher George Kneale and the scientists, activists and writers of the anti-nuclear movement, who now include Gayle Greene.

Now for the grim part of the story. In 1956 Stewart produced the first of her two celebrated studies, the Oxford Childhood Cancer Survey, which demonstrated that a single diagnostic x-ray received *in utero* doubles a child's risk of early cancer. Greene communicates the drama of how Stewart arrived at this finding by first visiting every one of England's 203 county health offices and then tracking down the mothers of children who had died of cancer (an accomplishment that is all the more remarkable since Stewart was working before the time of computerized databases). She persuaded the women to fill out a uniquely exhaustive questionnaire concerning their children's lifestyles going back to birth as well to events that had occurred during the fetal stage beginning with conception. As Greene makes clear, a conventional epidemiologist would have stopped the investiga-

Alice Stewart

tion at birth. The x-ray-cancer correlation leapt out at Stewart and Kneale, the brilliant, eccentric statistician who has been her lifelong research collaborator. This accumulating of great masses of data and letting it speak to her, this "letting in the noise" as Stewart calls it, is part of what she meant when she told me that she had invented epidemiology.

Their findings were initially received with enthusiasm and predictions of a Nobel Prize. Then the radiological community, which consists of radiologists, x-ray-happy M.D.'s , makers of x-ray equipment et al., who panicked at the potential loss of income, weighed in against her. Finally, after stormy, dramatic Congressional hearings, the American, followed by the British, medical profession reluctantly capitulated and recommended against the x-raying of pregnant women. As Stewart explains to Greene, when she started out, she had no idea that her Oxford Survey would eventually range far beyond the medical x-ray issue, even challenging the sacred cows of nuclear war and nuclear war's handmaiden, nuclear power. (Nuclear power reactors produce plutonium, which, after suitable reprocessing, is transmuted into the raw material of atomic bombs.) She began to get the picture in 1974 after she received a call for assistance from Dr. Thomas Mancuso at the University of Pittsburgh Medical School, one of the world's most respected occupational health researchers. It seemed that the U.S. Atomic Energy Commission had commissioned him to see whether workplace exposure had had any deleterious effect on the health of workers at the gargantuan Hanford complex in Washington State, which produced plutonium for nuclear weapons.

The sponsors of the research assumed that Mancuso would confirm the results of the Atomic Bomb Casualty Commission, which was created to study the health effects of the atomic bombs dropped over Hiroshima and Nagasaki. (In 1974 the ABCC was renamed the Radiation Effects Research Foundation in order to dissociate it from the atomic bomb.) The Commission, or Foundation, is set on Hiyama Hill, looking out over the Hiroshima River delta. As the Japanese bomb survivors who were summoned to Hiyama Hill found out, it is not so much a hospital as a research institution with the survivors as its subjects. Instead of doctors the ABCC/RERF staff consists largely of persons who have no clinical knowledge of the human body and its workings—"number crunchers," says Stewart disdainfully. Persons whose knowledge comes from textbooks. This sinister group decreed that Hiroshima caused no health effects beyond those of the high-level bomb explosion radiation: their findings formed the basis for international radiation standards.

"For years and years our prenatal study had been the only evidence that there was anything dangerous with low-dose radiation," Stewart explained. "At Hanford we were looking at people being exposed day in and day out over a period of time to doses only a fraction higher than background radiation, and we were finding a cancer effect... This meant there was a serious health hazard not only to workers in the atomic energy industry, but to the general public as well... We were challenging the official story that says, if the dose rate is reduced and given over time, you'll get less cancer—and if you lower it enough, you'll get no effect... Now we were saying, lower doses received over time might actually produce *more* cancer per unit of exposure than a single large dose." (The general public would have even higher rates of cancer than the Hanford workers since it contained old folks and children, known to be more susceptible to radiation insults than healthy primetime workers.) For his efforts, Mancuso lost his funding and was not allowed to publish his findings; Stewart and Kneale went back to England and continued to work on the project independently. It takes Greene more than a chapter to describe the ordeal by bureaucratic fire through which Stewart, Kneale and Mancuso had to pass in order to regain access to health records of the workers; it took them a decade. "Everyone in America who took our side in the years subsequent to the Mancuso incident lost their funding," she told Greene. "They don't burn you at the stake anymore, but they do the equivalent, in terms of cutting you off from your means to work."

Greene first laid eyes on her subject-to-be a decade or so ago during an interview that literary-scholar-turned health writer Greene was doing for a book ambitiously entitled *Cancer*, co-authored with Dr. Vicki Ratner. At first acquaintance Greene saw the great scientist as a sweet, somewhat doddering grandmother type until she shot Greene a couple of those piercing "I-do-not-suffer-fools-gladly" looks of hers and displayed flashes of her barbed wit. Greene was hooked. An overextended Scripps College professor of women's studies and literature with a big book in progress, she nevertheless knew she had to do the bio. It is likely that she considered that while Stewart might live to 100, she might not. At this writing Stewart is 95; that is to say there was an urgent need for a record of her actual living words. For who but Alice Stewart could speak for Alice Stewart?

Like Empson, Greene is a literary scholar, but she had more courage than he and took on the challenge of making Stewart's work accessible. Greene's book takes its place along with Robert J. Lifton's *Death in Hiroshima*, Harvey Wasserman's *Killing One's Own* and Carol Gallagher's magnificent *Ground Zero*, as a book that unflinchingly describes the contemporary human situation (where it's at, in all its horror, so to speak). May it be made into a film as soon as possible—Tim Robbins could do it—and by some miracle may it reach the hearts and minds of those who call the shots in the global nuclear economy.

Anna Mayo was a Village Voice *staff writer and columnist for over 20 years. She has written on nuclear issues since 1979.*

Essay Review

SUE RABBITT ROFF

NUCLEAR REVISIONISM

Eileen Welsome, *The Plutonium Files* (New York: Random House, 2000), 580 pp. ISBN 0 385 31954 1.

Gayle Greene, *The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation* (Ann Arbor: University of Michigan Press, 1999), 321 pp. ISBN 0 472 11107 8.

In October 1995, after eighteen months of deliberation, President Clinton's Advisory Committee on Human Radiation Experiments issued its final report.[1] Its findings were based on information received from research institutions, universities and hospitals across the United States. The Advisory Committee was composed of fourteen members – a citizen representative and thirteen experts in bioethics, radiation oncology and biology, epidemiology and statistics, public health, the history of science and medicine, nuclear medicine, and law. It reported to the President through a cabinet-level, Human Radiation Interagency Working Group, which included the Secretaries of Defense, Energy, Health and Human services, and Veterans' Affairs, together with the Attorney General, a representative of the National Aeronautics and Space Administration, the Director of the Central Intelligence Agency, and the Director of the Office of Management and Budget.

The Advisory Committee was set up in response to a series of articles in the *Albuquerque Tribune* in November 1993, concerning individuals who had been injected with plutonium without their knowledge as part of research in health physics during the Cold War. The reporter – who won a Pulitzer Prize for these articles – was Eileen Welsome, author of *The Plutonium Files*. Welsome is thus in the unprecedented position of having initiated a major review of human radiation experiments, which resulted in

[1] Advisory Committee on Human Radiation Experiments (Washington, DC: US Superintendent of Documents, October, 1995).

Minerva **39:** 259–264, 2001.

an official report of nearly a thousand pages. This is the ground she revisits in *The Plutonium Files* (itself nearly 600 pages long).

In the first 200 pages of its report, the Advisory Committee reviewed the prevailing standards for human experimentation between the 1940s and the 1970s, the period during which most of these activities took place. The next 400 pages documented cases of radiation experiments from archival documents retrieved by the Committee's diligent staff. These range from individual instances reported by Welsome to the Atomic Energy Commission's programme of radioisotope distribution, to incidents of non-therapeutic research on children, total body irradiation, research on prisoners in American jails, and data on nearly a quarter of a million men who participated in US nuclear weapons tests. There is also material on intentional releases of radioactive emissions at nuclear weapons plants and other installations, which have put 'downwind' populations at risk. The report concludes with the findings and recommendations of the Advisory Committee.

Welsome retraces these steps in *The Plutonium Files*, putting, as the Advisory Committee's report had said of her original articles, a human face on what had previously been anonymous data in official reports and technical journals. She places each experiment within the emerging science of radiation health physics, as it developed under the national security agenda of the Cold War. The book makes more accessible and more readable the voluminous information that was unearthed by the Advisory Committee's 85-member staff.

But how secret this information was, remains an interesting question. Much was documented by researchers, and, as I have documented elsewhere, published in peer-reviewed medical and health physics journals of the post-war period.[2] And many experiments were passed by ethics committees in the institutions in which they were conducted. Some institutions made gestures towards obtaining informed consent – albeit, as in the case of prisoner studies in Oregon and Washington State, with forms that fudged the central hazards, and were easily misunderstood by poorly educated inmates – attracted by cash payments and promises of vasectomies, without realizing the long-term hazards to their health (and reproductive capabilities).

Welsome is equally interesting on the recommendations of the Committee – which, she says, 'bore a remarkable resemblance to the experimenters they were investigating: They came from the same socio-economic class, attended the same colleges, and worked at the same

[2] Sue Rabbitt Roff, 'Human Radiation Experiments: What Price Informed Consent?' *Medicine, Conflict and Survival*, 16 (3) (2000), 291–301.

universities that sponsored the experiments' (p. 449). The chairperson, Ruth Faden, was a bioethicist from the Johns Hopkins School of Hygiene and Public Health, where some of the experiments had been conducted. Welsome believes there was pressure on the Committee to produce a consensus. In order to forge a consensus, '[e]ventually the group came up with an ingenious compromise that side-stepped the issue of whether individuals should be held culpable and ensured that a unanimous report would be delivered to the president. The committee declared that separate judgements could be made about the *wrongness* of an action and the *blameworthiness* of the person who committed the act. Simply put, it separated the experiments from the experimenters' (p. 460).

Welsome also says that the Committee was weakened by the outcome of the November 1994 elections, which left the Republicans with a majority in both houses of Congress for the first time in forty years. To improve their chances of adoption, the Committee toned down their recommendations. The prospect of medical monitoring of the survivors of the experiments, and compensation for all but a handful, was ruled out by a risk analysis that Welsome says was 'more restrictive than what other public health agencies use' (p. 465). President Clinton offered an apology, but this was lost in the media flurry surrounding the O. J. Simpson murder trial. The survivors were left to pursue their cases in the courts without a strong mandate from the President's Committee.

The legacy of the Advisory Committee on Human Radiation Experiments lies less in its compromise recommendations than in the estimated six million documents that were discovered by its staff. The advent of the Internet has meant that these documents are now accessible to the public, to historians who are revisiting the era of Cold War experimentation, and to ethicists, who are reconsidering the work of the Committee and its recommendations.

Today, we are also looking again at data from the last fifty years of radiation research, with reference to the risks from exposure to low doses – rather than to high levels such as at Hiroshima and Nagasaki. For many years it was thought – indeed, hoped – that there was a threshold below which radiation doses were not injurious to humans. Now it is generally accepted that even the most minute exposure can (although not necessarily) cause injury, and that the consequences may not be apparent for decades. However, detecting this effect by epidemiological studies in specific populations has been confounded by a number of factors.

In 1977, three researchers – Thomas Mancuso from the University of Pittsburgh, and Alice Stewart and George Kneale of Oxford University –

published a study of radiation exposures of Hanford nuclear workers in Washington State who had died of cancer and other causes in the thirty years after 1943.[3] Because of the clear 'healthy worker effect' at the plant – where deaths from all causes in the thirty-year period were 25 per cent less than expected from national rates, and cancer deaths were only 89 per cent of national rates – the researchers decided not to use a proportionate mortality method. Instead of comparing mortality rates at Hanford against national rates, they studied differences between groups of workers within the Hanford workforce – those who had been exposed to radiation, according to the monitoring system, and those who had not. They were able to calculate the Comparative Mortality Ratios among different groups of Hanford workers. Three cancers showed a dose-response relationship – in terms of lung, pancreas and multiple myeloma. Not only that, but they estimated the risk to workers at Hanford of a radiogenic cancer to be 10 to 20 times that estimated by the studies carried out since 1950 on the survivors of Hiroshima and Nagasaki.

In subsequent refinements, Kneale, Mancuso and Stewart suggested that the 'really dangerous jobs at Hanford were the prerogative of two groups of workers who had a reduced risk of dying from natural causes. Thus the principals had professional or technical qualifications that placed them in a high income bracket, and their assistants were skilled craftsmen who earned more than most manual workers.'[4] They argued that the Hanford sample should be studied to establish the risk for workers in the nuclear industries – in both weapons production and energy generation. But their findings provoked a furore among the national and international agencies responsible for regulating exposures of workforces and communities. Many studies questioned their statistical methods. However, they could not deny the evidence of cancers of the bone and pancreas. Although one study did acknowledge a positive correlation between cancer risk and radiation dose after 75 years of age, its significance was dismissed on the grounds that,

> although it is possible that the observed increase with age results from a cause-and-effect association, it seems more likely that this effect has resulted from bias in the data such as bias in the ascertainment of deaths, bias in the assignment of cause of death, bias related

[3] Thomas F. Mancuso, Alice Stewart and George Kneale, 'Radiation Exposures of Hanford Workers Dying from Cancer and Other Causes', *Health Physics*, 33 (1977), 369–385.

[4] G. W. Kneale, T. F. Mancuso and Alice M. Stewart, 'Job related mortality risks of Hanford workers and their relation to cancer effects of measured doses of external radiation', *British Journal of Industrial Medicine*, 41 (1984), 9–14.

to smoking and other potentially confounding factors for which data were not available, or bias related to dosimetry.[5]

In response, Stewart and Kneale argued that '[t]his lame conclusion was clearly the result of A-bomb data repeatedly leaving an impression of a greater cancer risk for persons who were under 50 years of age when exposed than for later exposures',[6] because of the loss of data in the crucial five years following the bombings.

Stewart, Mancuso and Kneale challenged both the multi-million dollar studies conducted in Japan under the auspices of the US National Academy of Sciences by the Atomic Bomb Casualty Commission (ABCC) and its successor, the Radiation Effects Research Foundation; and also the billion dollar, burgeoning nuclear power industry, which was claiming to produce cheaper power safely. Stewart pointed out that studies on Japanese survivors had not begun until 1950, a full five years after the two cities were bombed. She argued that this sample reflected the 'survival of the fittest'. From her pioneering work with the Oxford Survey of Childhood Cancers, where she had established links between x-rays of pregnant mothers and childhood cancers among their offspring, Stewart argued that the pre-cancer state is associated with lowered immunological competence, to such an extent that children are in grave danger of dying from secondary infections and accidents before the true state of affairs can be recognized. These two factors contributed to an underestimation of risk by the ABCC – whose studies went on to form the basis of contemporary radiation protection standards.

As Alice Stewart remarked in her Ramazzini Lecture on Delayed Effects of Ionising Radiation in 1991, her work made her about as popular as the founder of occupational health medicine, Bernard Ramazzini, three hundred years before, when he told the princes of Italy that their artisans were suffering from metallic poisoning. Gayle Greene's biography, *The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation*, traces the personal and intellectual life of a woman scientist who is still 'research active' in her mid-nineties. Her longevity is matched by her intellectual acuteness, and she is still publishing trenchant analyses of radio-epidemiological issues arising from the use of atomic bombs on Japan.

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[5] E. S. Gilbert et al., 'Updated analyses of combined mortality data for workers at the Hanford site, Oak Ridge National Laboratory and Rocky Flats Weapons Plant', *Radiation Research*, 136 (1993), 408–421.

[6] Alice Stewart and George Kneale, 'Occupational Exposures to Ionizing Radiations: Relations between Exposure, Age and Cancer Risk' (unpublished typescript, November 1994).

Gayle Greene, Professor of Women's Studies and Literature at Scripps College, asks why Alice Stewart was marginalized throughout her professional life as an epidemiologist in the UK. Stewart was keenly disappointed not to be appointed head of the Department of Social Medicine at Oxford following the death of her mentor, but this left her free to do research. After her divorce, she was a single parent, but she had a long-standing relationship with the literary critic, Sir William Empson. Clearly a woman of many parts – as befitted her Scottish schooling – she is resourceful and resilient. Greene's biography combines a feminist life story and a non-technical account of her analytical contributions. Like Stewart's own scientific papers, it bears close re-reading, especially given the accumulating data in support of her hypotheses.

These two books consider the history of radiation and nuclear energy from two complementary perspectives. They are important in helping us understand this still unfolding story, and to engage more constructively with the official histories. Relative ease of access to so many primary sources through the Internet will permit a new generation of historians to revisit the many issues. Epidemiologists have more longitudinal data against which to check earlier assumptions about the effects of exposure to ionising radiation. Radiobiologists have new techniques for making determinations about individual exposures, dating back decades. Always an exciting field of research, this wealth of new primary material is already helping us re-examine foundation assumptions, even as we enter the era of nuclear decommissioning.

ABOUT THE AUTHOR

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discover the history of the word from its first tentative appearance in 1834: an article in the *Quarterly Review* laments the fragmentation of science, as reflected in "the want of any name by which we can designate students of the knowledge of the natural world collectively ... some ingenious gentleman proposes that, by analogy with *artist*, they might form *scientist* ... but this was not generally palatable". In 1840 William Whewell (said to be the last man to know everything) re-invented the word and in time it stuck. But look down the column of adjoining entries on your screen and you can find what we were spared: "*Sciencer, Obs.* A professor of a particular science". And then there is the magnificent, and much-needed, conceit, "*Scientaster* [... after *poetaster*] A petty or inferior scientist", coined by the physiologist Michael Foster in 1899; a quotation follows from Foster's biography of Claude Bernard.

The physical sciences seem to me to do better on the whole than biology, perhaps because the corpus of knowledge is less diffuse. Here, under *flavour*, are the six flavours of quarks; *string theory* and *superstrings* get crisp definitions; *Higgs* appears, attached to *boson, field, mechanism* and *particle*; and, going back a little in time, *Debye* surfaces under *Debye effect, Debye–Hückel theory, Debye–Scherrer method, Debye temperature* and *Debye unit*. Here, too, is *buckminsterfullerene*, complete with a quotation from Harry Kroto in *Nature*. The besetting fatuity, still found in many dictionaries, of recording stoichiometric rather than structural chemical formulae has been largely but not entirely expunged, so the peptide *melittin* from bee venom comes out as $C_{131}H_{229}N_{39}O_{31}$ (who counted?). *Sulfur* — in the American and now internationally sanctioned spelling — is not in evidence. Prefixes for large units do better than those for small: we find *giga-* and *tera-*, but not *atto-* and *zepto-*.

As to biochemistry, all the most familiar proteins seem to be present and quite a number of others, although some definitions (*actin* for instance) are in sore need of revision. We have *transferrin, ferritin, laminin, reverse transcriptase, spectrin* and *ankyrin* even, but no *integrin, fibronectin, clathrin, calpain* or *G-protein*. *Oncogene* and *homeobox* are in, but *apoptosis* is missing and so are *T-cells* or *T-lymphocytes, genomics* and indeed *PCR*. In the revised M–MAH sliver, I looked for and found *magainin*, first isolated from the skin of the "clawed toad" — but *Xenopus*, I am assured, is not a toad, but rather a clawed-toed frog. Missing is *MHC* (major histocompatibility complex), ubiquitous enough, arguably, to qualify for inclusion. Of course, the *OED* does not purport to be a textbook or encyclopaedia of science and somewhere must draw an arbitrary line between the barely useful and the totally recondite, but among the lacunae are expressions that a journalist, for instance, might well want to track down.

The dictionary is diverting on misuses that have become irretrievably embedded in common speech. *Parameter* (first spotted in a mathematical tract in Latin by one C. Mydorge in 1631) receives separate definitions in conic sections, crystallography, mathematics, electricity and statistics, but also "In extended use: any distinguishing or defining characteristic or feature ...", with a quotation, fittingly enough, from *New Sociology* ("We would then say that a social theory has a human-nature parameter" — ah, so!). A *quantum jump* is not only a transition between stationary states of a quantized system, but more especially "*transf.*, a sudden large increase or advance", also now known to politicians and estate agents as a *quantum leap*.

The online format of the *OED* is friendly and responsive. A click of the mouse will bring up or hide pronunciation, etymology, quotations (2.5 million of them and, to my mind, the greatest treasure of all) and a date chart showing the development and decline of usages. You may retrieve quotations from any one author, and relate them to particular words; you may bookmark entries and you may search for your favourite cliché ("sick as a ..."). If you are unsure of a spelling you can enter a question mark in the middle of your word or use an asterisk (wild card) to denote an undefined number of letters. This will allow you, if you are so inclined, to play word-games. So, for illustration, a reader in a newspaper recently asked whether any words existed in which a single consonant appeared three times in tandem. Well, a brief search of the *OED* for words of the type, '*sss*' at once yielded *bossship* and one typo.

Today's science, with its headlong pace of progress and its ever-shifting frontiers, probably makes impossible demands of the *OED*'s editors, and it will be interesting to see how they grapple with it between now and 2010.

Meanwhile, we should celebrate a great and noble assertion of intellectual virtues and an inexhaustible source of pleasure, to those at least who can afford to or otherwise get at it. H. L. Mencken, journalist, lexicographer and sage, thought that the completion of the first edition of the *OED* in 1928 should be marked in Oxford by public revelry — "military exercises, boxing matches between the dons, orations in Latin, Greek, English and the Oxford dialect, yelling matches between the different colleges, and a series of mediaeval drinking bouts". I fancy I can see the benign shade of Sir James Murray, surrounded by his team of indexers, celebrating out in cyberspace with a small dry sherry. ■

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When silence is not a true option

The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation
by Gayle Greene
University of Michigan Press: 2000. 336 pp. $35, £19.95

Sunetra Gupta

"Practising medicine without asking these larger questions is like selling groceries across the counter," said Alice Stewart when asked why, at the peak of a career in clinical medicine, she had decided to abandon it in favour of practising epidemiology.

In 1945, the importance of identifying the risk factors of infectious diseases was becoming obvious, and efforts had already been made to define and understand the ecological processes underlying the spread of infection. The Institute for Social Medicine had been established at the University of Oxford in 1943, reflecting the recognition that it might also be worthwhile to investigate the causes of non-infectious diseases such as cancer. These diseases might have "discoverable origins in social, domestic, or industrial maladjustment", according to the institute's founder, John Ryle. Ryle died in 1950, and the institute was diminished to the Social Medicine Unit and its building taken away. Stewart, who had been Ryle's assistant, was given a readership and made its head with a budget so small that there was "barely enough to light a gas fire".

It would have been perfectly possible for Stewart at this time to keep up some semblance of research and devote the rest of her time to her country garden, not to mention the lively intellectual circuit in which she had a singular place as the lover of the distinguished literary critic, poet and mathematician William Empson. However, according to her biographer, "epidemiological investigation engaged her like a piece of detective work", and in 1950 Stewart set about organizing a retrospective case control study to identify risk factors for childhood cancer on a grant of £1,000 from the Lady Tata Memorial Fund for Leukaemia Research.

"I spent those £1,000 on railway fares traveling the length and breadth of England, going to each public health official, saying 'here are the questionnaires, will you help?'," said Stewart. From this incredible effort came the startling revelation that a single obstetric exposure to X-rays significantly increases the risk of an early cancer death. The Oxford Survey of Childhood Cancer, as it came to be known, continued for 30 years, beyond Stewart's retirement in 1974.

She relocated to the University of Birmingham, and found "an empty corridor

connecting two temporary buildings" to house the 23,000 manila envelopes containing the questionnaires. The findings of the Oxford Survey met with some opposition at a time when X-rays were routinely used for such things as measuring feet in shoe shops. However, they were eventually upheld by large-scale, long-term studies, leading finally to official recommendations against taking X-rays of a fetus.

But who was Alice Stewart, and how did she come to be in Oxford in the first place, choosing between clinical medicine and epidemiology? Gayle Greene provides us with an extended account of the events leading to this juncture in her life. She starts with the story of Stewart's mother, who in 1897 came to London from Scarborough in Yorkshire to study medicine, married a pioneering paediatrician and moved to Harrogate with the intention of practising medicine together with her husband. There is a touching account of them putting their professional name-plates up together, and incurring the wrath of a senior member of their Harrogate practice who did not wish his practice to be tainted by the presence of a female physician. Stewart's parents later bought their own practice in Sheffield, had eight children, and became deeply involved in welfare and the general reform of medical practice.

Eventually, the couple's career paths diverged, as Stewart's father qualified as a consultant physician, which by law prevented her mother from engaging in general practice. Instead, she took a position as a doctor in an armament factory and as 'Lady Tutor in Anatomy' at Sheffield Medical School.

Greene effectively links the early events in Stewart's life — growing up in these particular circumstances — to her indefatigable quest for intellectual stimulation and the terms of her independence in her life and work. From early days, she had been attuned to the trade-off between fighting her corner and finding fulfilment within the boundaries of compromise. In the 30 years of her life spent in Oxford, rather than seeking to further her status within the university, Stewart chose to accommodate herself within a "crack in the system" and get on with her work. Hers is the story of a proud woman, but one clever enough to place her pride outside the boundaries of institution, so that the repression she encountered did nothing to diminish her enthusiasm for life. Part of her extraordinary self-confidence appears to derive from her outstanding record in clinical medicine. "Now, I must tell you as a physician I was a tremendous snob," she tells Greene. Success in a different discipline, it appears, gave her the strength and courage to negotiate her position in a new field.

Greene is careful to point out the privileges of Stewart's background as well as the difficult experiences that equipped her for a life in science. She was educated at a

progressive public school, and came to Cambridge already integrated into a "charmed inner circle ... of beautiful well groomed young women". She married a fellow student at Cambridge who became a French master at Harrow School, and for a while she played the role of wife and mother. In the meantime, she hoisted herself out of a low-key research job at the London School of Tropical Medicine and Hygiene into full-time clinical medicine. She sat for her membership of the Royal College of Physicians and succeeded in her first attempt, and in 1939 was appointed to a consultant post.

Juggling a successful career, children and the demands of being a staff wife might have been the entire shape of Stewart's life had it not been for the Second World War. Stewart was asked to replace a senior assistant at the Nuffield Hospital in Oxford who had been called up for service. "It was the sort of job that was normally never open to women," says Stewart.

The quality of her life before the war and during her years in Oxford does little to substantiate the suggestion of persecution in the title of the book. It is only in the latter part of the book that we begin to identify with the sinister ring of the title, when Greene lays bare the extraordinary history of resistance by the US government to the progress of research on the hazards of radiation. Stewart's place in this scenario was as a proponent of the notion that sustained exposure to low-level radiation carries an increased risk of cancer. She became vocal in this post-retirement period of her life in supporting the various researchers who had been isolated by this process of "governmental interference". She began to serve regularly as an expert witness in compensation cases, and engaged at an international level in the public debate about nuclear safety.

In Britain, she participated in the Windscale, Sizewell and Dounreay inquiries and acted as an expert witness in the trial of the 44 women who had danced on the missile silo at Greenham Common. While not entirely comfortable with her position as a hero among activists, Stewart declares that she has "a responsibility as a scientist and physician to support them". Suddenly, she is no longer content with being invisible.

Greene attempts to comment on this change from the perspectives of gender and marginalization, and ends up with a rather diffuse amalgam of quotations and impressions. However, one clear message emerges: it can work for a time to plough on quietly, engirdled and protected by your self-esteem, but it is hard to make the same choice when your silence quite obviously affects the lives of others. ■

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DAVID NEWTON

Of science and men

The Genius of Science: A Portrait Gallery of 20th Century Physicists
by Abraham Pais
Oxford University Press: 2000. 364 pp. £25, $30

Giovanni F. Bignami

Having paid compulsory tribute to the Medicis, the Grand Dukes of Tuscany, Giorgio Vasari dedicates his monumental opus, *Lives of the Most Excellent Painters, Sculptors and Architects* (Giunti, Florence, 1568), to his fellow artists. Vasari was a great biographer of the artists of the Italian Renaissance. In 1,012 quarto pages, with illustrations, he turned their life stories into gripping tales. He could do this because he was one of them, a famous artist in his own right, for whom Michelangelo drew fresco cartoons. He was also a magnificent writer.

Not all biographers had such a style. Plutarch and Tacitus, who wrote biographies of the great men of the first century, were not emperors themselves, although they obviously moved in the right circles — Tacitus, for example, was the son-in-law of Emperor Agricola. We read (or are forced to study) their works, admire their heroes, and learn. In the case of Vasari, however, there's much more. We are transported into the minds and hands of great artists, and sit transfixed as we watch the unfolding of both history and genius — an apt comparison, I think, for the newly published work of Abraham 'Bram' Pais, albeit one he himself would not make.

Pais is a scientist of world class, and he has obviously been moving in the right circles for quite a few years now. He, too, has Vasari's capacity for making his biographees jump out of the page, both in his more extended works (like his famous ones on Albert Einstein and Niels Bohr) and within the 'microbiography' genre which he himself, I submit, invented.

Pais is the man who can say that he knows "so well" the article that Bohr wrote for Einstein's seventieth birthday (1949), because "I helped him prepare it"; or the personal recollection of Paul Dirac (Nobel prizewinner at

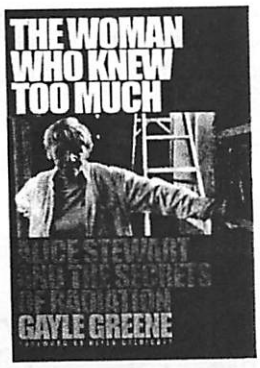
Alice Stewart

The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation
By Gayle Greene
University of Michigan Press, 1999
352 pages; $35.00

Tara O'Toole —
Dept. of Energy 1994-98

The Woman Who Knew Too Much is an estimable book about the life of Alice Stewart and her role in the long, painful effort to understand and control the health effects of radiation.

Gayle Green, a professor of women's studies at Scripps College, does not cover the technical history of the scientific controversies surrounding radiation health effects. Nor does she attempt to present the scientific arguments of Stewart's more responsible critics. But her account of Stewart's major scientific studies and explanations of countervailing opinions about the effects of low-level radiation provide readers with a good sense of what some of the fighting is about.



A brilliant iconoclast, Stewart has compiled an impressive body of scientific work despite being denied the recognition or institutional support that most researchers take for granted. Stewart, who is now 94, is a fragile-looking woman of great energy, warmth, and charm. Her persona contrasts with her reputation, which in some health physics circles is akin to that of Darth Vader. In other, more generous scientific communities she is referred to with the furtive nervousness used when speaking of a lunatic relative who might at any moment break out of the attic and embarrass the family.

Stewart's courageous struggle to uncover the truth about radiation effects demonstrates how individuals can accomplish a great deal outside the mainstream of institutional power. But the independence that enabled Stewart to pursue her own scientific agenda also left her without a recognized status or the support of colleagues within the scientific community. If she had received such support, her ideas might have had more leverage and influence.

Stewart's first major work on the health effects of radiation was a study she coauthored while at Oxford about the increasing rates of leukemia among children. Called the Oxford Study of Childhood Cancer, the work was published in *Lancet* in 1956.

The study was a landmark in the history of radiation science, the first epidemiological study to examine the health effects of small doses of radiation. Using detailed questionnaires administered to the mothers of study subjects, Stewart compared prenatal exposures among children who had died of leukemia with those of children who had died of other forms of cancer. She then compared these data to results from living controls matched for age, sex, and region. Children from both cancer groups had received twice the amount of prenatal X-rays as had the living children. Stewart and her colleagues concluded that the effect of a single diagnostic X-ray, which was a mere fraction of what was considered a "safe" dose at that time, doubled the risk of childhood cancer. Stewart remarked to her biographer, "That was what we found and that finding has determined the course of my life ever since."

Although the initial reviews of Stewart's findings were complimentary, criticism of the report grew rapidly. Critics assaulted everything from the potential of recall bias arising from the authors' technique of administering questionnaires, to Stewart's sanity. Wrote one critic, "Stewart used to do good work, but now she's gone senile."

However, Stewart persisted with her research and continued to accumulate data. A second report appeared in the *British Medical Journal* in 1958. This analysis—which tracked 80 percent of all childhood cancers occurring in Britain between 1953 and 1955—confirmed the earlier findings.

The Oxford study was published at the peak of atmospheric nuclear weapons testing. Concerns about the consequences of nuclear fallout were rife in both the United States and Britain, and Stewart's findings landed her in the middle of controversies about radiation effects. These controversies are as bitterly debated today as they were half a century ago. The scientific "truth" about the effects of low-level radiation remains confused and difficult to unravel.

Stewart's work includes analyses of data about Energy Department workers and investigations of the data on the atomic bombings in Japan, which are now managed by the Radiation Effects Research Foundation (RERF)—an institute jointly funded by the Energy Department and the Japanese government. The RERF data are considered the "gold standard" of radiation epidemiology, largely because of the massive number of people studied and the length of the observations. Stewart's critique of this data set has important implications and deserves more serious attention than it has received thus far.

She contends that the bomb survivors included in the RERF analyses are not representative of the population affected by the bomb, or of humans generally. The RERF studies began five years after the bombings—by which time, according to Stewart, many of those who survived the immediate horrors of the explosions had died of wounds or other causes. She argues that the RERF data selectively

describe radiation effects among an atypically hardy subsection of the community and are a poor basis from which to derive radiation protection standards for the world at large.

Stewart's interpretations of radiation effects conflict with prevailing wisdom—and the science that has determined the world's exposure standards. Greene contends that there has been an international "campaign" to denigrate Stewart's work, although Stewart has never been confronted directly. In fact, officials from the Energy Department and the nuclear industry have never asked Stewart to explain her conclusions. This absence of a straightforward investigation of Stewart's findings by organizations that work with radiation or are charged with protecting people is puzzling.

During the Cold War, most government and industry officials were principally concerned about defending nuclear work, and the adverse consequences of radiation exposure were covered up for national security reasons. But this argument is not valid today, and the evidence is clear that the Energy Department denied the ill effects of radiation among workers to avoid financial liability and adverse publicity. But the department also employed scientists and technical people who should have been more responsible—more curious.

At one point in the book, a friend speculates that the most tragic consequence of Stewart's professional isolation was the absence of colleagues and mentors who could have forced her to be more precise and clear about her ideas before publication. In person, Stewart is stunningly eloquent. I have heard her deliver a two-hour lecture on the intricacies of complex epidemiology, complete with numbers, without a note or pause or misplaced participle. Stewart's written work, however, is extremely difficult to follow—many experts claim it is incomprehensible. The statistical methods she employed in her investigations of Energy workers are especially hard to decipher.

In fairness, it must be said that few articles on epidemiology or radiation science make for scintillating or casual reading. As our understanding of molecular biology expands and statistical analysis becomes more sophisticated, research on radiation health effects has become increasingly difficult to interpret and evaluate.

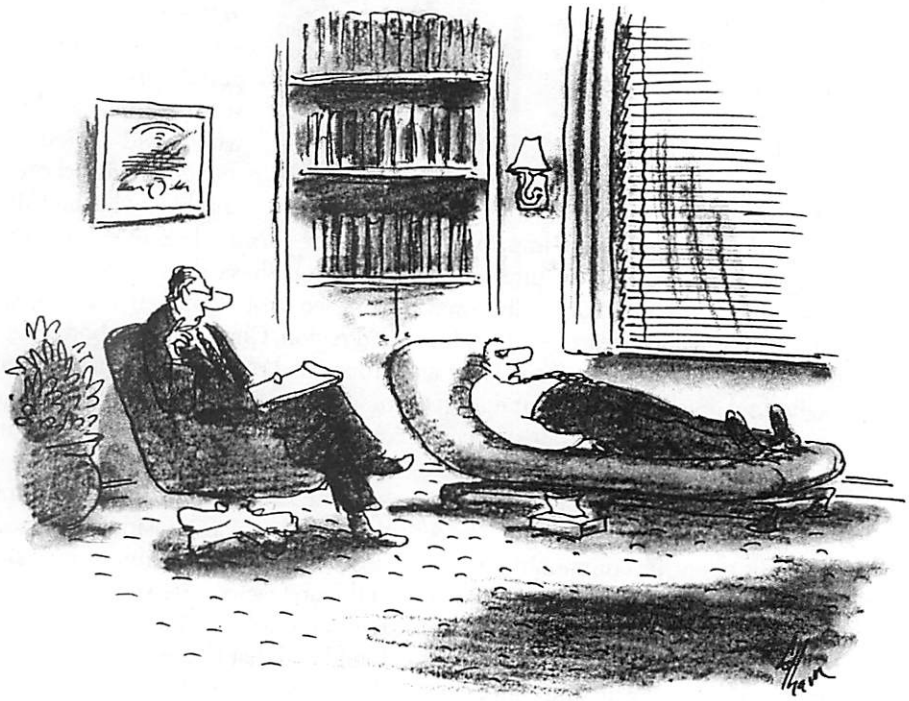
In 1986 Stewart received the "Right Livelihood Award"—known in Europe as the "alternative Nobel"—in recognition of her "work on practical and exemplary solutions to the most urgent problems of today." The British embassy in Stockholm refused to acknowledge her honor and did not even send a car to pick her up at the airport or accord her the attention and courtesies customary for most recipients. (The award is presented by the Swedish Parliament on the day before the Nobel ceremony.)

Stewart has never held a prestigious academic post or received the kind of accolades and honors one would expect of a scientist of her caliber. Yet she is a hero to many, and activists regard her with awe. Stewart has selflessly testified at numerous hearings on workers' compensation and has spoken at dozens of gatherings for a minimal or no fee.

Greene's biography can be read on a number of levels. On the one hand, it is the story of a remarkable woman—that Stewart is both a female scientist and a caring mother is not incidental to her experiences or her way of moving through the world. One comes away from this book with a deep admiration for Stewart's brains and guts—and for her decency and generosity.

Stewart's life is also a cautionary tale that warns us that our institutions are not adequately structured to deal honestly or creatively with the forces unleashed by modern technologies. The institutional backdrop of Stewart's life—universities, professional societies, government agencies, and the science community—are displayed as sexist, exploitative, incapable of constructive adjustment to change, and largely devoid of leadership.

Finally, this book serves as a re-



"I never watch television, but sometimes television watches me."

minder of the foolish, lamentable, and repugnant ways government agencies, professional organizations, and private industry have dealt with the unintended consequences of nuclear energy. Had these groups behaved more honestly when faced with unwelcome data about radiation health effects, the current debates about what to do with nuclear waste, how to weigh the dangers of nuclear power, and the health and environmental costs of nuclear weapons production might be better informed, and the chances of reaching sensible consensus considerably higher. ■

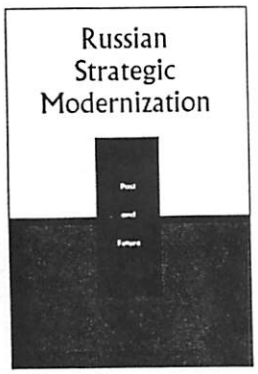
Tara O'Toole is the deputy director of the Johns Hopkins University Center for Civilian and Biodefense Studies. From 1993 to 1997, she served as assistant secretary of Energy for Environment Safety and Health.

Misreading the Soviets

Russian Strategic Modernization: Past and Future
By Nikolai Sokov
Rowman & Littlefield, 2000
222 pages; $24.95

Walter C. Uhler

In the late 1970s and early 1980s, alarmist presumptions about the Soviet Union's strategic intentions spurred the United States to adopt an aggressive, militarized stance towards its Cold War rival. The U.S. public was inundated with propaganda about America's "window of vulnerability" and why the Soviets thought they could win a nuclear war. Lending plausibility to these scenarios was the belief among U.S. officials that the Soviet Union had by the end of the 1970s acquired a first-strike nuclear posture.



Eventually, access to information contained in previously classified Soviet documents showed that the Soviet Union's Cold War posture was not nearly as threatening as once presumed. In 1956, when Nikita Khrushchev repudiated the notion that war between capitalist and communist countries was inevitable, he was not simply propagandizing. Similarly, Leonid Brezhnev's speech at Tula in January 1977, in which he explicitly denied U.S. charges that the Soviets were seeking a first-strike capability, was not an attempt at deception. Instead, both statements were expressions of actual Soviet policy.

Unfortunately, by the time the United States figured this out, it was already too late—billions, perhaps hundreds of billions, of defense dollars had already been wasted on a massive military buildup and a fantastic Star Wars missile defense system.

In *Russian Strategic Modernization*, Nikolai Sokov, a senior associate at the Monterey Institute of International Studies and a former Soviet arms control adviser, describes the various elements of Soviet defense planning that led the United States to misinterpret that country's strategic posture.

According to Sokov, the source of U.S. misinterpretations was an uncritical acceptance by conservative ideologues of what Stephen Meyer has called the "military mission model" of Soviet weapons deployment. This model posited that "weapons which the Soviets are technically capable of building, but for which no current missions exist, will not be built."

Discerning few second-strike weapons in the Soviet arsenal, U.S. policy-makers asked: Why would the Soviets allow their first-strike missiles to remain vulnerable to an American first strike—unless they were planning to strike first themselves? In response to this question, Sokov demonstrates that this "ominous" strategic posture was largely "unintended," the product

"Are you sure you shouldn't say something about economics?"

of an influential and self-interested Soviet defense industry.

Sokov points out that Joseph Stalin and Khrushchev played a predominant role in shaping the Soviet Union's strategic posture, but Brezhnev's rule was characterized by compromise and consensus. He writes, "For issues of weapons acquisition, the principle of consensus meant, among other things, that the defense industry enjoyed the same power and status as the Ministry of Defense." As a result, weapons designers were able to veto unfavorable defense proposals and push through procurement plans for what Sokov calls "half-baked" weapons systems.

Thus, designers who introduced the first successful liquid-fueled intercontinental ballistic missiles (ICBMs) were more inclined to MIRV (place multiple warheads on) these heavy weapons than they were to develop the light, solid-fueled ICBMs—which were mobile and thus more survivable—sought by the military. Also, because of the high priority assigned to ICBMs by the bureaucratically preeminent Strategic Rocket Force, the production and deployment of MIRVed ICBMs took precedence over the procurement of submarine-launched ballistic missiles and air-launched cruise missiles.

This "logrolling" for MIRVed ICBMs was disrupted in the early 1970s by Dmitry Ustinov, then–Deputy Secretary of the Communist Party's Central

THE TIMES HIGHER JANUARY 12 2001

Joan Mason

Alice queries science's wonderland

The devastation of Hiroshima and Nagasaki in 1945 was plain to see, but the true horrors of radiation damage to thousands of survivors were concealed by the nuclear establishment and self-deluding politicians. Worse, their gross underestimates became benchmarks for radiation hazards. One of the courageous few to challenge the establishment view, from the 1970s, was the epidemiologist Alice Stewart, the maverick subject of this biography. She uncovered the true hazards of X-raying pregnant women, linking them to childhood leukaemia and cancer, and in all her research she challenged accepted safety standards.

Her story is well worth telling, not least because it is insufficiently known. Like her mother, she was a pioneer doctor. She qualified in a female medical school then led an enviable intellectual life at Cambridge in the 1920s. She heard Virginia Woolf's talk to the "One Damn Thing after Another" Society that later became *A Room of One's Own*.

Although William Empson was Stewart's first and last love, she married Ludovick Stewart. His appointment to Harrow School in London helped her career. She became a registrar at the Royal Free Hospital, sharpening her diagnostic skills, and a consultant at the Garrett Anderson Hospital in 1939, evacuating to St Albans during the war. The Stewarts' careers diverged when Ludovick went to Bletchley Park and Alice moved into social medicine at the Nuffield Hospital in Oxford. "The war enabled me to leap over barriers that would otherwise have blocked my way as a woman," she says.

The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation

By Gayle Greene

University of Michigan Press, 321pp, £19.95
THES bookshop £18.95
ISBN 0 472 11107 8

Stewart was elected fellow of the Royal College of Physicians in 1946 — the ninth female fellow, and the first under 40. She was co-founder of the *British Journal of Industrial Medicine*.

It was in Oxford that she studied the health risks of industrial chemicals in factories doing war work. With 40 undergraduate volunteers filling shells with TNT, she showed the risks of anaemia and liver disease to be dose-related.

She studied pneumoconiosis among coal miners in Wales, working with their communist leader, Arthur Horner. Risks were downplayed. The deaths of miners at 55 were recorded as "succumbed to old age". A miner who died of drink at 82, she reckoned, was an excellent advertisement for drink. As ever, she battled against the established view.

In 1943, appalled by disparities in infant mortality between the rich and poor, John Ryle founded an Institute of Social Medicine in Oxford and appointed Stewart as his assistant. After Ryle died in 1950, Stewart was made head of a social medicine unit as a reader, and fellow of Lady Margaret Hall. With no resources she raised money to hire an assistant and a statistician, systematised the records and studied leukaemia. The Oxford Survey that Stewart produced was rich in detail, which, with her insight, uncovered vital correlations. For example, she found that exposure of either parent to ionising radiation correlated with childhood leukaemia, often recorded as cot death. She fought to establish that there is no "safe" or threshold dose of radiation. Nowadays we recognise the hazards to cells in division, and therefore to the foetus — a single hit can cause mutation. X-raying of pregnant women was discontinued and X-ray viewers disappeared from shoe shops.

Stewart left Oxford in 1974 and, along with George Kneale, her statistician, took the Oxford Survey to the University of Birmingham, which later made her a professor.

Invited to the United States in the 1970s, she observed workers in the nuclear weapons industry at Hanford and Oak Ridge dying of radiation-induced cancers. Safety standards, though better than elsewhere, were too low. High exposures were concealed, injury was disputed, compensation was mean and whistleblowers were blacklisted. Stewart noted subtle factors, such as the survival of the healthiest workers, even though they were put in higher-risk occupations, which pointed to a genetic link. When she was 80, she was awarded $2 million (£1.3 million) to study the records of nuclear workers from the US weapons complex.

Her evidence of the hazards of parental exposure to radiation around nuclear installations is still disputed. She showed supposedly "safe" levels to be too high, but lowering them would open the floodgates to claims. A 1982 study by the National Cancer Institute, commissioned by Congress, estimated that in the west of the US, people received doses of radio-iodine in atom-bomb fallout that were 100 times greater than those estimated in 1959, ten times greater than at Chernobyl, leading perhaps to 10-75,000 thyroid cancers, most as yet undiagnosed.

Stewart's 1970 *Lancet* article on "Gene-selection theory of cancer causation" quotes from an Empson poem: "How small a chink lets in so dire a foe." Slowly international researchers are demolishing what she calls "the gold standard": the long-standing, meretricious interpretation of the Hiroshima data. "Truth is the daughter of time," she says.

Gayle Greene's biography is well referenced, while betraying its American origin. It tells a good story, much of it in its subject's own spirited words. Photographs show Stewart's family and friends, and her progress from charming young woman to lively, indomitable 90-plus year old. Nuclear weaponry has done more damage than Hiroshima, Nagasaki and nuclear testing. The killing of Lumumba, support of Mobutu and Kabila, and much of the subsequent tragedy of sub-Saharan Africa can be traced to "safeguarding" Congolese uranium. What will Sellafield do with its 60 tonnes of plutonium (half-life 24 millennia)? The Barents Sea, rich in fish, is described as "Chernobyl in slow motion" — what are those nuclear submarines doing? We need more whistleblowers like Alice Stewart.

Joan Mason is senior affiliated research scholar, department of history and philosophy of science, University of Cambridge.

Gayle

shorter articles, so I had hoped to find detailed calculations and applications to justify the intuitions. I found myself agreeing with Lord Kelvin who said that he only understood something that he could put into numbers.

I recommend that you read the book, then go to some earlier Saperstein articles where he works out some detailed calculations, and then play around with the Richardson model and with the two- versus three-nations coupled non-linear equations.

There are some mistakes in the text due to insufficient proof reading. Two notable mistakes are on p. 102, where the parameter epsilon should equal zero (NOT one) to reduce the three-nation system to the two-nation system; and p. 118 where in Eq. (1) the parameters x(j) should be coupled not to x(i) but to the time derivative of x(i).

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The Woman Who Knew Too Much: Alice Stewart (1906-) and the Secrets of Radiation

By Gayle Greene, University of Michigan Press 2000, ISBN 0 472 11107 8, £19.95 <www.alicestewart.org>.

[This review first appeared in the *Times Higher Education Supplement* (United Kingdom), and is reprinted here by permission.]

The devastation of Hiroshima and Nagasaki in 1945 was plain to see. But the true horrors of radiation damage to thousands of survivors were concealed by the nuclear establishment and self-deluding politicians; worse, their gross underestimates became benchmarks. One of the courageous few to challenge this, from the 1970s, was the epidemiologist Alice Stewart. She had long been a thorn in the side of the medical establishment, for she uncovered the true hazards, namely childhood leukaemia or cancer, of X-raying pregnant women.

Like her mother, she was a pioneer doctor, qualifying in a female medical school. This followed a dazzling intellectual life at Cambridge in the 1920s: her circle included Cartier-Bresson, Redgrave, Lowry, Bronowski, Trevelyan, Alistair Cooke, Anthony Blunt, and Kathleen Raine. She heard Virginia Woolf's talk which became '*A Room of One's Own*'. William Empson was her first and last love. Cambridge expelled him (after he had written 'Seven Types of Ambiguity', in two weeks) when his landlord reported finding 'various birth control mechanisms' in his room. They married other people—Empson went to Japan and China, she married Ludovick Stewart—coming together again after 30 years.

Ludovick's appointment to Harrow school helped her career. She became a registrar at the Royal Free (where her parents met in 1901) and sharpened her diagnostic skills. She became a consultant at the Garrett Anderson Hospital in 1939, evacuating to St Albans with the war; Ludovick went to Bletchley Park, decoding, and their careers diverged. She moved into social medicine at the Nuffield Hospital in Oxford: with two children, she avoided call-up, and received help with child care. "The war enabled me to leap over barriers that would otherwise have blocked my way as a woman", she says, "It tells you what women could do if society would change its attitude."

She studied health risks of industrial chemicals in factories doing war work. With 40 undergraduate volunteers filling shells with TNT she showed that the risks of anaemia and liver disease were dose-related. The students' blood counts recovered! As incentive, she set them in prize essays, published as *Impressions of Factory Life*. She co-founded, in 1946, the *British Journal of Industrial Medicine*. She studied pneumoconiosis among coal miners in Wales, working with their Communist leader, Arthur Horner. As ever, risks were downplayed. Miners dying at 55 were recorded as "succumbed to old age"; a miner who died of drink at 82, she reckoned, was an excellent advertisement for drink.

In 1943 John Ryle founded an Institute of Social Medicine in Oxford and appointed Stewart as his assistant. They were appalled by disparities in infant mortality at top and bottom of the social scale. After he died in 1950, Alice was made head of a Social Medicine Unit, as a reader (and fellow of Lady Margaret Hall), with no resources. She raised money to hire an assistant and a statistician, systematized the records, and began to study leukaemia.

Her Oxford Survey work was rich in detail which, with her insight, uncovered vital correlations. Exposure of either parent to ionising radiation correlated with childhood leukaemia, often recorded as "cot death." She fought to establish that there is no "safe" or threshold dose. Nowadays we recognise the hazards to cells in division, and so to the fetus—a single hit can cause mutation. X-raying of pregnant women stopped, and X-ray viewers disappeared from the shoe-shops.

Richard Doll was appointed Regius Professor in 1969 (Doll and Hill had linked smoking with lung cancer). Doll had little time for Alice Stewart, and research funding was difficult. When she retired in 1974 she and George Kneale, her genius statistician, moved with their Oxford Survey to Birmingham University, which appointed her Professor when she was nearly 90.

Invited to the US in the 1970s, she could see workers at Hanford or Oak Ridge, producing nuclear weapons, dying of radiation-induced cancers. Safety standards were low, high exposures concealed, injury disputed, compensation was mean, and whistle-blowers were blacklisted. Gradually, her conclusions were confirmed by other scientists. When she was 80, she was awarded $2 million to study nuclear workers' records from the US weapons complex.

Her evidence of the hazards of parental exposure to radiation around nuclear installations is still disputed. She showed supposedly safe levels to be too high; lowering them would open the floodgates to claims. A 1982 study by the National Cancer Institute, commissioned by Congress, estimated that Western Americans received doses of radioiodine in atom bomb fallout 100 times greater than those estimated in 1959, 10 times greater than at Chernobyl, leading perhaps to 10-75 thousand thyroid cancers, most as yet undiagnosed.

Her *Lancet* article in 1970 on "Gene-Selection Theory of Cancer Causation" quotes from an Empson poem: "How small a chink lets in so dire a foe." Slowly, surely, international researchers demolish what she calls "the gold standard," the long-standing, meretricious interpretation of A-bomb data. "Truth is the daughter of time," she says.

Gayle Greene's book is well referenced, while betraying its American origin. It's a good story, much of it in Alice Stewart's own spirited words. Photographs show her family and friends, and her progress from a charming young woman to a lively indomitable ninety (plus)-year-old.

Nuclear weaponry has done more damage than Hiroshima, Nagasaki and nuclear testing. The killing of Lumumba, support of Mobutu and Kabila, and much of the subsequent tragedy of sub-Sarahan Africa, can be traced to "safeguarding" Congolese uranium. What will Sellafield do with its 60 tonnes of plutonium, half-life 24 millennia? The Barents Sea is described as "Chernobyl in slow motion"—what are those nuclear submarines *doing*? We need more whistle blowers like Alice Stewart.

Dr Joan Mason
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March 5, 2000

Time Bomb

A biography of the woman who studied links between prenatal X-rays and leukemia.

By MATTHEW L. WALD

Every study that tries to measure the effects of radiation on health adds to a never-ending debate. Among the very few ideas that are generally accepted is that children X-rayed before birth, even if only once, have a measurably higher chance of developing leukemia.

THE WOMAN WHO KNEW TOO MUCH
Alice Stewart and the Secrets of Radiation.
By Gayle Greene.
Illustrated. 321 pp. Ann Arbor: University of Michigan Press. $35.

That idea, well entrenched now, was a long time coming, and it came because of Alice Stewart, an English doctor and (before the term gained wide acceptance) an epidemiologist. Stewart, born in 1906, did her pioneering work on childhood leukemia in the mid-1950's, but is today still pushing the envelope, with studies of workers in nuclear weapons plants that find a variety of health problems she attributes to radiation. She continues to publish scientific papers in peer-reviewed journals and to speak at conferences.

Gayle Greene's "Woman Who Knew Too Much" seeks to trace Stewart's unconventional approach in investigating the effects of man-made radiation. It provides some shrewd insights into her personality and methodology.

For example, in the project she oversaw known as the Oxford Survey of Childhood Cancer, Stewart said she drew the link between prenatal X-rays and the incidence of leukemia not only by reviewing health records but by asking a wide variety of questions of the mothers. "They might have a memory of something prenatal that the doctors might have forgotten," she said.

The survey, which grew to cover hundreds of thousands of children in England in the mid-50's, including me, was not her first experience in getting close to her subject matter or, for that matter, her closest. In the early days of World War II, called upon to find out whether TNT was making the workers in a munitions factory sick, she decided "I could get a much better grip on it if I went and filled some shells myself."

At times the book hews so closely to Stewart's recounting of her own story that it is almost a memoir. Elsewhere, Greene, a professor of women's studies and literature at Scripps College in Claremont, Calif., traces a history of professional slights and nonrecognition, and seeks to build a case that Stewart is like Galileo and Copernicus, recognized only in hindsight.

The problem with this approach is that it presumes that the scientific mainstream will come around to Stewart's point of view about the effects of radiation on adults. It may, but it hasn't so far.

"The Woman Who Knew Too Much" doesn't work as a history of science -- the technical material given by Greene isn't broad or deep enough, and some of the detail is oversimplified. It doesn't work as a history, either, offering only limited context for the politics and economics of the nuclear age. But it does provide a picture of Stewart as a woman in an area not hospitable to women for most of her century, and working in a pioneering field, epidemiology, that raised still more suspicion. Even today epidemiologists are not much in favor with other scientists; a joke among Energy Department officials is that they are good at finding health problems -- as long as the problem you are looking for is an epidemic. Stewart's work on childhood leukemia, though, was based on about one extra case per 2,000 babies, a subtle problem.

In the last few years Stewart has been trying to build the case that data on Hiroshima survivors, the main source of our knowledge about radiation health effects, is a poor yardstick for predicting the health of nuclear workers, who get their doses in small, chronic increments, not in one large event. She adds that the Hiroshima studies do not even represent the complete experience of the bomb survivors, since the work there did not start until five years after the bombing, by which time many of the weaker survivors had died.

All this is characteristic of Stewart's unorthodox thinking. If "The Woman Who Knew Too Much" provides only a limited understanding of the science, it does provide a good understanding of the scientist.

Matthew L. Wald, a Washington correspondent for The Times, writes frequently about nuclear issues.

See my NYT letter →

Return to the Books Home Page

Letters

3/26/00

Traumatizing Woody

To the Editor:

In her review of Marion Meade's "Unruly Life of Woody Allen" (March 5), Mim Udovitch seems to claim that Allen's reprehensible behaviors "originated in trauma." If she knows of some trauma inflicted on Woody Allen, she should tell us what it was. She adds that Allen has characterized his relationship with his mother "in terms that could be translated as abusive." There's a little language problem here, but she appears to be saying that Allen has accused his mother of abusing him — a serious charge. Again, she should say what she means. Otherwise, we are likely to assume that the trauma and abuse in question are of the kind that in today's pop psychology are said to characterize the childhood of anyone who quarreled with his parents or didn't like his lunch and, above all, anyone who engages in disapproved behavior such as, for example, having an affair with his girlfriend's daughter. Colette had a long affair with her stepson. Was she traumatized and abused?

JOAN ACOCELLA
New York

Not a Fellow Traveler

To the Editor:

Alonzo L. Hamby's letter (March 5) quotes Arthur Herman's book on Joe McCarthy as saying that my father was "heavily involved in various fellow-traveling activities." Hamby's skepticism about this charge is well justified. My father was *not* heavily involved in fellow-traveling activities (unless Herman regards support for the republic in the Spanish Civil War as fellow-traveling). Indeed, when Herman credits me with signing the powerful anti-Soviet statement sponsored by John Dewey and Sidney Hook in May 1939, three months before the Stalin-Hitler pact, he has the wrong Schlesinger. The Schlesinger who signed this famous attack on fellow-traveling was my father.

ARTHUR SCHLESINGER JR.
New York

Secrets of Radiation

To the Editor:

Matthew L. Wald is correct that my biography, "The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation" (March 5), is not a history of radiation epidemiology or of "the politics and economics of the nuclear age"; it was not intended to be. But I do wish he had read the book closely enough to get straight a crucial fact: Stewart's research turned up a link between prenatal X-rays and *all* types of childhood cancer, not just leukemia. To imply — as Wald has — that her findings address only or even primarily leukemia is to diminish and misrepresent them.

Stewart's 50 years of research with children's cancer and nuclear workers have shown that radiation from all sources causes far more cancer than traditional epidemiological studies indicate. It is time for her work to get a fair reading.

GAYLE GREENE
Claremont, Calif.

To the Editor:

As radiation physicists, we would like to respond to Matthew L. Wald's review. Wald states that one of the very few ideas generally accepted about the effects of radiation on health is that "children X-rayed before birth . . . have a measurably higher chance of developing leukemia." In fact, the reports of a correlation between childhood cancer and in-utero radiation have been criticized for a number of shortcomings, such as not taking into account the influence of pre-existing medical conditions for which the examinations were required. Statements like the reviewer's take a terrible toll when desperately ill pregnant women refuse to undergo necessary X-ray examinations, putting their own lives and the lives of their children at risk.

THOMAS LOWINGER
Brooklyn
DANIEL P. HAYES
New York

The Times welcomes letters from readers. Letters for publication should include the writer's name, address and telephone number. Letters should be addressed to The Editor, The New York Times Book Review, 229 West 43rd Street, New York, N.Y. 10036. We regret that because of the large volume of mail received, we are unable to acknowledge or to return unpublished letters.

ON THE WEB *Weekday and Sunday book reviews since 1980 — along with this week's Book Review, expanded best-seller lists, special features, first chapters and audio readings — are available from The New York Times on the Web:* **www.nytimes.com/books**

Int J Occup Environ Health 7(1): 74-78 (2001)

We urge the HSE to consider the opinions of other scientists. An alternative we have suggested is that there be an international, possibly European industry-wide, study. This is the only way that a statistically adequate study could be undertaken. It is important to note that the study should look at ill health rates across the board in key semiconductor workers.

As has been stated, there are only two places where there are enough semiconductor workers to undertake a study. One is Japan, where there is no will to undertake such a study. The other is the United States, where the industry has refused to cooperate. We would like to add a third proposal, a European-wide study.

Phase Two would like to know why the HSE does not listen to its international critics. Why does the HSE persist in its efforts to conduct another flawed study?

JAMES MCCOURT
Coordinator, Phase Two

GRACE MORRISON
Secretary, Phase Two

Injured Semiconductor Workers Group
Greenock, Scotland

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2. Elliott RC, Jones JR, McElvenny DM, et al. Spontaneous abortion in the British semiconductor industry: an HSE investigation. Am J Ind Med. 1999;36:557-72.

Book Reviews

Karl Morgan and Alice Stewart, Survivors on the Nuclear Stage

The Angry Genie: One Man's Walk through the Nuclear Age

By Karl Z. Morgan and Ken M. Peterson.
Norman, University of Oklahoma Press, 1998

The Woman Who Knew Too Much; Alice Stewart and the Secrets of Radiation

By Gayle Greene
Ann Arbor, University of Michigan Press, 1999

These books present accounts of an American physicist and of a British physician, who independently were involved in bruising battles over the calculation of the risks of exposure to low levels of radiation, but who ultimately persuaded regulators and courts that serious reservations had to be applied to the data and concepts on which the estimates of the risks to the health of individuals and of populations exposed to ionizing radiation had been based. The reviewer has no compunction about giving the ending away early as these books were not written as whodunnits. They can be read at a superficial level as modest accounts of heroic exercises by two individuals, or in the case of Alice Stewart, as an addition to the feminist canon. The heroism was not that of fighting a dramatic adrenaline-fuelled decisive battle and living happily ever after, weighed down with the glittering prizes, but that of sustaining over decades, bloody but unbowed, campaigns against adversaries who outnumbered them, were better resourced, and were closer to power. Stewart, by her unremitting intellectual challenge to received wisdom, was to make powerful enemies and was to be denied the resources and academic recognition she merited.

Their contiguous publication symbolizes how in the history of awareness of the effects of ionizing radiation, physics and medicine generally went in tandem. It was equally fitting that they were honored jointly by a conference in 1998 at the New York Academy of Sciences.

An occupational lung cancer problem was recognized in the 1870s by the physicians attached to the Schneeberg mines of Saxony, though it was some time before the Kobold demons, traditionally held responsible for the afflictions of miners, were identified as radon and its daughter products. Within 30 years of this report, physicists were investigating the physical properties of various sealed and unsealed sources of ionizing radiation, and their physicians were observing their adverse biologic effects. Shortly after Röentgen described his body-penetrating rays, physicians were to observe their damaging effects on the skin, much as physicians were to broaden their dermatologic experience as a result of chemists' carrying tubes of pitchblende extract in the pockets of their gilets (vests).

Detecting the effects of radiation after heavy exposures, and their *secundem artem* management, presented no challenge to clinical acumen. The serious intellectual challenge to physicians came when the choice of the criteria of effect was influenced by radiobiologic studies in the laboratory, and when the risks came to be measured in terms of the statistical excess cancer mortality or of cancer registration in industries or in other populations. Epidemiology offered to be a valuable technique for studying adverse population health effects, but it had serious limitations. In the case of radiation-risk predictions for low-level exposures, initially considerable reliance was placed on extrapolation from the heavy exposures at Nagasaki and at Hiroshima. Even if the dosimetry had been reliable, and there were to be several stabs at getting the theoretical modelling of those complex historic events right, there were still problems. The shape of the dose–response curve was a matter of controversy, and was critical for the prediction of effect at low-level exposures. There were those who held that there was a threshold below which radiation was harmless. In this school, it is possible to identify a subset afflicted with the inability to overlook the

awkwardness that the limitations of the data precluded categorical exculpation, who nevertheless were prepared to offer reassurance of there being an unquantified because unquantifiable low risk at low-level exposure. Others, while acknowledging that zero effect could be guaranteed at zero dose only, considered it "conservative," in the sense of overstating the risk at low-level exposures rather than understating it, to extrapolate the rectilinear dose–response "curve" derived from the higher exposures to the origin of the graph. Unfortunately, data consistent with the lower end of the graph's being curvilinear and convex upwards detracted from this claim for overassessment. With the large populations involved, the disparities between the risks at low doses calculated from the rectilinear and from the curvilinear models were significant. Finally there was the problem of obtaining reliable dose and response data from the large population required to provide adequate statistical power to evaluate with confidence the predictions of risk at the low levels of exposure deemed to be "acceptable."

Stewart differed from the nuclear establishment scientists importantly in her contention that it was unreasonable to predict the risk to nuclear workers, and for that matter the general population, from the health experience of the survivors of the A bombs, a view supported by discrepancies found between predicted cancer risks and those observed in nuclear workers. Not only did the bomb survivors constitute a special group, but so did the nuclear workers who would share the "fit worker" effect appropriate to all working groups as well as constituting a peculiar socioeconomic group. The epidemiologist is bedevilled by the perennial question of how to find an appropriate group with which to compare the study population, and how to interpret disparities. In a survivor population, the grim reaper will have biased it towards fitness, and the conditions that have operated to constitute a working population will also have selected the healthier.

Initially, standard-setting bodies could be comfortable with an excess mortality in a working population believed to be below 2%, and were confident in their dose response predictions. Yet when the epidemiologists who conducted the U.K. Atomic Energy Authority employee mortality study inter alia attempted to evaluate the ICRP [International Committee on Radiation Protection] predictions, they were to conclude that, despite even their substantial 40,000 population: "the confidence interval round the risk estimates was very wide, ranging from zero at one extreme to an upper limit which would imply that the ICRP safety limit could be 15 times too low" [Beral et al., British Medical Journal, 1985;291:440–7].

As with other contentious agents, for example tobacco and asbestos, there were scientists to interpret the findings of studies to support a more sanguine view of the risks of radiation. Under the critical eyes of the Morgans and Stewarts, claims for the utter safety of low-level radiation being no longer generally plausible, different approaches were called for to provide reassurance. One technique employed was to put the risks in the context of everyday activities in the form of: The risk is no worse than, crossing the road twice a day/ flying 20,000,000 miles in a civilian aircraft/ 10 high-level flights/ smoking 3 cigarettes/ etcetera (not a verbatim quotation but just to give the flavor). Then there were the plays upon words, offering such anodynes as "Virtually risk-free," "a practical safety level," and "no measurable risk," all of which beg questions galore. By "virtual" did they mean "Being in essence or effect, not in fact"? Is "practical" being used in the sense "that may be used," "derived from practice," or "matter of fact"? Or did they mean "that with current technology this is the level that it is reasonably practicable to attain"? As for "no measurable risk," what are the limits of resolution? (The perverse will conjure up the image of Admiral Nelson clapping a telescope to his blind eye and declaring that he saw no ships.)

There is a Pfeiffer cartoon in which two characters are expressing increasing concern about environmental radiation in a background growing steadily darker. In the final frame, one of the characters remarks: "They say that the black specks are good for you!" This was right on target. Quite early on, entrepreneurs seized on the new snake oil, selling radiation-rich spa water to those unable to take the Cure at the spa or in the radiation-rich atmospheres of certain mines and caves, but then nobody is on oath when trying to turn a fast mark, franc, or whatever. Latter-day apologists for radiation are again offering the comforting principle of Hormesis. Broadly speaking, they claim that low doses of radiation are proven to be good for you, though its advocates have not yet accused Stewart of unethically advocating the deprivation of radiation workers of the health and longevity benefits of low-level exposure.

Negotiating an "acceptable" burden of excess disease and mortality first requires that scientists and physicians produce reliable dose response relationships for the various effects of the various ionizing radiation agents acting externally and internally. This process has been a learning one for members of the prestigious expert committees, who have periodically been required to recalculate the putative doses to which populations have been exposed, taking into consideration that energy emitted is not necessarily to be equated with dose received by the critical site, revision of the different relative biologic equivalents of the received doses measured for different sources, and the variation in radiosensitivity of different tissues at different ages. Having come to terms with these variables, they then have had to contend with the different beliefs of the shapes of the dose–response curves held by their various members.

Until quite recently, it was accepted that decisions about the acceptability of risks from chemical or physical agents might be taken by members of self-electing committees of experts meeting in private, who required no mandate from the constituency of the exposed. A leavening of Doctors of Philosophy by Doctors of Medicine was taken as assurance that the best interests of mankind were served. Latterly, for a number of agents, it has been considered appropriate for members of the constituency to which the standards will apply to play roles in the discussions and decision-making process. One day, this may even apply to ionizing radiation.

This sets the scene in which Morgan and Stewart were to play their parts as depicted in the biographies under review, Morgan from within the councils of radiation-standard setters, Stewart as an outsider. The titles of these books notwithstanding, here are no highly spiced exposes to provide the "quick fix" of righteous indignation, although in all conscience there is enough to find discomforting in the blighting of Alice Stewart's career. The books neither canonize the subjects nor demonize their opposition. Nor for that matter do they cater for the connoisseur of elegant biography and fine writing. Only persevere, and readers will be rewarded with accounts of the parts played by two quite ordinary mortals who rose to the occasion and sustained their roles against powerful adversaries.

That the U.S. military and civilian nuclear alliance was a powerful, deter-

mined, and resourceful one, rather than a bugaboo or a Quixotic figment against which Morgan and Stewart foolishly tilted, has been repeatedly testified to by a number of reliable sources. To those who hold with the belief that they manage these things much better abroad, at home Stewart faced a no less real and formidable U.K. nuclear establishment. This was confirmed by her compatriot, the late Geoffrey Rose, who as Professor of Epidemiology at the London School of Hygiene was of the ranks of the Great and the Good to be relied on by Government to advise on such politically sensitive issues as tobacco and radiation. On retirement he was to state publicly: "I have become aware that in investigating the environmental health impact of large industries (especially if they have military interests), we are confronting the seat of immense economic and political power . . . doctors constitute no more than an innocent and ill-equipped David confronting Goliath, the well-armed and experienced giant." [Journal of the Royal College of Physicians London, 1991;25: 48–52.]

The history of the war over the derivation of ionizing radiation dose–response relationships and by implication "acceptable" levels of exposure is an account of battles where the majority wishful thinking of pragmatism triumphed repeatedly over a minority-led policy of prudence in the face of the deficiencies of the data. While the subjects of these biographies were iterating their attacks on the Giant's intellectual weak spot, other scientists were able successfully for a long time to obscure the issue with the dust of polemic, and sustain the illusion that Goliath was untouched.

Morgan and Stewart were to battle on until the promise of Psalm 91 was to be realized: "With length of days I will satisfy him." With longevity came honors from those academic institutions that wished to do honor to themselves, and government was sufficiently influenced as to take note of Morgan's and Stewart's reservations about the order of risk to health at low levels of radiation that had been calculated by national and international expert committees.

Karl Z. Morgan was born in America in 1907. His father was a Lutheran minister whose ancestry included the formidable Daniel Boone. (The reviewer has long been haunted by that Z in the radiation literature, and had wondered which biblical character had been set for him in the cradle as a model. The Library of Congress data gives it in full as Ziegler, though the biography describes his mother as coming from a long line of Lutheran ministers by the name of Zigler. The Z in his name would have served Morgan as a constant reminder of his spiritual legacy.) After thoughts of following in the family tradition, he abandoned the study of theology and turned to physics.

Alice Stewart was born in England in 1906 into a family where, quite unusually, her mother and father were both medical doctors, but unlike Morgan she did follow in their footsteps, graduating as a doctor from Cambridge University.

The timing of their graduation and entry into the labor market, coinciding with the Great Depression, was unpropitious. Morgan was fortunate in obtaining an academic post investigating the nature and properties of the novel enigmatic cosmic particles. In addition to the Depression, Stewart faced the career problems presented by gender, marriage, and children: these were to operate from the start of her career until quite late. Although bogged down initially in "part-time woman" [sic] posts, an occupational hazard of women in medicine that has been on the verge of being remedied in the U.K. for the past 40 years, she persevered and obtained a higher medical qualification at first go, which, while it was quite an achievement, was not to prove an immediate professional open sesame.

The Second World War was the ill wind that was to change both their careers decisively. With America's entry into the war, Morgan's recruitment to the Manhattan Project established him in another innovative field, that of health physics, where his function was to measure the release of ionizing radiation from sealed and unsealed sources, and to monitor and control internal and external exposures of the workforce involved, all of which is easier said than done. There was a world of difference then between carrying out the measurement of a controlled source of radiation in a physics laboratory and monitoring the unpredictable mixed exposures of a radiation worker on site. For the surveillance of exposures to external sources, the health physicist had to develop instruments that were small enough and robust enough to be carried or worn in the workplace, yet could reliably measure instantaneous incident radiation, as well as record cumulative doses by a reliable means that could be processed on an industrial scale. Ingenuity produced several types of film badges with a variety of filters to cover the different energies, with cumulative exposures derived from the degrees of blackening of the emulsion. There were portable ionization chambers to sound the alarm when acute exposures were excessive, and pen-like electrostatically charged dosimeters to measure cumulative exposures, which the operative could also use to monitor exposure. As for the monitoring of isotopes that had been taken up by the body, that continued to present formidable challenges.

With the call up to the services of male doctors at the outbreak of the Second World War, Stewart was able to take up an appointment as consultant physician to a London Hospital, and later for a short period in an academic unit in Oxford. By a relatively young age, our heroes full of promise seemed to have their feet set firmly on their respective career ladders. How then did it come about that such properly brought up, able, intelligent, and privileged people, could end up at loggerheads with the establishment?

In their nineties, Morgan and Stewart was persuaded to give accounts of their lives, and of their roles in the ionizing radiation controversies. The resulting texts are paradoxical on a number of scores. As every English schoolboy knows, Americans are larger-than-life uninhibited extroverts, wherein lies the first paradox. Morgan's walk through the Nuclear Age is a modest account of a pioneer of health physics in the nuclear setting. He was a long-term member and at times founder and senior officer of sundry national and international radiologic protection committees, in which he would have played the roles both of expert in his own right and of national or company representative. The reconciliation of these two roles must often have been difficult, and once he was persuaded of Stewart's views on the widely-held illusion that there was a level of exposure below which lay utter safety (the threshold hypothesis), impossible. His biography reveals little of the man, but concentrates on the role he played as a highly competent, modest, and ethical health physicist at a difficult time in a difficult setting. Although this represents only one man's view of the history of nuclear physics from its origin, the reader will be rewarded by his worm's-eye living testimony of a number of critical events. For all his involvement in the Manhattan project being at a remove, merely being engaged in protecting the scientists and workers involved, he shared the angst about the product with a number of his peers actively engaged in the development and construction of the bomb.

With their long half-lives, some of the radioactive isotopes will continue to constitute human health hazards for tens of thousands of years, so that the importance of the public health role envisaged for health physics as the guardian of the workforce and of the world community of this generation and for generations to come as far as may be, in relation to the safe containment of waste products, was self-evident. (Sixty years into the nuclear age, solutions are still wanting.) So long as the health physicists kept within bounds and did not threaten seriously to embarrass nuclear development and production, they were an acceptable incubus. The physicists may have considered that they fully justified their existence by the important role they played in the protection of radiation workers, the general public, and the environment, but in the fullness of time they would have to come to realize that management valued them for their important public relations image. Further to Morgan's dismay, health physicists began to be asked to provide testimony in court favorable to the defendant, in compensation cases brought by fellow employees, and, as he sadly observed, in general they complied. He was to decline, and compounded his intransigence after retirement by providing expert testimony on behalf of claimants in the two most significant radiation cases of the century.

Morgan's involvement in the nuclear program must be seen in the context of the critical national security conditions under which America and her allies were laboring during the Second World War, and those resulting from the protracted brittle peace that existed between erstwhile allies in the postwar period. When he stumbled across human experimental exposures that he deemed unethical, there could be no question of public whistleblowing, he might only draw attention to them in confidence to his seniors, and when conscience prompted him to decline to become involved in an experimental activity, this too he had to do discreetly. For all his discretion, Morgan was unlikely to have endeared himself to his lords and masters, and neither perhaps to his colleagues for that matter. Ethical principle is as a naked lady whom all gentlemen admire, but from whom they delicately avert their gaze. There will have been those of his peers who agreed with Morgan's opinions, but experience suggests that few could be expected to support him publicly. Others might even have been resentful of him for taking the high moral ground, because of the reflection on their own compliance, and as for his masters, when did an unwelcome message ever endear a messenger? Morgan does a bit of breast beating for some of the errors of his ways, but to do him justice, this is usually in consequence of hindsight.

In a hierarchical organization with such historic military/civilian security imperatives, one might well wonder how on earth a southern gentleman, as some have categorized Morgan's style, continued in his post until retirement at 65. For all the influence that Ken Peterson, the attorney who acted as co-author, may have tried to bring to bear on Morgan to overcome his reticence, no clues to the secret of his survival in his post are let slip. A simple answer, and a plausible one, would be, only endure. Bereft of Henry II of England's facilities to deal with the turbulent, and it no longer being accepted policy to shoot the occasional commander to encourage the others, Morgan's managers need not have been without means for taming "difficult" experts. Reports on him need not be false, but could be restricted to faint praise, and the odd word dropped judiciously off record, intimating that he was an uncooperative colleague, and perhaps even an irresponsible one, would have been more effectively damning. In the public service, generally security of tenure operates unless the employee can be proven to be grossly incompetent, has betrayed state secrets or their equivalent, has used public facilities improperly, or has been dishonest in claiming expenses, or the function is abolished. Petty humiliation and discreet marginalization are quite good means of punishment of employees who think their own thoughts, and they act as powerful deterrents for others. Whatever persuasion was exercised on Morgan, either the attempts were not very skillful or he had inherited the familial tough nonconformist spiritual material that yields to physical annihilation only.

Alice Stewart was brought up to meet personal slights and adversity with fortitude, and as she explained to the reviewer, was of a generation for which it simply wasn't done to complain, certainly not in public. Gayle Greene's provision of more details of a personal life than are strictly necessary to provide a faithful account of Alice Stewart's professional battles and selfless contributions to the common good will therefore come as quite a shock to her acquaintances. Morgan had been brought up in a family in which testifying to belief was important, while Stewart was born into an environment of good works, and while she was sent to church she describes her mother as not having any feeling for religion. Both of her parents are described as having been dedicated to an unlucrative practice of medicine in grim industrial Sheffield. Her mother started in general practice with a strong community medicine slant, but during the First World War she worked initially as medical officer to a large armaments factory, then as an unpaid hospital physician, a post she combined with teaching anatomy to medical students and bringing up a family of eight. With the outbreak of the Second World War she evacuated Sheffield for five years, to nurse her disabled son until his death in remote North Wales. Stewart's father had started his career backwatered as a reluctant general practitioner, but at a time when he had five children he abandoned this livelihood for higher study to quality as a consultant physician. In this he was successful and proceeded to academic honors and distinctions. Their daughter Alice was the third-born, with all the duties this entailed in a family where mother was pursuing her medical interests. She studied for two years at a local school before joining the crème de la crème at a boarding school in Scotland from the ages of 13 to 17. Thence she entered Cambridge University and, although not distinguishing herself academically in her preclinical examinations, had a marvelous four years, being lectured to by the stars of the day, and in the company of students who were later to feature prominently as members of the intelligentsia, actors, scientists, or rogues. She went on to study clinical medicine at the Royal Free Hospital, where a flair for diagnosis became apparent, and she acquired a fistful of prizes that were useful on her CV when, after having stepped off her career ladder for marriage, she attempted to return to mainstream medicine. For three years she held an appointment of part-time junior physician (a highly educational but "dogsbody" job that occupied her full time), covering the whole of internal medicine, teaching undergraduates, doing hospital administration, and acting as locum for consultants. In her off-duty time there were the demands of home, children, and husband. The outbreak of the 1939 war gave her the opportunity to return to clinical medicine in a senior position. With her husband's recruitment to a code-breaking establishment for the duration of the war, and with in-laws, friends, and acquaintances rallying to the care of her children, she was

freed from their impediment to her career. After two starts in clinical medicine, based on Oxford she gravitated into wartime population studies of the adverse health effects of filling shells with TNT, and of malaise in Yorkshire workers exposed to carbon tetrachloride, and immediately after the war she was asked to set up a study of pneumoconiosis in South Wales coal miners.

Before the war, a visionary civil servant had identified the need for the establishment of Institutes of Public Health. As part of the Brave New World envisaged for the postwar era, John Ryle was appointed at Oxford and founded his Institute of Social Medicine. Although Stewart had an attractive offer to head a new department of industrial medicine, or could have returned to her earlier clinical post in London, she accepted his invitation to be his first assistant. With Ryle's death, Stewart was appointed in his place, but in the night of the long knives, the Institute was demoted to a Unit, its building shrunk to a room, and its directorship downgraded to a personal readership, salaried but unfunded, unstaffed, and unwanted. With assistance she acquired funds from another source to appoint a statistician and another physician, and between them they set out to investigate the histories of mothers whose children had died of leukemia, and to compare them with controls. Their observation that there was a powerful association between antenatal radiography and the subsequent development of excesses of leukemia and other malignancies was met with enthusiasm that turned to antipathy. Her findings were ultimately to be confirmed by several studies in the United States, but in the interim were challenged by the negative findings of a study by Court-Brown and Doll, whose opinions carried more weight. As a consequence, obstetricians were to persist in their heavy use of pelvic radiography in the management of pregnancy long after Stewart had sounded the alarm.

The rest is the history of a tenacious lady and her unusual statistician George Kneale, who went on to cause further consternation and antagonism by the conclusions derived from their more sophisticated analyses of mortality data from the Hanford plutonium plant workers, in which Tom Mancuso had a part to play. (to an extent, Mancuso was a bird of a feather. He had acquired an international reputation from extensive epidemiologic studies of occupational diseases, and was well savaged for his pains. Wounds and scars, however, did not affect him as lightly as apparently they did Stewart.) These analyses were to be conducted at Birmingham University, where Professor George Knox deserves credit for providing Stewart and Kneale with the desk space that was not available in Oxford: later he and his colleague Tom Sorahan were to collaborate in a mortality study of servicemen who had been present at a nuclear test. The list of scientists in the United Kingdom who have had the temerity to support Alice Stewart is short, and Knox and Sorahan, to name two, do not appear to have suffered professionally. The American list, on the contrary, is much longer, and the scientists on it were punished for their support.

In his final chapter, Morgan devotes two pages to a testament, reflecting on mortality and his faith, whereas a comparable spiritual apologia is not given for Stewart's life. The reader may dig deep and hard to identify common roots and motivations linking Morgan and Stewart, without success. However, if one looks elsewhere, one may identify analogous instances where apparently discordant classes of person made good partners. For example, when Bentham established University College in London as a secular institution, those of a nonconformist religion and those of no religion were given access to higher education that they had previously been denied. Not only were members of such disparate faiths able to study together, but alumni who subscribed to a religious ethic and those who followed the utilitarianism of the College founders were to be found among those actively exercising social consciences. One might almost believe that all members of humanity possess an intrinsic wish to benefit their fellow humans independent of their beliefs, which they would willingly exercise were it not for the painful consequences, and that they bruise easily.

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Medicine, Conflict + Survival
17:3 April-June (2001)

good faith on effective measures relating to the cessation of the nuclear arms race at an early date and to nuclear disarmament'.

Generally speaking, the established nuclear weapon powers and their allies wanted the Treaty to be extended indefinitely. On the other hand, the non-aligned countries were opposed to indefinite extension. Non-governmental organizations were also split on the issue, some supporting an indefinite extension and others arguing the case for a limited extension. The latter group argued that a non-permanent treaty offered effective opportunities to put political leverage on the nuclear weapon powers to negotiate nuclear disarmament and urgent nuclear arms control treaties.

On 15 May 1995, four days after the NPT Conference ended, China exploded a nuclear weapon at its test site at Lop Nor. Another Chinese nuclear test occurred at Lop Nor on 17 August 1995. On 13 June 1995, less than a month after the NPT Conference ended, President Jacques Chirac announced that a new series of French nuclear-weapon tests would take place. On 5 September the French conducted a nuclear test on Mururoa in eastern French Polynesia. A total of six nuclear tests were carried out, the last on Mururoa on 27 January 1996.

The Chinese and French tests, conducted so soon after the end of the NPT Review Conference, were taken by those arguing against the permanent extension of the Treaty as justification for their opposition to its indefinite extension. It was argued that as soon as the nuclear-weapon states had achieved a permanent treaty they felt free to continue their activities. They no longer felt restrained by the fear that the NPT would not survive. A non-permanent extension may have given the nuclear-weapon states pause for thought. Be this as it may, the road to far-reaching nuclear disarmament has been downhill since 1995.

Will nuclear disarmament return to the international agenda in the foreseeable future? It is not easy to be optimistic. It is generally assumed that the next nuclear arms control measure to be negotiated is a multilateral treaty prohibiting the further production of fissile material for nuclear weapons (often called a Fissile Material Cutoff Treaty, FMCT) and that the negotiations will take place in the Conference on Disarmament in Geneva. Depressingly, there are currently (April 2001) no indications that the CD will soon start such negotiations.

A Nuclear-Weapon-Free World was prepared in honour of Sir Joseph Rotblat, the moving spirit behind the Pugwash Conferences on Science and World Affairs, as part of the celebrations of his 90th birthday in 2000. Joseph Rotblat is an inspiration for all working towards the abolition of nuclear weapons. *A Nuclear-Weapon-Free World*, essential reading for students of nuclear-weapon and nuclear disarmament issues, is certainly a credit to him.

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(7 April 2001)

The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation
By Gayle Greene
University of Michigan Press, Ann Arbor, 1999, 321 pp., £19.95, ISBN 0 472 11107 8.

The waste remains, the waste remains and kills
William Empson, *Missing Dates*, 1935.

Alice Stewart is nearly ninety-five. When I picked up this book, I found it addictive because so much of her life fascinated me. To start with she was favoured by having

been born into an environment where both her parents were doctors and it seems to have been understood almost from the beginning that the children would follow in their footsteps. Indeed, over half their children followed a medical career, two girls and three boys. There was no feeling that medicine was an unsuitable career for a lady.

Alice was educated at a time when there was discrimination against female medical students – quotas were imposed to limit the numbers accepted – and she was not allowed to undertake clinical studies in her home city of Sheffield. However, she could study at the Royal Free Hospital where she must be considered as a brilliant role model for future generations. The main focus of the book is Alice Stewart's life work, persuading the medical and scientific world that radiation, although providing untold benefits for human health in its application to diagnose and treat disease, could also be a cause of ill-health and suffering.

The start came when she ascertained that the mothers of children who died of cancer or leukaemia in their first decade of life had been X-rayed during pregnancy. At that time it was standard practice to X-ray pregnant women in order to assess pelvic size, if there was any concern about the adequacy of the pelvic outlet for childbirth, but this result was unforeseen and startling. This finding was a shock to clinicians and initially hotly disputed but it has now been accepted and irradiation during pregnancy is now only used where there is no possible alternative.

However, Stewart's career suffered as a result of this work. She fell foul of the establishment and, as far as the medical hierarchy was concerned, her work was relegated to the second division. Fortunately, she had acquired a co-researcher who was an able statistician. In George Kneale she found an ally who would remain with her for the rest of her work, indeed the two names are virtually inseparable in their field. This was to be a crusade against the damage caused by low level radiation caused by the atomic bomb, nuclear power plants and the vested interests of government in these projects.

Her story took place, not just in the national, but in the international arena and she was a witness in the fight to prove that nuclear workers had sustained damage to their health in both England and America. In America in the 1960s, the health of those who worked in the nuclear industry was called into question and Dr Thomas Mancuso was asked to look at the data in the expectation that low-level radiation exposure caused no damage. Others were concerned about a reported high incidence of cancer in nuclear workers. Mancuso, together with George Kneale and Alice Stewart, showed in 1977 that there was a six per cent increase in cancer in people who worked in the nuclear industry but were exposed to less than the official safety limit. Of course any late effects of radiation to the survivors of nuclear bombs and to workers in the manufacture of radioactive substances could not have been foreseen; these people were taking part in a human experiment to which they had not consented.

The International Commission on Radiation Protection has been lowering its permissible dose level over the decades and it is now accepted that there is *no* safe lower-limit and that people do not respond identically to radiation exposure. In Britain, Alice Stewart has rarely been officially involved in the enquiries into the incidence of leukaemia in the vicinity of nuclear plants or the health studies of nuclear workers and sceptics may doubt the reassurances of an industry that does not have independent scrutiny. With the Freedom of Information Act in America, Alice Stewart and her co-workers obtained the records of the nuclear workers and their initial findings were confirmed. Today, she continues to take up the cudgels on behalf of those who are concerned about the environmental impact of nuclear waste.

The story of her life is as riveting as one might expect for someone who has lived through two world wars and has waged a personal battle for recognition by the scientific establishment. People do not usually expect that they will still be

regarded as accredited experts in the international arena decades after their retirement. For those who are intrigued by others' life experience, this book has all the necessary ingredients: loyalty; love and a life that has been lived to the full. For those who relish the triumph of tenacity over adversity, this story illuminates the fight of those who believe that science may do harm as well as good and those who think that too rigid an application of regulation may stifle research which is contrary to received wisdom. Why not read it for yourself and identify the 'heroes and villains'?

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(17 April 2001)

Chemical Warfare

Gassed: British Chemical Warfare Experiments on Humans at Porton Down
By Rob Evans
House of Stratus, London, 2000, 520 pp., £20.00 hbk, ISBN 1-84232-071-8.

During the Second World War, Nigel Nicolson wrote to his mother, Vita Sackville-West, as she was creating her beautiful garden at Sissinghurst while aircraft fought overhead:

> 'You do realise, don't you, that the Germans are very likely, if they invade, to use gas. Our intelligence reports say that the most probable types are Arsine (have you got the new respirator?), liquid blister gas, and Lewisite sprayed from the air, and pure acid. The safest way to avoid them is to stay indoors. Please do' (*Long Life*, Weidenfeld and Nicolson, 1997: 88).

In the event, chemical warfare was not used in battle in Europe by either side during the Second World War. The only military casualties from poison gases came from an explosion in the Italian port of Bari when an Allied vessel carrying supplies of mustard gas was blown up.

The earliest poison gases had been developed for warfare by the Germans in the First World War, although the Hague Conventions of 1899 and 1907 stipulated that the warring countries should 'abstain from all projectiles whose sole object is the diffusions of asphyxiating or deleterious gases'. These German gases were derived from Fritz Haber's work on ammonia and chlorine and were released from fixed positions in the German trenches when the wind was blowing towards the Allies, thus avoiding the ban on projectiles. Haber's wife shot herself because of her opposition to his work. Derivatives of these early gases were used in the gas chambers of the Holocaust during the Second World War.

The British were quick to respond to the challenge posed by the advent of chlorine and mustard gas. The physiologists JS Haldane and his son JBS Haldane developed new gases, often experimenting on themselves and their families. They argued that chemical weapons that disabled rather than killed were more humane than the alternatives. However it has been argued that their view rested on weak statistics: there were no reliable records of the actual casualties during the First World War and no follow-up studies of the health of men whose immune systems had been compromised by mustard gas.

By the end of the First World War all the belligerents had established chemical warfare agencies such as Porton Down in the UK and the Chemical Warfare Service at Edgewood Arsenal, MD, in the US. These agencies were much better at refining poison gases than they were at developing protections or antidotes, as was apparent during the Gulf War when the Israeli population was issued with supplies of

(ASCII text format)

The following is mirrored from its source at: http://members.nbci.com/razlag/alicestewart.html

Vedi anche: Alice Stewart, 93 anni, ancora sulla breccia

La donna che sapeva troppo

di Matt Henry

Quando durante la seconda guerra mondiale 150.000 persone presero parte in un progetto scientifico segreto condiviso dagli USA e dal Canada, anche in Congresso ed il vicepresidente rimasero all'oscuro su che cosa si stesse producendo. Fu questo progetto che diede nascita al fenomeno nucleare; uno schema concepito nello stesso modo segreto con cui è stato da allora condotto. Solamente poche persone hanno potuto penetrare il velo di segretezza che l'industria nucleare USA si era autoimposto nei decenni passati, e riemergere per dire al mondo che cosa realmente sta succedendo con l'energia nucleare. Una di queste persone è Alice Stewart.

Nata a Sellafield nel 1906, Alice Stewart fu educata a Cambridge e ricevette lodi in medicina clinica diventando la più giovane donna che sia mai entrata nel Collegio Reale dei Medici. Dal 1945, lei si è occupata di un nuovo ramo di studi che indagavano i fattori socioeconomici dell'origine delle malattie -- un nuovo modo per fare della prevenzione una cura. Come capo dell'Istituto di Medicina Sociale di Oxford, ha condotto una ricerca per esplorare il cancro infantile, che avrebbe avuto enormi implicazioni.

Nel 1956 Alice scoprì che una singola dose di raggi X diagnostici poco prima della nascita, avrebbe raddoppiato nel neonato il rischio di una morte prematura per cancro. Invece di ricevere l'attenzione e l'interesse che ci si sarebbe aspettati dal risultato di questa importante scoperta, la risposta delle istituzioni mediche inglesi ed americane fu estremamente minimizzante. Avendo già dovuto affrontare il taglio tipicamente patriarcale della professione medica, adesso si presentava con un'ottica in cui ignorava qualsiasi cosa che non avesse strettamente riferimento con il punto di vista curativo. Sempre più l'etica, che già fioriva all'interno delle professioni inglesi ed americane, veniva alterata attraverso la commistione con gli interessi dell'establishment nucleare. Mentre aumentava la corsa agli armamenti e gli investimenti si ingigantivano nella tecnologia nucleare, l'energia nucleare e la

The Woman Who Knew Too Much

By Matt Henry

When, during the Second World War, 150,00 people took part in a secret scientific project that spanned the U.S. and Canada, even Congress and the Vice-President remained ignorant of what was being produced. It was this project that gave birth to the nuclear phenomenon; a scheme that was conceived in the same deliberately secretive manner in which it has been run ever since. Only a few people have really managed to penetrate the US nuclear industry's self-imposed veil of secrecy over the past few decades, and emerge to tell the world what is really going on with nuclear power. One of those people is Alice Stewart.

Born in Sellafield in 1906, Alice Stewart was educated at Cambridge and went on to achieve honours in clinical medicine, becoming the youngest ever woman to enter the Royal College of Physicians. By 1945, she had branched out into a new field of study that planned to explore the socio-economic factors of disease and illness -- a more preventative form of treatment. As head of the Oxford Institute for Social Medicine, she conducted an epidemiological survey to explore childhood cancers that was to have massive implications.

In 1956, she discovered that a single dose of diagnostic X-ray radiation shortly before birth will double the risk of an early cancer death for the newborn child. Yet far from receiving the concern and enquiry she expected as a result of this important discovery, the responses of the British and American medical establishments were overwhelmingly dismissive. Having already faced the patriarchal nature of the medical profession, she was now presented with an entrenched mindset that ignored anything straying from a curative standpoint. Moreover, the commercial ethos already fluorishing in the British and American professions was intensified through a new partnership in progress with the nuclear establishment. As the arms race escalated and investment in nuclear technology soared, nuclear power and medicine provided research and

medicina provvedevano a finanziare la ricerca per gli scienziati da ambo le parti dell'Atlantico. Non era negli interessi dei dottori o degli scienziati l'indagare sugli effetti sulla salute causati dall'energia nucleare.

Venne condotto uno studio sui sopravvissuti di Hiroshima [NdT: usando come gruppo di controllo gli stessi abitanti di Hiroshima] dalla Radiation Effects Research Foundation (RERF), un organismo con stretti legami con la governativa Atomic Energy Commission (AEC, ora: Nuclear Regulatory Commission), che divenne il bastone con cui l'establishment bacchettava le asserzioni di Alice. Estrapolando dalle alte dosi di radiazioni in maniera lineare, il RERF ed i vari organismi internazionali nucleari, potevano pretendere che le radiazioni divenissero meno pericolose alla diminuizione delle dosi. Si trattava di una industria che stava creando i suoi stessi standard e regolamenti, una situazione che Alice paragonò ad "una volpe incaricata di far la guardia alle galline".

Attraverso gli anni sessanta e gli anni settanta, Alice Stewart divenne una dissidente nucleare ben conosciuta e nel 1977 entrò nel gruppo di ricerca di Thomas Mancuso e George Kneale per studiare gli effetti delle radiazioni sui lavoratori nell'industria nucleare. Scoprì che l'industria era circa 20 volte più pericolosa di quanto ammesso negli standard dei lavoratori (NdR: vergogna permessa grazie all'accordo scandaloso IAEA-ILO). La maggioranza delle istituzioni mediche e nucleari faceva affidamento sui dati RERF usando qualsiasi mezzo per isolare chiunque dicesse il contrario. Alla fine degli anni '70, Mancuso Kneale e Stewart non venivano più invitati alle conferenze: si cercava di sequestrare i loro studi, gli veniva rifiutato l'accesso ai dati e divennero oggetto di una specie di lupara bianca morale.

Mentre scoppiava lo scandalo e la pubblica opposizione montava contro quello che è diventato il più grosso business della storia (NdT: anche rispetto al numero delle vittime), Alice Stewart divenne una figura leader nella battaglia per dimostrare che le radiazioni erano pericolose a qualsiasi dose. Gli scienziati che si alleavano con lei negli anni '70, venivano immediatamente discreditati, i fondi venivano tagliati, le automobili speronate, le prove rubate e distrutte. Dopo aver preso parte ad audizioni davanti al Congresso e testimoniato in cause per danni ed aver informato gruppi di cittadini sia negli USA che in Inghilterra, la Dottoressa Stewart all'età di 80 anni ricevette il primo finanziamento da parte del Fondo per la Salute Pubblica di Three Mile Island, nel 1979, per studiare le cartelle cliniche dei lavoratori in quattro dei maggiori impianti nucleari. Dopo più di un decennio di schermaglie con il riluttante Dipartimento dell'Energia, le informazioni vennero finalmente reperite. Si tratta delle informazioni

nuclear power and medicine provided research and funding for scientists on both sides of the Atlantic. It was not in doctors' or scientists' interests to question the health effects of nuclear power.

A study of Hiroshima survivors conducted by the Radiation Effects Research Foundation (RERF), a body with close links to the American governmental Atomic Energy Commission (AEC, now Nuclear Regulatory Commission), became the stick with which the establishment beat Alice's claims. By extrapolating from high-dose in linear fashion, the RERF, and international and national nuclear regulatory committees, could claim that radiation becomes less dangerous as the dose diminishes. Here was an industry that was effectively creating its own standards and regulations, a situation Alice compared with the "fox guarding the chicken coop".

Throughout the sixties and seventies, Alice Stewart became a well-known nuclear dissident, and in 1977 teamed up with Thomas Mancuso and George Kneale to study the effects of radiation on workers in the nuclear industry, discovering that the industry was about 20 times more dangerous than worker standards admitted. [The Italian version at left cites the following but does not include that here in the english version – 1958 IAEA-ILO Agreement -- editor]. The mainstream medical and nuclear establishments clung to the RERF data, employing all the usual tactics to sideline anyone who made claims to the contrary. In the late 1970s, Mancuso, Kneale and Stewart remained uninvited to conferences, had attempts made to seize their findings, were refused access to data, and became the subject of character assassinations.

As scandal broke, and public opposition mounted to what had become one of the largest and most powerful business enterprises in history, Alice Stewart had become a leading figure in the battle to prove that radiation was unsafe at any dosage. The scientists who allied with her in the seventies were swiftly "discredited", as funds were cut, cars rammed off roads and evidence stolen and suppressed. Having taken pat in Congressional hearings, testifying in compensation cases and addressing citizens' groups throughout the US and Britain, Dr Stewart (aged 80), finally won a grant from the Three Mile Island Public Health Fund, following the accident of 1979, to study the workers' records at four of the major nuclear plants. After over a decade of wrestling with a reluctant Department of Energy, the information was finally secured; data that she has been working on ever since.

As findings continue to point to the harmful

sulle quali da allora Alice sta lavorando.

Mentre i risultati continuano ad indicare i pericolosi effetti delle radiazioni di basso livello, Alice, che ora ha 92 anni, sembra sia stata finalmente vendicata dopo anni di lotta contro un'industria dotata di immense risorse finanziare con le quali può comprare la pubblicità, il gradimento e gli scienziati a piene mani.

Mentre ulteriori studi indicano irrevocabilmente i danni genetici, ma anche altre malattie come la Sindrome della Improvvisa Morte Infantile (SIDS), possiamo solo sperare che Alice Stewart sia nel vero quando dice che: "La verità è la figlia del tempo".

Il problema principale tuttavia è questo: il trionfo della verità sarà mai capace di rimediare ai danni che fino ad oggi sono stati provocati dall'industria nucleare?

Matt Henry ha studiato Scienze Politiche alla Università di Nottingham e attualmente è un fotoreporter freelance.

effects of low-level radiation, Alice, now 92, seems to have been vindicated after years of fighting a war against an industry equipped to buy as much advertising, good publicity and scientists as they can get their hands on.

As further studies point to irrevocable genetic damage, as well as links with other diseases such as Sudden Infant Death Syndrome (SIDS), we can only hope that Alice Stewart is right in her assertion that "truth is the daughter of time".

The real question, however, is whether this triumph of truth will ever be able to reverse the damage that has already been done by the nuclear industry.

Matt Henry studied Politics at Nottingham University and is currently a freelance photojournalist.

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Women's Studies, 32:111–114, 2003

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DOI: 10.1080/00497870310084

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Gayle Greene. *The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation.* Ann Arbor: U of Michigan P, 1999.

SARAH FIELDS

Claremont Graduate University, Claremont, California

During the twentieth century, few state institutions in America and Western Europe have so easily and so justifiably excited the passions and suspicions of their own citizenry as the American military. Probably the most long-standing and well-guarded source of such controversy has been nuclear weapons research and testing, with the checks and balances that ought to oversee its actions often located within, rather than outside, the established power structure. Many private citizens have challenged industry claims regarding the level of danger posed by nuclear reactors and their by-products, from former lab tech and martyr to the cause Karen Silkwood, to consumer watchdog Ralph Nader. The undeservedly lesser-known Dr. Alice Stewart, a British epidemiologist noteworthy for her triumphs over misogyny in the medical profession and intriguing for her long affair with literary critic William Empson, eventually became an important critic of nuclear-industry safety standards from within the scientific establishment. As is evident from her recent biography, *The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation,* Stewart brought to her struggle on behalf of public health, as to all of her professional struggles, a heroism deserving of elegy. Written in close collaboration with Stewart by Gayle Greene, professor of English at Scripps College, this biography is both a well-rounded character study focused on a fascinating woman and an exhaustively documented catalogue of its subject's enviable list of scientific accomplishments and feats of sometimes inadvertent social activism.

Address correspondence to sarah.fields@cgu.edu

Medicine, radiation, and a woman

The woman who knew too much: Alice Stewart and the secrets of radiation
Gayle Greene. Ann Arbor: University of Michigan Press, 1999. Pp 336. £19·95. ISBN 0472111078.

Alice Stewart is probably best known for her work, published initially in *The Lancet* in 1956, on diagnostic irradiation in utero and childhood malignancies. *The woman who knew too much: Alice Stewart and the secrets of radiation* is a sympathetic perspective about her long career, and about her role in the ongoing controversies about the carcinogenic risks of exposure to low-level ionising radiation.

The author, Gayle Greene, is a Professor of Women's Studies and Literature at Scripps College. She is not a scientist. As she notes on page 15:

> "I am interested in the life story as it illuminates the making of this extraordinary woman, her mind and her work, and her role in this major scientific-political controversy . . . [The book is] more than a memoir, since I've added much information that contextualizes her story historically and politically. I don't give a lot of time to the other side of the controversy . . . ".

A major weakness of the book is the absence of any attempt to present a balanced view of issues that continue to be controversial, even after decades of research. A major strength is the information that is provided about the life of a remarkable woman. For example, after she turned 90, on Oct 4, 1996, Alice Stewart continued to speak, at international conferences, about the effects of radiation on populations.

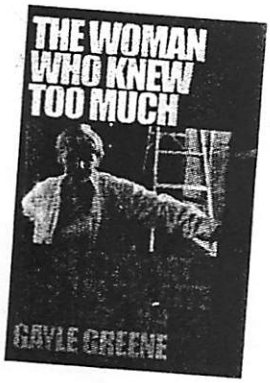
The image of Alice Stewart that emerges from this book is that of an "insider-outsider". Both of her parents obtained medical degrees, and four of their eight children (including Alice, their third child) became doctors. But, her mother had to deal with prejudices about female doctors, and so did Alice. For example, when Alice entered the room for her first physiology lecture (at Cambridge) she recalls hearing the sound of 200 male medical students stomping their feet, in unison and in time with her steps. After graduation, marriage, motherhood, and some experience in medical practice, she switched from general medicine to epidemiology. Stewart subsequently joined the Institute of Social Medicine at Oxford, and became, almost by accident, a pioneer in the new and relatively unpopular specialty of "social epidemiology". Even to this day, this specialty has remained somewhat unpopular by comparison with laboratory-based biomedical research.

The woman who knew too much: Alice Stewart and the secrets of radiation seems to be intended for those interested in the history of women in science and medicine, and for those interested in the history of science and technology. It was not intended to provide (and it doesn't) an in-depth analysis of the complex and controversial topic of how best to deal with the hazards of low-level radiation exposure.

James E Till
Joint Centre for Bioethics and Department of Medical Biophysics, University of Toronto, and Division of Epidemiology, Statistics and Behavioural Research, Ontario Cancer Institute, University Health Network, Toronto, ON M5G 2M9, Canada

Unsafe at Any Dose

Public Citizen News, 11/12, 2000



The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation

Gayle Greene, The University of Michigan Press, $35.00

"If Alice Stewart had discovered that radiation was good for you," writes Gayle Greene, "she might have won the Nobel Prize." Instead, "since she is the bearer of bad news, (so) there's been a tendency to ignore her."

Deftly blending biography and biology, Greene chronicles the life and career of Dr. Alice Stewart. As a Cambridge-educated physician, Stewart's unassuming pursuit of rigorous science ultimately "cost her standing, salary" and "access to funding." But, Greene writes, it also gave her the satisfaction of seeing her work shape a critical scientific debate: Is there such a thing as a "safe" level of exposure to radiation?

A pioneer in the discipline of epidemiology and one of few female doctors of her day, Stewart was an early champion of prevention as a medical model. Almost by accident, her research at Oxford revealed a doubled risk of early cancer death among children exposed to prenatal X-rays. Stewart's finding unsettled the medical establishment of the 1950s and proponents of safe atomic energy at a time when nuclear testing was at its height.

In 1974, officially retired and 68 years old, Stewart was "about to embark on the most dramatic chapter of career." She was invited to study worker records from the Hanford reactor in Washington state, the oldest and largest nuclear complex in the world. To the chagrin of the Atomic Energy Commission, her findings indicated that people were "as much as twenty times more sensitive" to "radiation-induced cancer than anyone had thought." Her research called into question the A-bomb studies that had "set radiation standards for the entire world."

In the wake of the nuclear accident at Three Mile Island, Stewart was awarded a grant to study the health effects of low-level radiation. She spent nearly 10 years battling the Department of Energy to obtain nuclear worker records and became a hero to anti-nuclear activists.

This book is a scathing account of the government's cover-up of data revealing the danger of exposure to radiation. It is also the personal story of a scientist whose work is only now receiving the attention it strongly deserves.

— THOMAS SEIDMAN

Read More Science

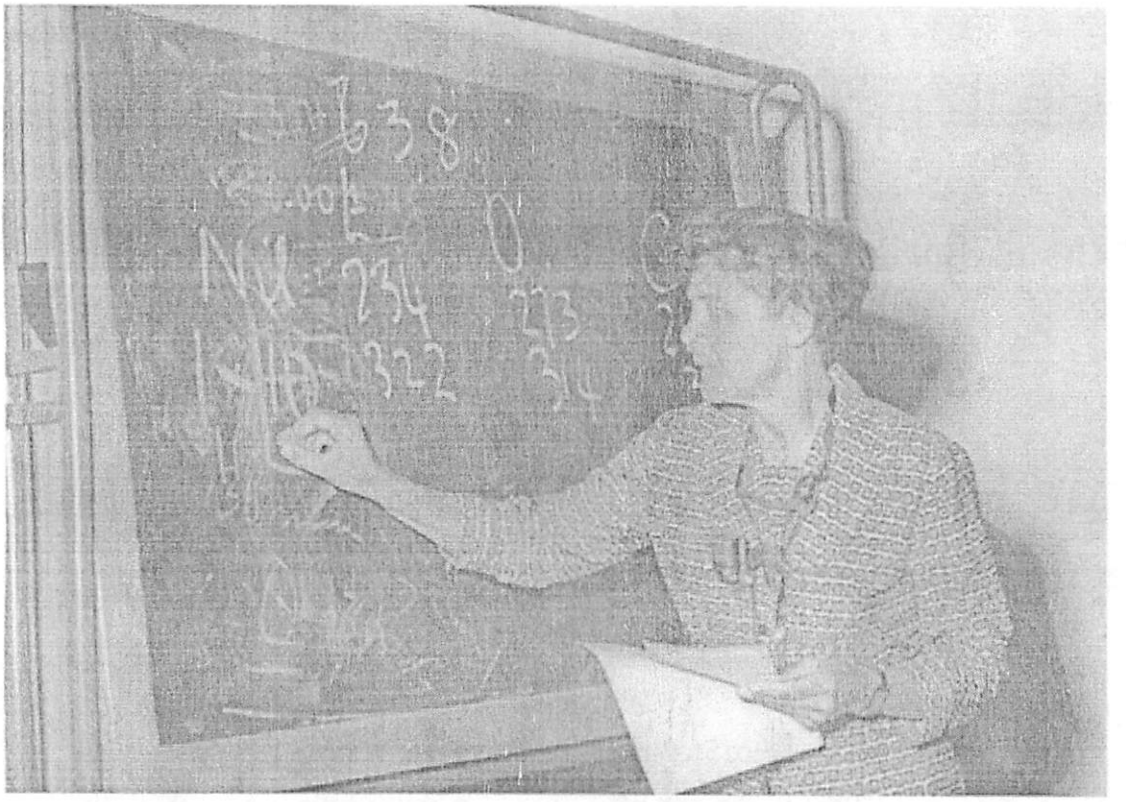
Because Science is for Everyone

Read About the Remarkable Female Scientist Who Fought to Regulate Radiation

October 9, 2018December 29, 2018

Gayle Greene's The Woman Who Knew Too Much: Alice Stewart and the Secret of Radiation is an incredible overview of the life and work of Stewart, whose voice fills the pages and echoes through time to help readers better understand the field of radiology in the twentieth century. Through extensive interviews with the indomitable Alice Stewart herself, and thorough research into the controversial issues of radiation and nuclear power in the twentieth century, Greene tells a story that deserves a place in the history books.

Who was Alice Stewart?



Alice Stewart. Source (http://blog.wellcomelibrary.org/2013/03/paying-attention-to-what-women-say/)

Dr. Alice Mary Stewart (1906-2002) "was a British physician and epidemiologist specializing in social medicine and the effects of radiation on health" (Alice Stewart, Wikipedia (https://en.wikipedia.org/wiki/Alice_Stewart)). She is known for being the first person to find a link between prenatal x-rays and childhood cancer, the reason that pregnant women today must avoid x-rays. She is also known for her study of the effects of radiation on workers at the Hanford plutonium production plant in Washington. Her work is still cited today by those who argue that low-level doses of radiation have lasting negative effects on our health.

Greene begins with Alice's parents, particularly her mother, "who became a physician at a time when this was barely a possibility for a woman". Greene takes us through Alice's life — the story of their large family, then Alice's days at Cambridge. Alice was born in 1906, the third of eight children. She went on to study medicine at Cambridge, and shared with Greene the experience of her first physiology lecture:

> It was a large room, an auditorium you entered from the rear with a long set of steps descending to the speaker's podium in the front. I slipped in, hoping to take a seat as close to the back as possible. But when I stepped into the hall and took my first steps, the students, all male, began stomping, slowly and deliberately, in time with my steps. As I took my first step into that room, bang! came the sound of two hundred men stomping their feet in unison. I took my second step and the stomp was repeated. Every step I took, there was this stomp, stomp, stomp. My first instinct was to duck into a seat and disappear, but no — every row was blocked by the men. I was forced down to the front row, where I found three other girls and a Nigerian. These medical students had managed to segregate us out — they weren't going to have anything to do with women or minority populations. I wasn't whipped. I was stomped." Alice Stewart

Although women women had been allowed to study medicine within the past few years, Greene notes, they were still yet to be accepted in the field. Throughout her education, as well as her career, Alice struggled to be recognized by her peers in medicine. Although she would come to be recognized by many as an expert in radiology, she fought sexist stereotypes her entire life — treatment that only served

to smother her important, controversial work even further. Take into account the state of the world at her time of research – the budding of nuclear energy, the competition for nuclear weapons – and it seems as though the entire world was willing to turn their gaze away from her argument that these industries were killing their workers from radiation exposure.

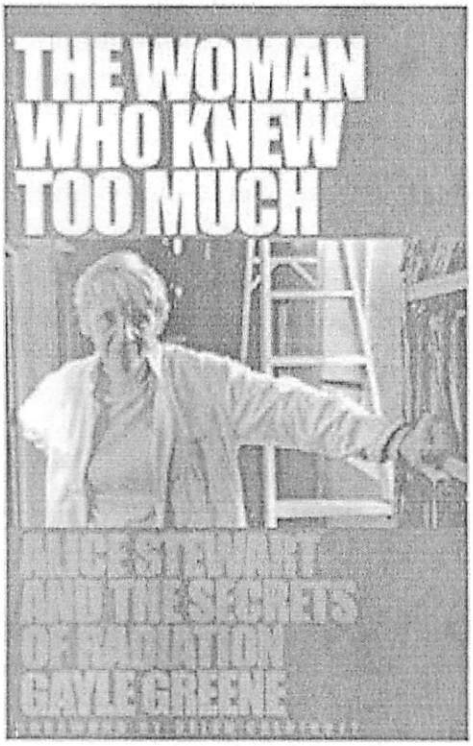
Greene does an excellent job exploring this controversy in great detail as she examines the societal obstacles, as well as looking at the way Alice was treated as a woman in her field. As a reader, she is our guide through Alice's life. But I don't recommend starting with Greene's introduction in chapter one. Though I was trained as an English major and always read footnotes, check citations, and never skip the introductions or forewords, I don't think it's worth it for The Woman Who Knew Too Much. This biography is much better experienced by diving into the second chapter, where Greene's wonderful storytelling immediately sweeps you into the story. It almost feels as if she betrayed too much information in the introduction, and you won't get a good feel for her writing style. However, it does allow the reader to meet Alice Stewart herself and lay the groundwork for how Greene ended up writing her biography in the first place, which is valuable backstory.

Aside from the introduction, the rest of the book is astoundingly intellectual and well-written. Green has put considerable effort into researching Alice Stewart's work and interviewing the formidable scientist herself. This is an incredibly important biography – Gayle Greene has captured a picture of one of the most important and overlooked female scientists of history, and captured her brilliantly. Alice Stewart shines in Greene's writing: her voice and personality is memorable, her work is fascinating, and perhaps most important, Greene is careful to put her in the context of culture at the time. Through a mix of reflection and action-filled description, Greene does an excellent job presenting a story worth telling. It's a documentary and biography in one book.

Why is this worth reading about? Why would Greene have dedicated so much time into getting to know Alice Stewart and sharing her story with readers? The story of Alice Stewart is not only that of a scientist whose work was censored and barred in every way possible by the industry she fought to regulate, it's the story of a woman who fought hard to be recognized in her field. It's the story of a female scientist who rose to recognition through hard work, passion, and occasionally, sheer luck.

We need more stories like this to be told. We need more about the women who knew too much, women who were silenced and censored. In the context of our world today, we need women's stories to be told, now more than ever.

Start with this one.



Published by Sarah Olson

Sarah is a science writer and college student interested in science subjects ranging from marine biology to microbial ecology. She lives in Oregon's Willamette Valley with her fiancé, who studies physics. Sarah works full-time at an independent bookstore and is the curator of their science and nature sections. She is a member of the National Association of Science Writers. View all posts by Sarah Olson

BLOG AT WORDPRESS.COM.

Cassandra's career

by Janet Golden

The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation by Gayle Greene. Ann Arbor, MI: University of Michigan Press, 2000, 344 pp., $25.00 hardcover.

In response to the question many readers might raise—who is Alice Stewart?—Gayle Greene's new biography offers some cogent answers.

An Englishwoman, a physician, an epidemiologist and discoverer of the dangers of x-raying pregnant women, Stewart has spent much of her life trying to inform the world of the dangers of low-level radiation. For far too long the scientific community ignored her, while the nuclear establishment did its best to censor her research and her findings. With her anti-nuclear allies and some brave colleagues, she has foiled them. Stewart is now in her nineties, and her opponents have had to concede that she was right. It is a Pyrrhic victory: had they listened when she first began to demonstrate the risks of radiation exposure, many lives would have been saved. Instead, many await compensation for illnesses caused by radiation exposure while others wait for settlements after the deaths of loved ones. (Recently, United States Secretary of Energy Bill Richardson announced a plan to compensate nuclear bomb plant workers who became ill or died as a result of their exposure to radiation and industrial chemicals.)

Alice Stewart, 1986. From *The Woman Who Knew Too Much.*

Greene's book is a fascinating mixture of biography and oral history. She elicited from Stewart reminiscences about her life and trenchant commentary on radiation epidemiology. Stewart's scientific passion, her feistiness, her political naivete and her wit shine in each chapter. Greene herself has taken on the task of contextualizing Stewart's life and scientific endeavors. By calling her Alice, she also invokes a comfortable familiarity.

The book begins with Stewart's family—both her parents were physicians—and follows her through medical training, marriage and the births of her two children. Stewart's marriage ended in the early 1950s; then she resumed a relationship with an old Cambridge flame, William Empson, the leading poet and literary critic, with whom she would share her life until his death in 1971.

It is in the early sections of the book that the reader may feel most distant from Stewart. Her World War One-era childhood and education among the group that would become the English literary and cultural elite make her life appear to offer few lessons—other than a reminder of the advantages conferred by social class—to contemporary readers. It is only in the later sections, where Stewart emerges as a maverick scientist, that readers can appreciate the complexities of her life and the messages it offers modern feminists.

The strongest section of the book begins when Stewart and Greene reach World War Two. The war opened many professional doors that would have otherwise been closed. As Stewart put it: "The war enabled me to leap over barriers that would otherwise have blocked my way as a woman. It tells you what women could do if society would change its attitude." Stewart leapt over the barriers eagerly, at one time holding two positions, teaching and running a clinical practice while also undertaking studies for the British Medical Research Council. She conducted a number of important investigations in the field of occupational health, and by the time the war ended had committed herself to the emerging field of epidemiology, working with John Ryle, the founding chair of the Institute of Social Medicine at Oxford.

Deployed to a new study, the Child Health Survey, she began collecting data on children throughout England, obtaining vital records that would yield all kinds of practical findings. Unfortunately, the doors that the wartime emergency had opened were beginning to slam shut. The Social Medicine unit essentially closed up shop after the death of Ryle, Stewart's mentor. She remained at Oxford and limped along with diminished funding but, as it turned out, great intellectual vigor. Stewart explained: "The good thing was that I had no work to do—they had to keep paying me until retirement age and I had nothing to do. But I thought, I can do better than that."

Undaunted, she began a study of childhood leukemia. She tells Greene that "we kept the show going on a sort of repertory theater budget," dubbing her research group, composed of an odd assortment of individuals, "Dr. Doolittle's Team for the Moon." And they made it to the moon, metaphorically speaking. In 1956 Stewart published her findings that showed that children who died of leukemia had been x-rayed before birth twice as often as the matched controls who did not get the disease.

The x-raying of pregnant women should have ceased once this information was disseminated, but it was not halted for about another twenty years. A critical reason for the delay was the fact that the noted epidemiologist Richard Doll conducted research that appeared to contradict Stewart's findings. Later his studies would be shown to be sloppy and his results unreliable—something Stewart noted from the very beginning.

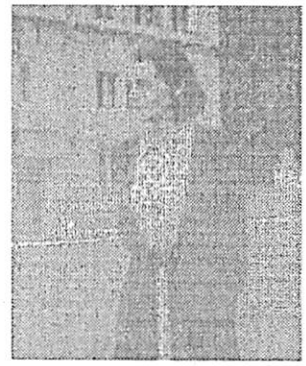
The two scientists continued to clash. Doll, knighted for demonstrating a link between smoking and lung cancer, would, from his lofty perch as Regis Professor at Oxford, stand as a staunch defender of the claim that radiation exposure had no effect on life expectancy or cancer rates. Stewart and her quirky companion, statistician George W. Kneale, would continue to turn up evidence that he was wrong, but to little avail. Finally, in the 1970s American scientists studying low-level radiation began discovering its detrimental effects. Searching the literature, they discovered that Stewart and Kneale had already documented much of what they were unearthing.

At that point Stewart's story began to resemble a movie plot. Colleagues who took on the nuclear industries and the government agencies overseeing them lost funding and jobs. Stewart's efforts to gain access to the records of nuclear workers were consistently thwarted. She became a great ally of the anti-nuclear movement, which served only to discredit her in the eyes of the British and American governments, who denied her access to data and lined up experts, like Doll, to refute her findings. Stewart persisted heroically in her studies and continued to speak out about her findings. My favorite quotation from her is a blunt dismissal of the radiation establishment's attitude: "The best way not to find something is not to look for it." But Stewart looked. Greene charts her involvement in numerous anti-nuclear causes—tracing cancer clusters around nuclear facilities, charting cancer deaths among nuclear workers and testifying in class-action suits brought by employees of the nuclear industry.

In the concluding section of the book, Greene reflects on the implications of Stewart's life and reviews some of her epidemiological speculations regarding the causes of childhood cancer, sudden infant death syndrome, Burkitt's lymphoma and other medical conditions. Time will tell whether they are brilliant insights or wild speculations. However, given Stewart's track record, it makes sense to believe she will probably prove to be right about many of them.

Greene is at her best describing how Stewart reached her epidemiological insights by relying on her clinical experience and an ability to ask basic questions that others too often neglected. She also does an excellent job of portraying Stewart's marginalization: she was barred from many critical scientific venues and repeatedly denied funding. Many in the scientific community shoved her aside as a cranky old woman, even as she was

Alice Stewart at Oxford, .
From *The Woman Who Knew Too Much.*



being honored with the Right Livelihood Award, conferred by the Swedish Parliament for making contributions to the betterment of society and termed by some the "alternative Nobel." Drawing upon recent biographies of other women scientists, Greene points out that the attacks Stewart faced were typical of those launched against bold women with substantive ideas that challenged the scientific orthodoxy.

Like many biographers, Greene became enormously enamored of her subject, which unfortunately tends to undermine the power of her narrative. It is not simply that she overlooks Stewart's flaws; rather, she seems intent on anointing her as a singular heroine. To shine a bright light on Stewart, Greene sometimes places her colleagues and comrades in the shadows. In doing so, she fails to illuminate adequately the mix of scientific findings and cultural forces that allowed all of them to question the authority of the nuclear industry. Greene does turn to Stewart's colleagues for testimony about her significance, but much of this, too, seems forced and unnecessary. At times, the narrative is cluttered with names and events; the brief recitations of Stewart's involvement with various scientific researchers, anti-nuclear groups and law cases, for example, are overwhelming. Devoid of sufficient interpretation and context, they read like quick cuts written into a movie script rather than solid interpretive biography.

Hollywood has brought us the stories of Erin Brokovich and Karen Silkwood, but Alice Stewart's life has yet to make it to the silver screen. This is a serious oversight, but one I trust will be soon remedied.

A critic's work is never done

by Maureen T. Reddy

Critical Condition: Feminism at the Turn of the Century

by Susan Gubar. New York: Columbia University Press, 2000, 221 pp., $24.50 hardcover.

Retrospectively, we can all trace epochs in our lives, moments when everything changed. It is more difficult to recognize those moments in the present tense; but I remember knowing I was living through such an epoch-change in my own life in 1979 as I read Sandra Gilbert and Susan Gubar's co-authored *The Madwoman in the Attic: The Woman Writer and the Nineteenth-Century Literary Imagination*. I was a beginning graduate student in English, planning to focus on Victorian fiction; I had read most of the feminist literary criticism then in print (amazing now that it once was possible to do such a thing!) and knew that I wanted to contribute to that field, but was uncertain about what exactly I might do.

Slogging through the scads of non-feminist criticism assigned in my classes, I was increasingly disheartened by its prevailing tone of superiority, its competitive mode, its lack of relation to the world outside itself. Reading Gilbert and Gubar was exhilarating: there was real passion in their work, a clear sense of more at stake than their own academic careers, a collaborative sensibility totally at odds with the usual solitariness evident in literary criticism. Even when I strongly disagreed with particular insights, scribbling objections in the margins of the book, I felt a powerful sense of connection with the co-authors. *Madwoman* was, in short, an amazing inspiration.

I begin with this bit of personal history in order, first, to pay tribute to Susan Gubar and also to try to give some sense of how important her work (both alone and with Sandra Gilbert) has been. But lest this opening give the impression that Susan Gubar is some sort of icon of the past glory of feminist criticism, I want to make clear that her reputation does not rest on *Madwoman* alone, but has been built and sustained on numerous works published since then, including the co-edited *Norton Anthology of Literature by Women*. This new book, *Critical Condition*, extends her already considerable reach and is another kind of inspiration, as in it she engages with new feminist critical methods and problems.

But *Critical Condition* is also sometimes disheartening, for, despite her critical acuity, Gubar occasionally missteps rather seriously. For example, the book's subtitle—*Feminism at the Turn of the Century*—misleads: Gubar's seven essays are not about feminism per se but about one branch of feminism, the academic variety. This qualification strikes me as a significant one, but one not sufficiently acknowledged in the book. Gubar's essays analyze particular women artists, poets, novelists, dramatists and writers of non-fiction; the underlying subject is academic feminism, particularly feminist literary criticism from the 1970s to the present—a topic related to but not the same as "feminism," as any feminist outside of academia would immediately note, perhaps with some asperity. Although the introduction to the book relates the world outside the academy to the narrower concerns of these essays, both the subtitle and the essays themselves elide the distinction. A reader approaching the book expecting a survey of feminism at the present moment will be disappointed.

That said, I think the essays have considerable appeal outside the academy, and most definitely beyond the boundaries of literature departments. Gubar's diagnosis of feminism's "critical condition" stresses her ambivalence: her "sense of being poised between causes for regret and for celebration." Feminist studies' condition, she argues, "has itself become critical because of a number of heated disputes that have put its proponents at odds."

We could, of course, extend that claim to feminism in general. Gubar sees current feminist theory as largely irrele-

We are still all right

"Your body is locked behind bars, but your spirit remains free..."
—Ho Chi Minh

with the way things are. My age has not held you back.
You are still strong enough to give me the setting sun
turning our mountains to blood. Beyond delicious deviance,
colliding cultures and my earlier eight year record,
we are still here.

I was not, after all, deported. We were not forced to
a country where you didn't speak the language. No more
beginnings. Until you did begin again, learned you
were born to teach, thrill in passing it on. Each hour
straining against the clock.

If you grow weaker, we will go by car. If less able, I will
guide your dance. If the pain returns, I will gentle your
body, calm your breath. Be legs for you, hands, eyes.
And when I lose the words, retreat into memory, you
will become my mouth.

Will we still be all right? Words that rise off my pillow
at night, settle in lungs, hang between us like dark smoke.
Unless we betray it, the question keeps us here,
you drinking from the bottom of the glass, I
licking your angry tears.

Every day

"I am learning new syllables of revolution" —June Jordan

of your life something hurt, somewhere in your body.
Small or large. Bearable or, yes, continuing
bearable. Like a suit of mail you wear this judgment
beneath the skin, curled tight about nerve and muscle,
holding its own.

Pain as language. As old clothes. Not comfortable
but familiar. Our first years you swallowed pills,
said they took the edge off, swept a clearing of
dark trees where you might stand. A tradeoff in
three-quarter time.

Now you no longer medicate and the pain is almost equal
in every way. Perhaps a half-note less, your body
so startled at being left alone. Know me, pain says,
live in me without fear of falling or regret for
all that has not been.

What this means: beyond the point. If judgment, possessed
by someone else. You can let that go. I watch as you
choose to live where you are, inhabit the place
you have earned, note the old riddle on your brow
unraveled, spent.

—Margaret Randall