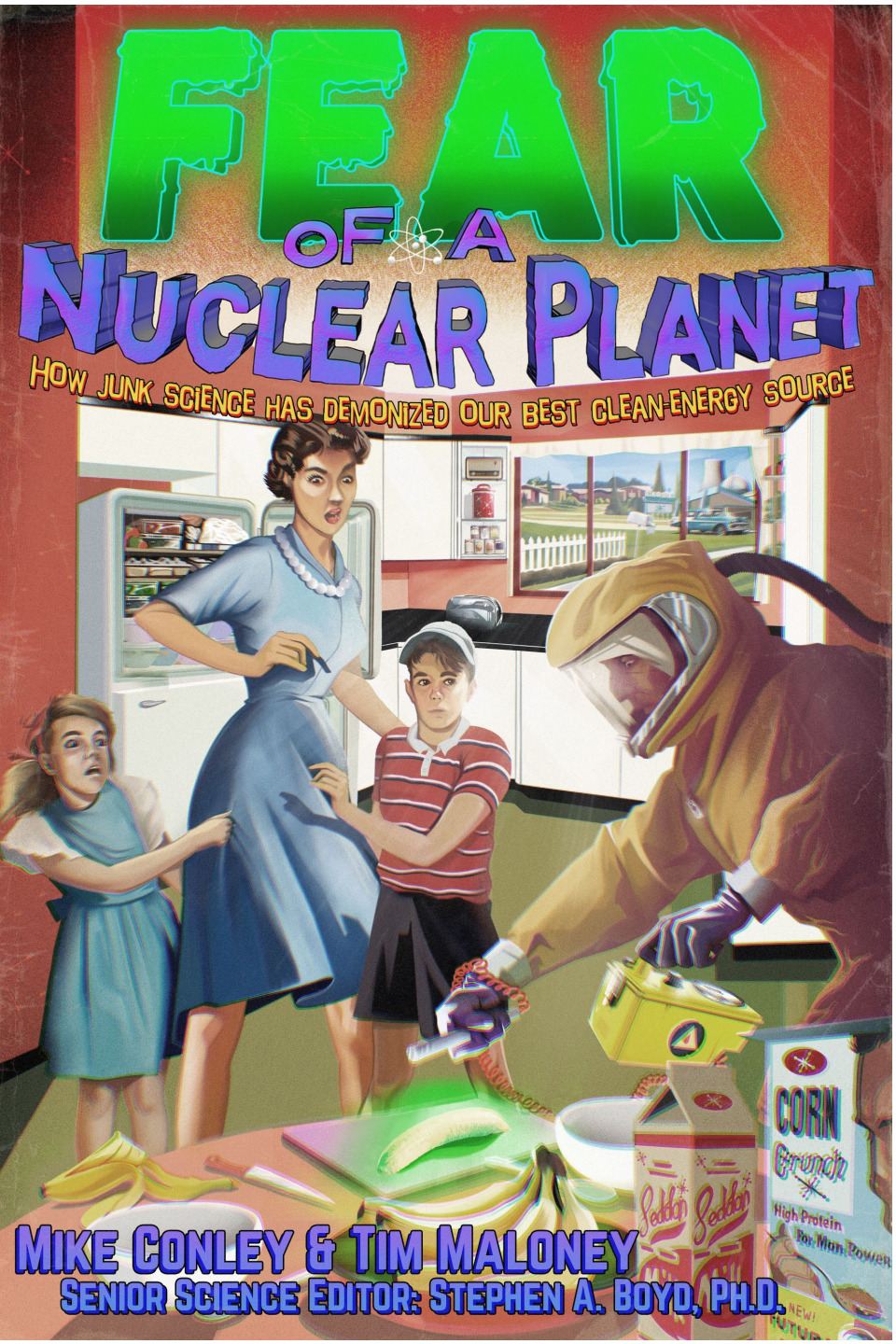
FEAR OF A NUCLEAR PLANET

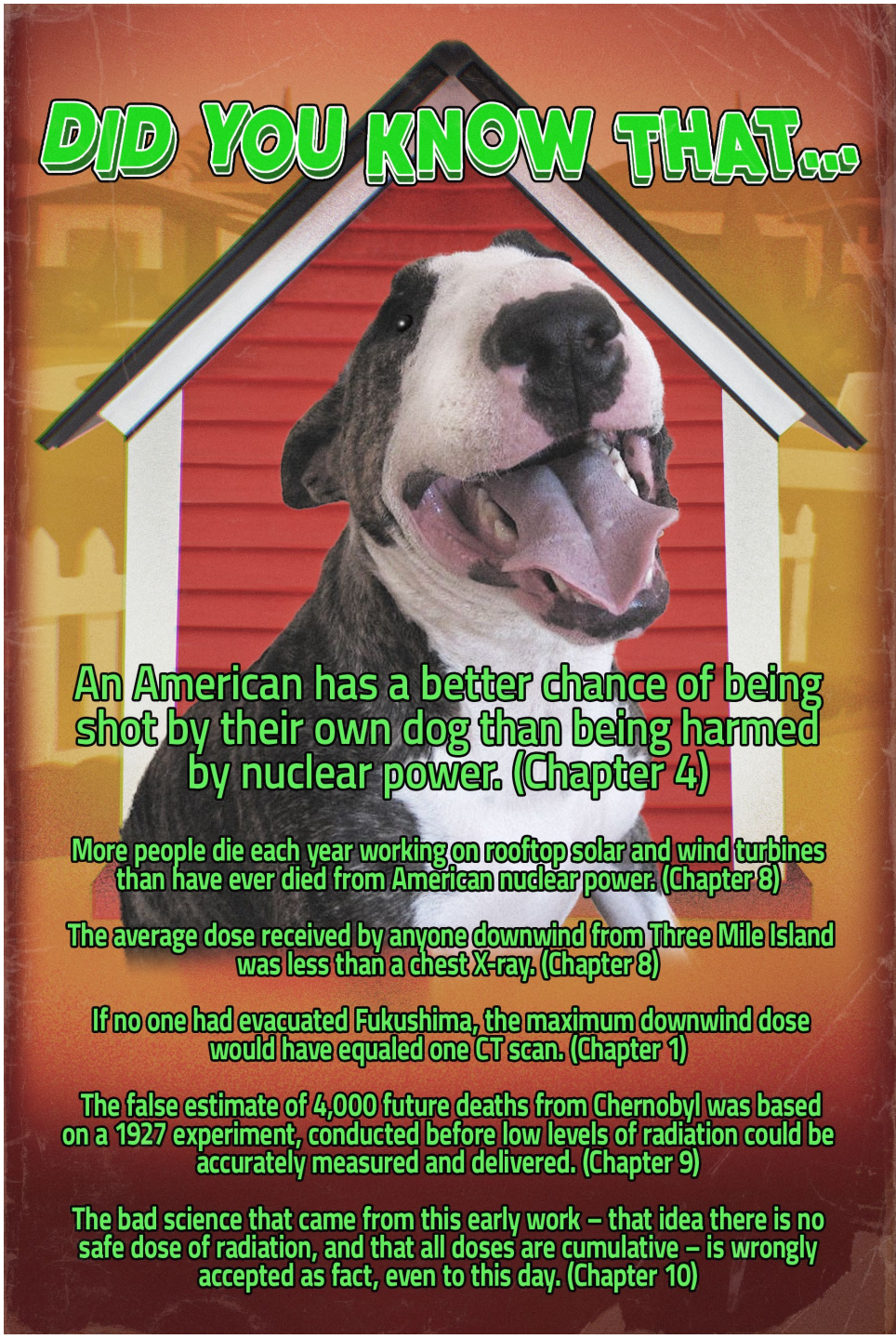
How junk science has demonized our best clean-energy source



Mike Conley & Tim Maloney

Senior Science Editor: Stephen A. Boyd, Ph.D.

Did You Know That...



An American has a better chance of being shot by their own dog than being harmed by nuclear power. (Chapter 4)

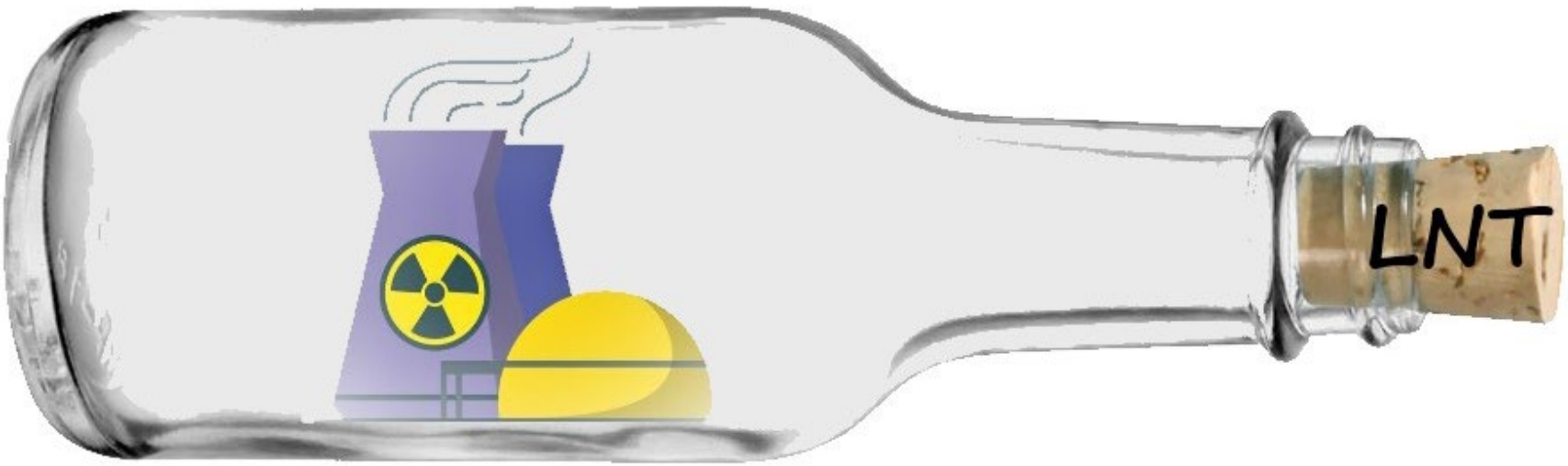
More people die each year working on rooftop solar and wind turbines than have ever died from American nuclear power. (Chapter 8)

The average dose received by anyone downwind from Three Mile Island was less than a chest X-ray. (Chapter 8)

If no one had evacuated Fukushima, the maximum downwind dose would have equaled one CT scan. (Chapter 1)

The false estimate of 4,000 future deaths from Chernobyl was based on a 1927 experiment, conducted before low levels of radiation could be accurately measured and delivered. (Chapter 9)

The bad science that came from this early work – that idea there is no safe dose of radiation, and that all doses are cumulative – is wrongly accepted as fact, even to this day. (Chapter 10)


LNT

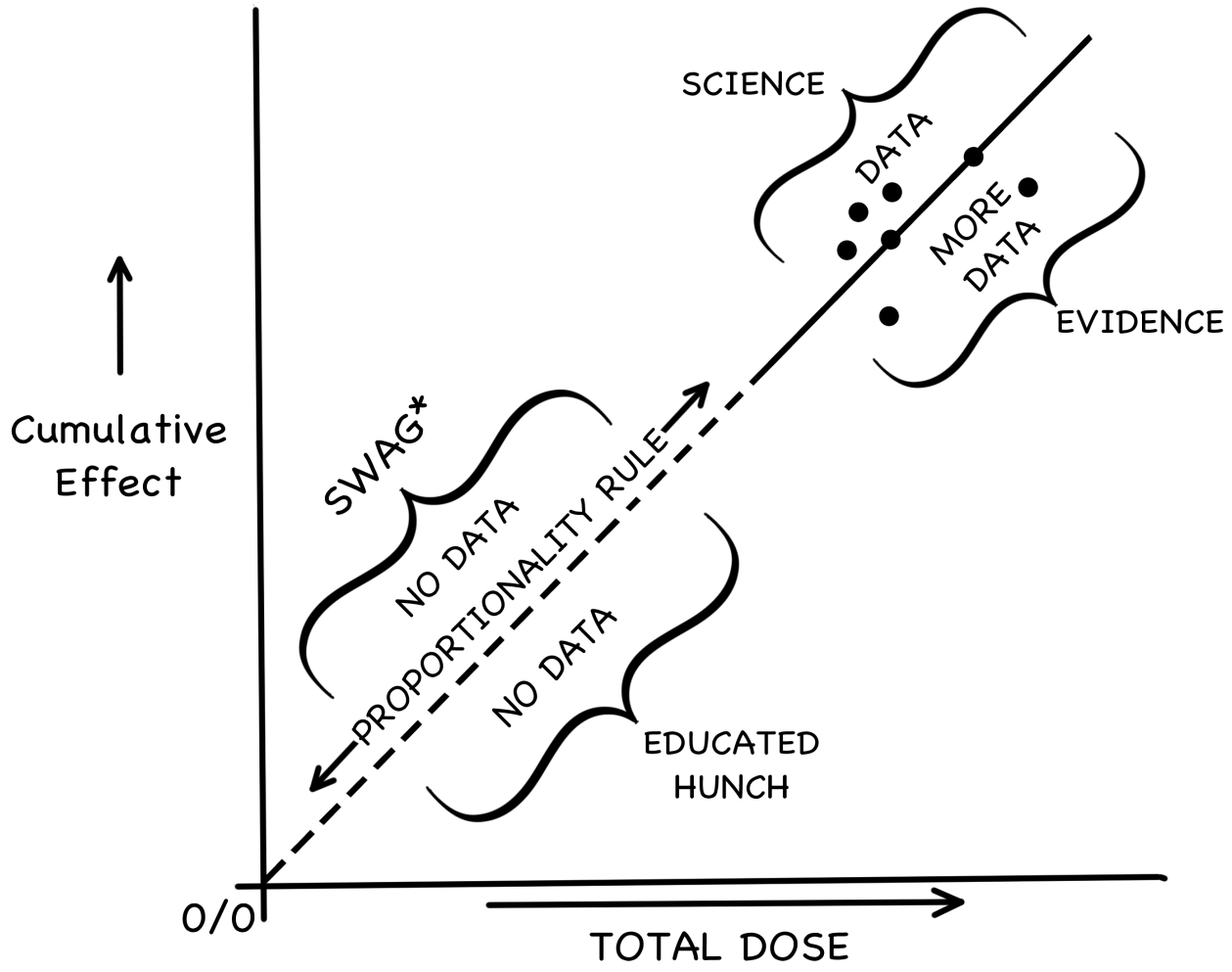
There is no safe dose of radiation, and all doses are cumulative.

– Hermann Muller's 1946
Linear No-Threshold model
of radiation risk assessment

Muller's Proportionality Rule:

- Twice the dose causes twice the effect.
- Half the dose causes half the effect.
- This relationship holds true down to zero dose / zero effect.

The LNT Model



*Scientific Wild-ass Guess

"There is no minimum amount of radiation which must be exceeded before mutations occur. Any amount, however small, that reaches the reproductive cells can cause a correspondingly small number of mutations. The more radiation, the more mutations."

– 1956 BEAR-I REPORT
US National Academy of Sciences

"The point here, however, is that in the absence of any other information, it seems to me – this is my personal opinion – that the only prudent course is to assume that a straight-line relationship holds here [in the low-dose region] as well as elsewhere in the higher dose region."

– Ed Lewis in testimony to Congress May 27, 1957

"WARNING OF DANGER was sounded by Dr. E. B. Lewis of CalTech. In an article in *Science* he proved that there is a direct relationship between radiation and leukemia. He predicts a five to 10 percent increase in leukemia if strontium-90 level in humans [from bomb test fallout] reaches a figure which the AEC still considers harmless."

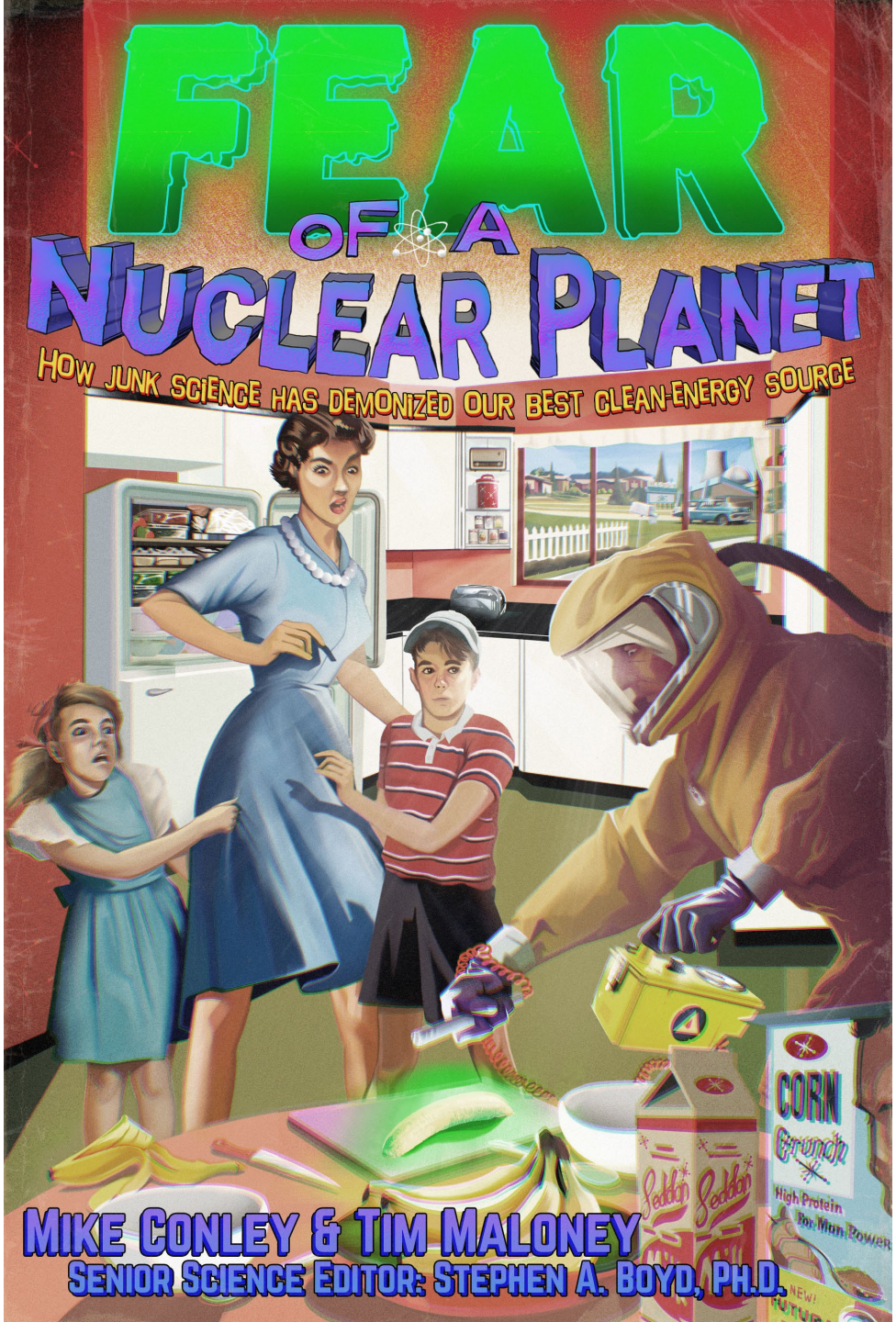
– *Life* Magazine June 10,1957

All Radiation Held Perilous: Nation's Top Geneticists Unanimous In Opinion, Fallout Produced Now Will Shorten Lives in Future, Congress is Told

– Washington Post June 3,1957

FEAR OF A NUCLEAR PLANET

How Junk Science has Demonized Our Best Clean-Energy Source



Mike Conley & Tim Maloney

Senior Science Editor: Stephen A. Boyd, Ph.D.

DID YOU KNOW THAT...

An American has a better chance of being shot by their own dog than being harmed by nuclear power. (Chapter 4)

More people die each year working on rooftop solar and wind turbines than have ever died from American nuclear power. (Chapter 8)

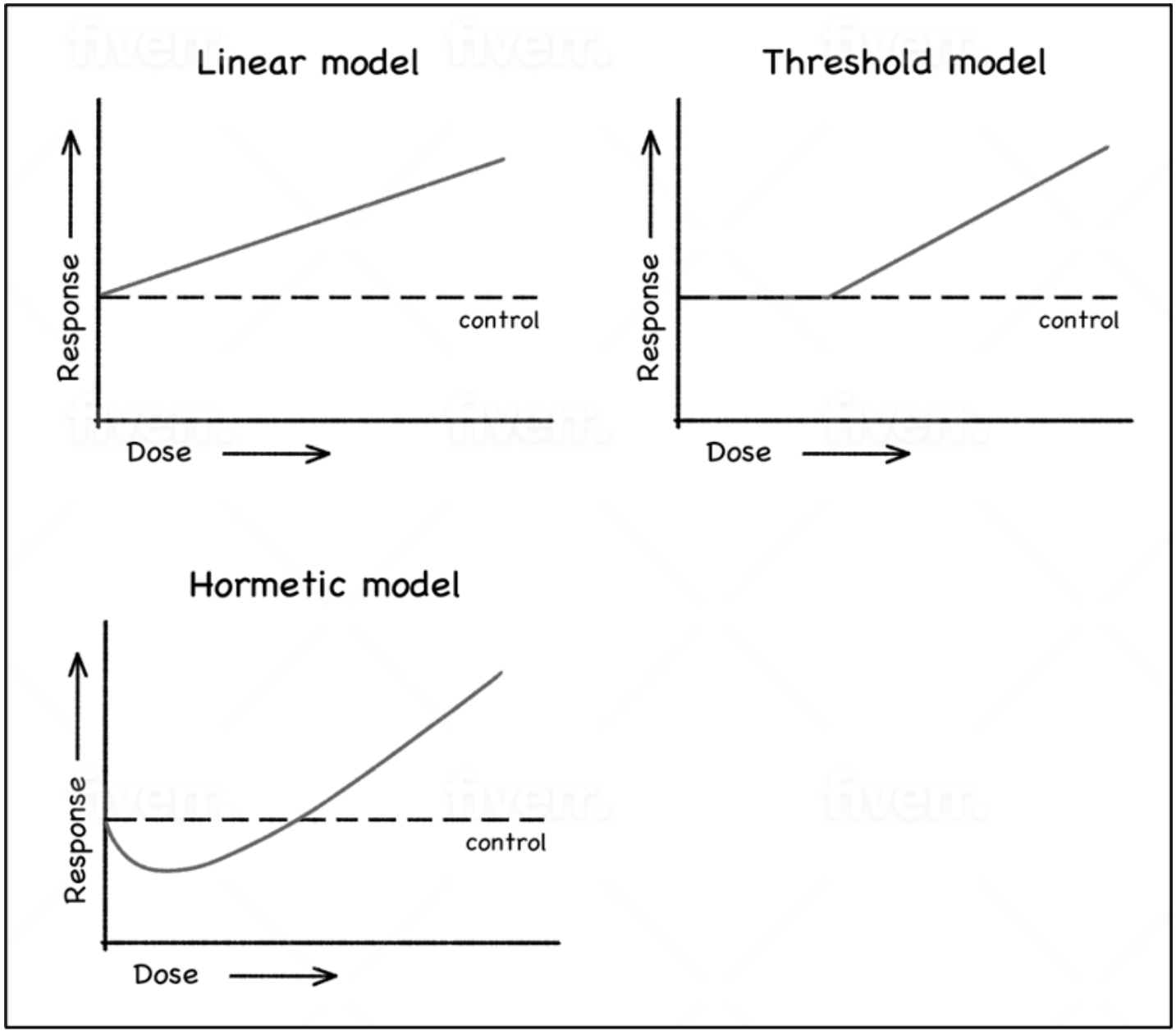
The average dose received by anyone downwind from Three Mile Island was less than a chest X-ray. (Chapter 8)

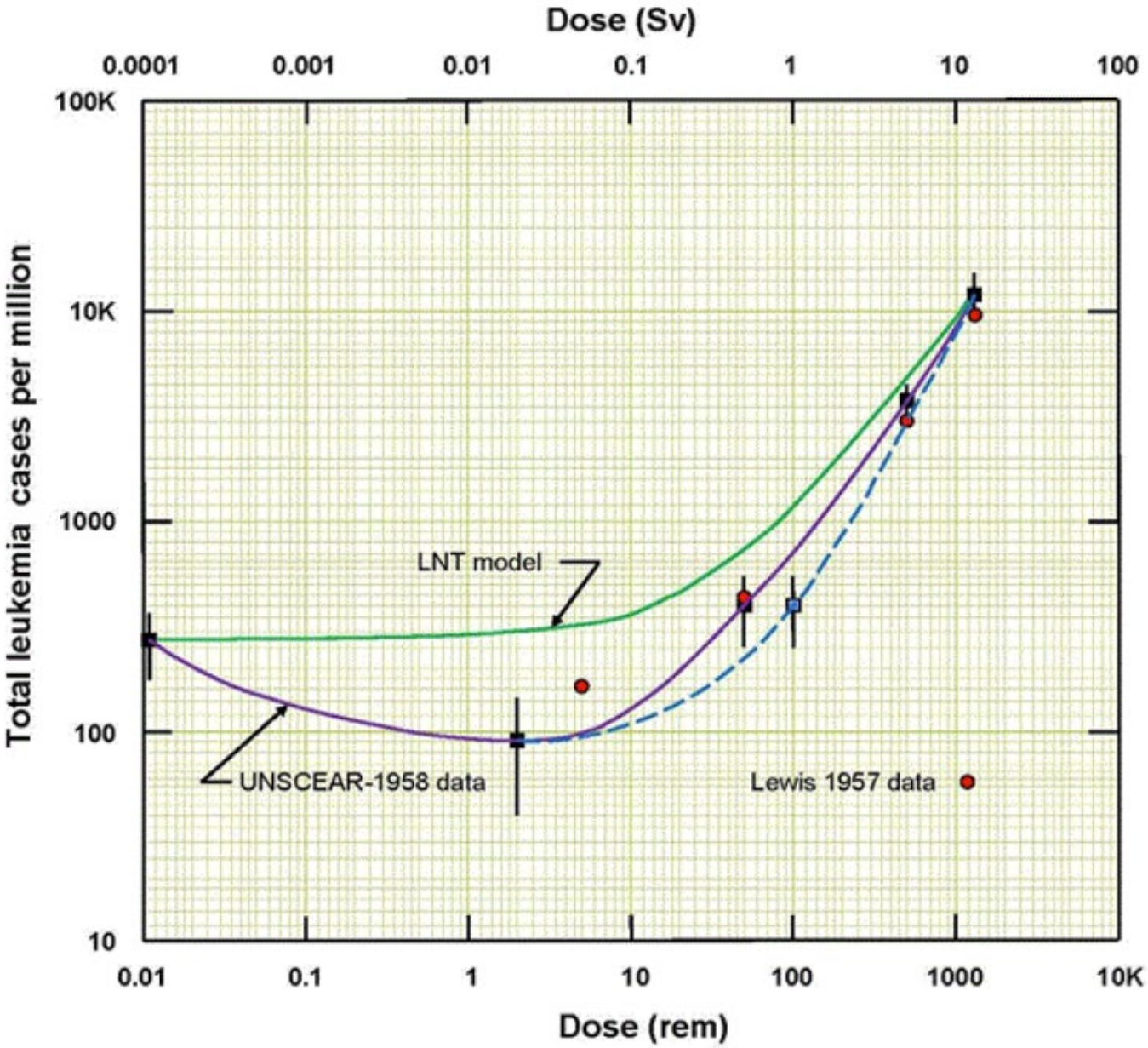
If no one had evacuated Fukushima, the maximum downwind dose would have equaled one CT scan. (Chapter 1)

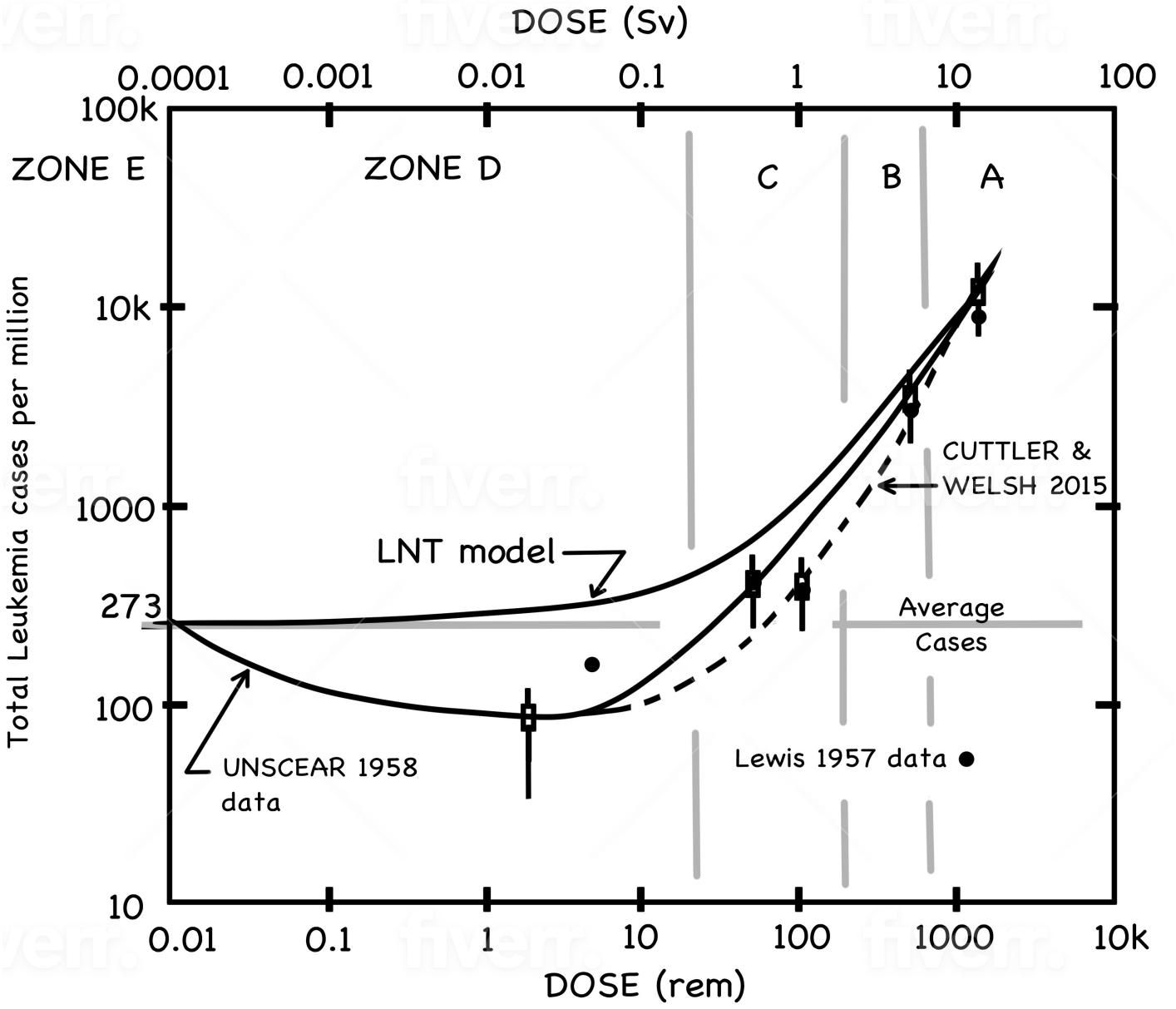
The false estimate of 4,000 future deaths from Chernobyl was based on a 1927 experiment, conducted before low levels of radiation could be accurately measured and delivered. (Chapter 9)

The bad science that came from this early work – that idea there is no safe dose of radiation, and that all doses are cumulative – is wrongly accepted as fact, even to this day. (Chapter 10)

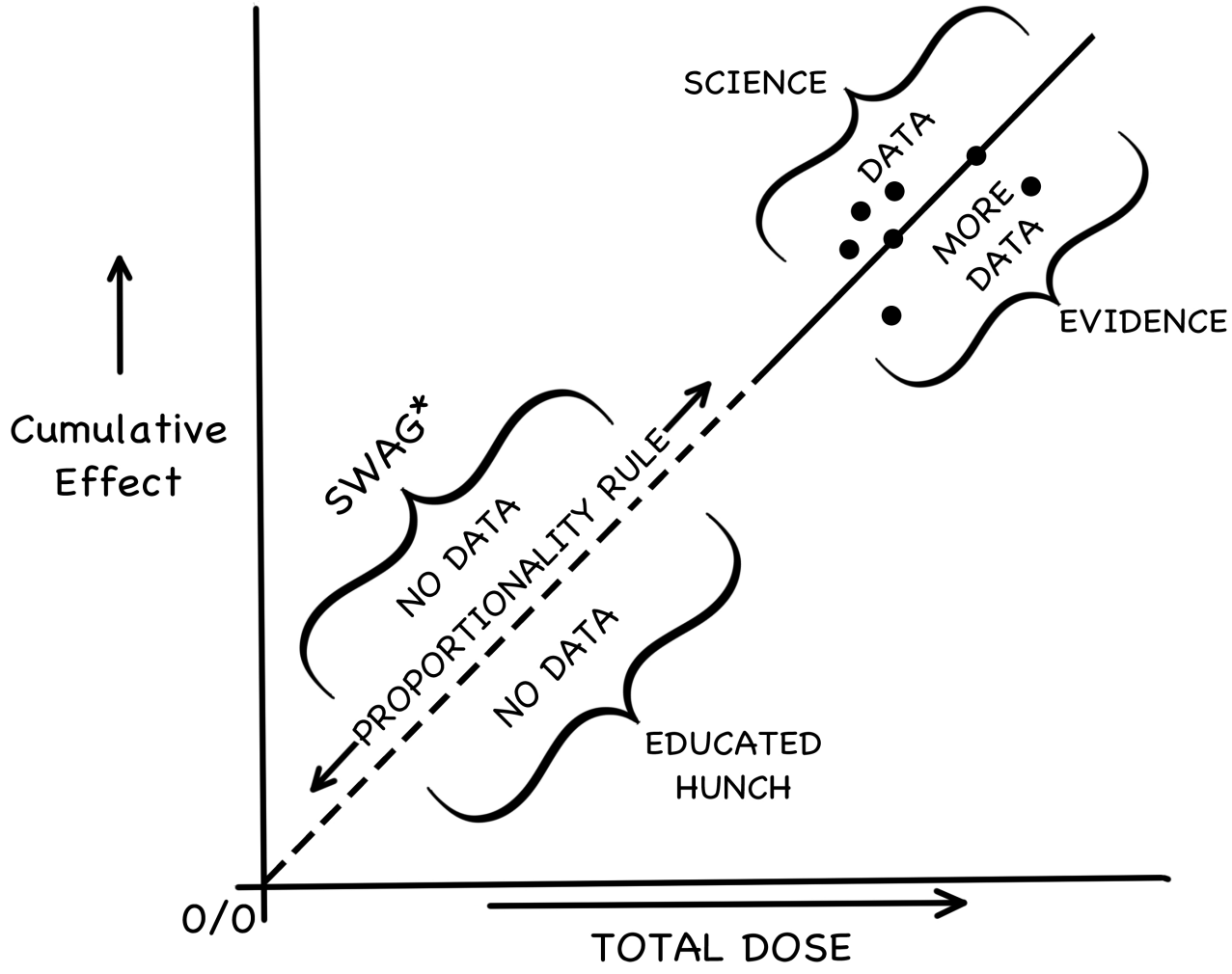
James Welsh, M.D.
Department of Radiation Oncology


Linear model
Response
control
Dose
Threshold model
Response
control
Dose
Hormetic model
Response
control
Dose

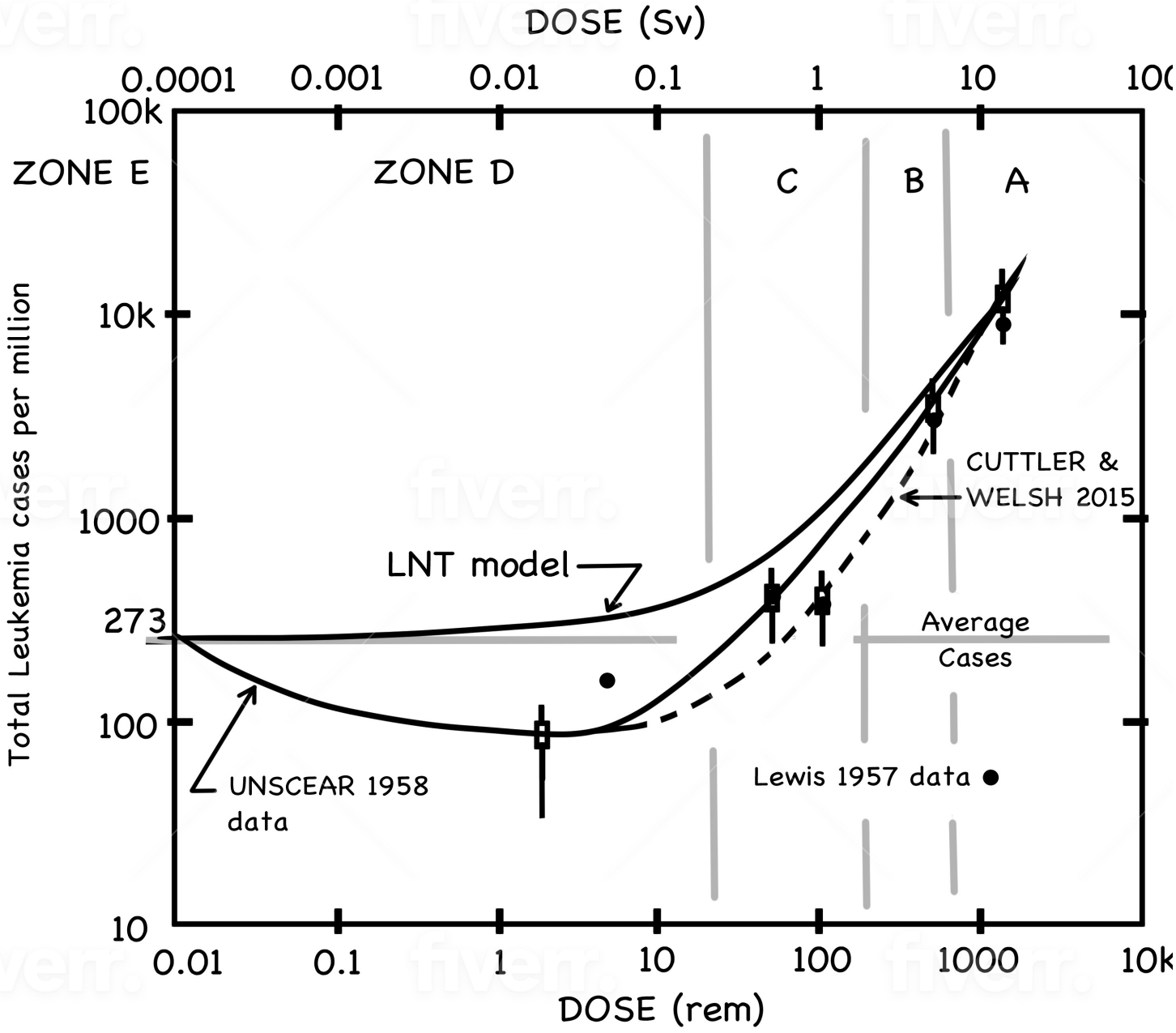

Dose (Sv)
0.0001
0.001
0.01
0.1
1
10
100
100K
10K
1000
100
10
Total leukemia cases per million
LNT model
UNSCEAR-1958 data
Lewis 1957 data
0.01
0.1
1
10
100
1000
10K
Dose (rem)


DOSE (Sv)
0.0001
0.001
0.01
0.1
1
10
100
100k
ZONE E
ZONE D
C
B
A
10k
1000
273
100
10
Total Leukemia cases per million
CUTTLER &
WELSH 2015
LNT model
Average
Cases
UNSCEAR 1958
data
Lewis 1957 data
0.01
0.1
1
10
100
1000
10k
DOSE (rem)

The LNT Model



*Scientific Wild-ass Guess


DOSE (Sv)
0.0001
0.001
0.01
0.1
1
10
100
100k
10k
1000
273
100
10
ZONE E
ZONE D
C
B
A
Total Leukemia cases per million
LNT model
CUTTLER &
WELSH 2015
Average
Cases
UNSCEAR 1958
data
Lewis 1957 data
0.01
0.1
1
10
100
1000
10k
DOSE (rem)

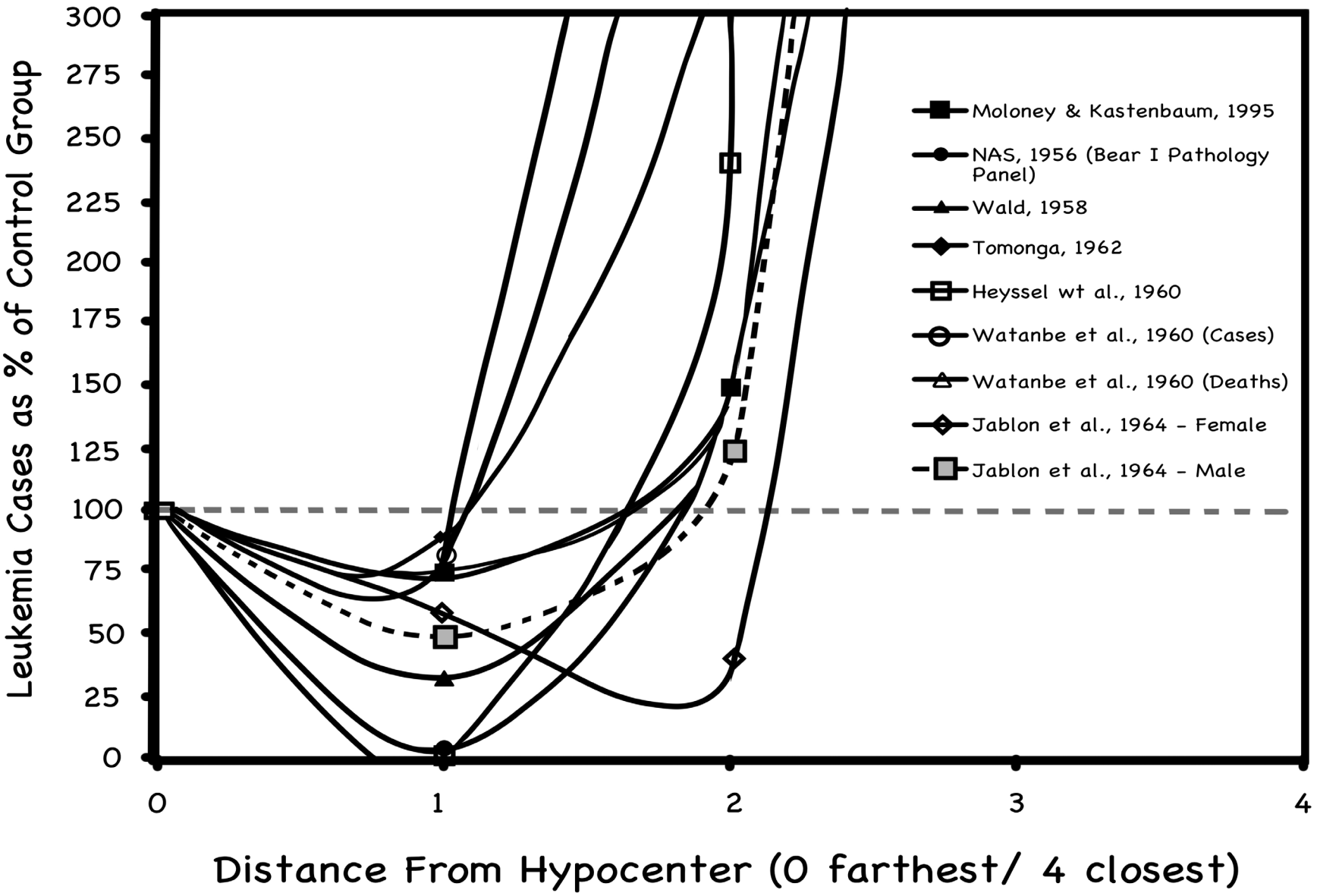

Leukemia Cases as % of Control Group
300
275
250
225
200
175
150
125
100
75
50
25
0
0
1
2
3
4
Distance From Hypocenter (0 farthest/ 4 closest)
Moloney & Kastenbaum, 1995
NAS, 1956 (Bear I Pathology Panel)
Wald, 1958
Tomonga, 1962
Heyssel wt al., 1960
Watanbe et al., 1960 (Cases)
Watanbe et al., 1960 (Deaths)
Jablon et al., 1964 - Female
Jablon et al., 1964 - Male

TABLE VII. LEUKEMIA INCIDENCE FOR 1950–57 AFTER EXPOSURE AT HIROSHIMA[a]

Zone	*Distance from hypocentre (metres)*	*Dose (rem)*	*Persons exposed*	*L (Cases of leukemia)*	$\sqrt{L}$	*N[b] (total cases per 10^6)*	*N_x (Radiation-induced cases per 10^6)*	*N_x/rem*	*P_L ($N_x/10^6$/year/rem)*
A	under 1,000	1,300	1,241	15	3.9	12,087 ± 3,143	11,814	9.1	1.14×10^{-6}
B	1,000–1,499	500	8,810	33	5.7	3,746 ± 647	3,473	6.9	0.86×10^{-6}
C	1,500–1,999	50[c]	20,113	8	2.8	398 ± 139	125	2.5	0.31×10^{-6}
D	2,000–2,999	2	32,692	3	1.7	92 ± 52	−181	−90	-11×10^{-6}
E	over 3,000	0	32,963	9	3.0	273 ± 91	Control	—	—

[a] Based on data in reference 13. Prior to 1950 the number of cases may be understated rather seriously.

[b] The standard error is taken as $N(\sqrt{L}/L)$.

[c] It has been noted [15, 16] that almost all cases of leukemia in this zone occurred in patients who had severe radiation complaints, indicating that their doses were greater than 50 rem.

TABLE VII. LEUKEMIA INCIDENCE FOR 1950–57 AFTER EXPOSURE AT HIROSHIMA[a]

Zone	Distance from hypocentre (metres)	Dose (rem)	Persons exposed	L (Cases of leukemia)	$\sqrt{L}$	N^b (total cases per 10^6)	N_x (Radiation-induced cases per 10^6)	N_x/rem	P_L ($N_x/10^6$/year/rem)
A	under 1,000	1,300	1,241	15	3.9	12,087 ± 3,143	11,814	9.1	1.14×10^{-6}
B	1,000–1,499	500	8,810	33	5.7	3,746 ± 647	3,473	6.9	0.86×10^{-6}
C	1,500–1,999	50[c]	20,113	8	2.8	398 ± 139	125	2.5	0.31×10^{-6}
D	2,000–2,999	2	32,692	3	1.7	92 ± 52	−181	−90	-11×10^{-6}
E	over 3,000	0	32,963	9	3.0	273 ± 91	Control	—	—

[a] Based on data in reference 13. Prior to 1950 the number of cases may be understated rather seriously.

[b] The standard error is taken as $N(\sqrt{L}/L)$.

[c] It has been noted [15, 16] that almost all cases of leukemia in this zone occurred in patients who had severe radiation complaints, indicating that their doses were greater than 50 rem.

Table 2. Incidence of leukemia among the combined exposed populations of Hiroshima and Nagasaki by distance from the hypocenter (January 1948–September 1955).

Zone	Distance from hypocenter (m)	Estimated population of exposed survivors (Oct. 1950)	Number of confirmed cases of leukemia	Percentage of leukemia
A	0– 999	1,870	18	0.96
B	1000–1499	13,730	41	0.30
C	1500–1999	23,060	10	0.043
D	2000 and over	156,400	26	0.017

TABLE VII. LEUKEMIA INCIDENCE FOR 1950–57 AFTER EXPOSURE AT HIROSHIMA[a]

Zone	Distance from hypocentre (metres)	Dose (rem)	Persons exposed	L (Cases of leukemia)	$\sqrt{L}$	N^b (total cases per 10^6)	N_x (Radiation-induced cases per 10^6)	N_x/rem	P_L ($N_x/10^6$/year/rem)
A	under 1,000	1,300	1,241	15	3.9	12,087 ± 3,143	11,814	9.1	1.14×10^{-6}
B	1,000–1,499	500	8,810	33	5.7	3,746 ± 647	3,473	6.9	0.86×10^{-6}
C	1,500–1,999	50[c]	20,113	8	2.8	398 ± 139	125	2.5	0.31×10^{-6}
D	2,000–2,999	2	32,692	3	1.7	92 ± 52	−181	−90	-11×10^{-6}
E	over 3,000	0	32,963	9	3.0	273 ± 91	Control	—	—

[a] Based on data in reference 13. Prior to 1950 the number of cases may be understated rather seriously.

[b] The standard error is taken as $N(\sqrt{L}/L)$.

[c] It has been noted [15, 16] that almost all cases of leukemia in this zone occurred in patients who had severe radiation complaints, indicating that their doses were greater than 50 rem.

Table 2. Incidence of leukemia among the combined exposed populatio
and Nagasaki by distance from the hypocenter (January 1948–Septembe

Zone	Distance from hypocenter (m)	Estimated population of exposed survivors (Oct. 1950)	Number of confirmed cases of leukemia
A	0– 999	1,870	18
B	1000–1499	13,730	41
C	1500–1999	23,060	10
D	2000 and over	156,400	26

Zone	Distance from hypocentre (m)	Dose (rem or cSv)	Persons exposed	Number of cases of leukemia	Total cases per million
A	0 - 999	1300	1,241	15	12,087
B	1000 - 1499	500	8,810	33	3,746
C	1500 - 1999	50	20,113	8	398
D	2000 - 2999	2	33,692	3	92
E	over 3000	0	32,963	9	273

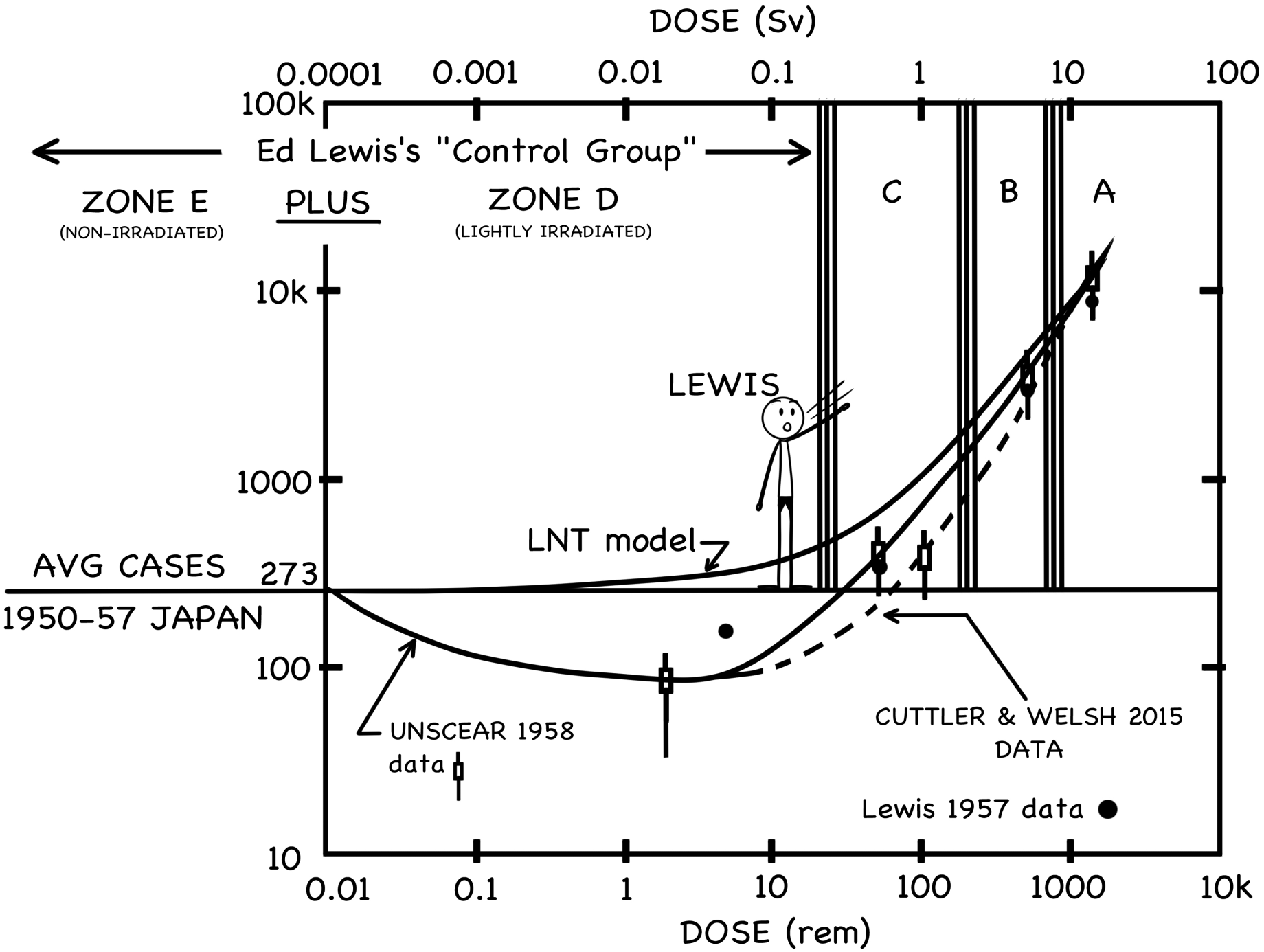
Table 2: Leukemia incidence for 1950-57 after exposure at Hiroshima (adapted from UNSCEAR-1958, Annex G, Table VII) [8].

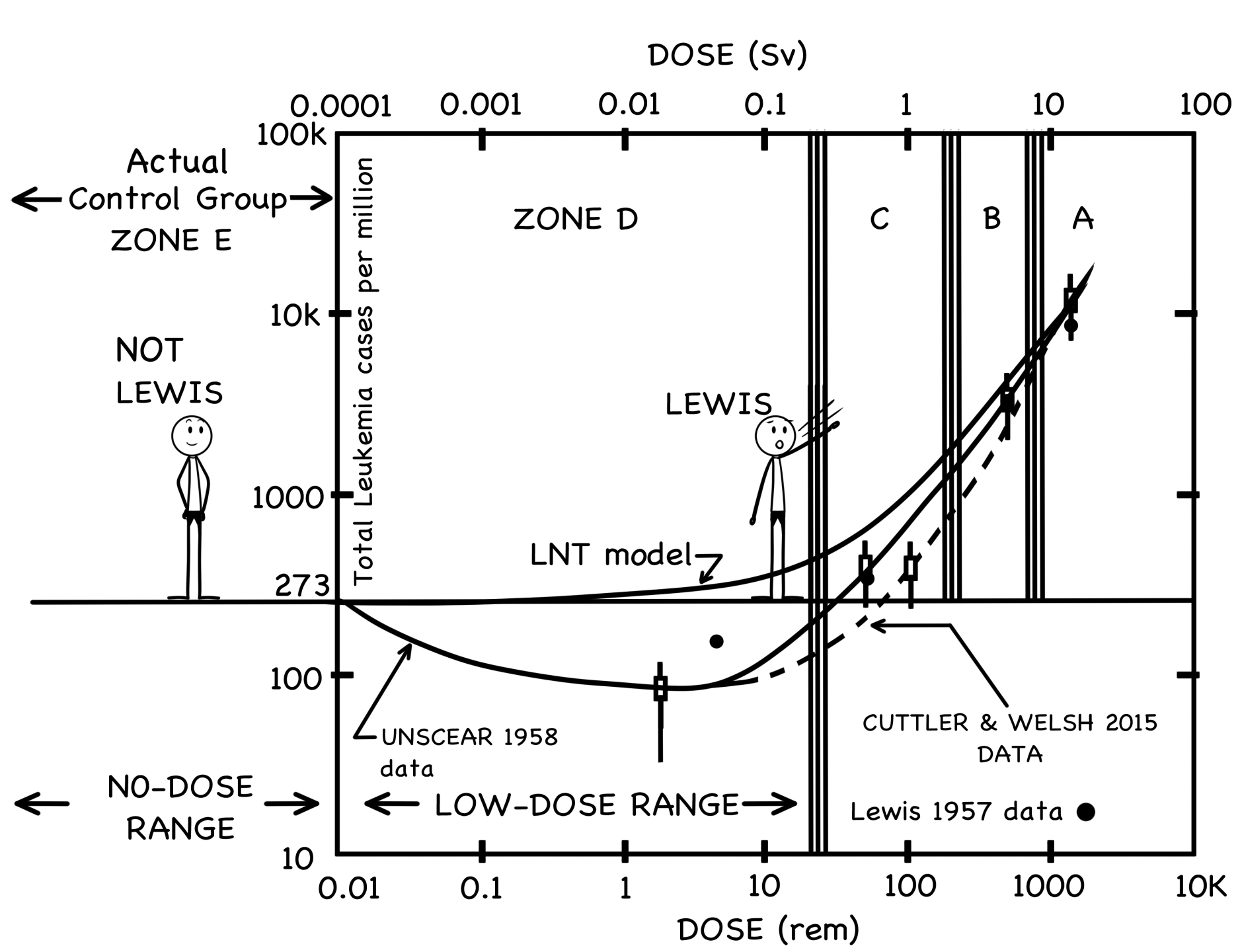
"Since the majority of the population in Zone D (from 2000 meters on) was beyond 2500 meters, the average dose is under 5 rem [50 mSv] and is thus so low that Zone D can be treated as if it were a 'control' zone."

– Ed Lewis, 1957

"Um, no it can't."

– Cuttler and Welch, 2015
(paraphrased)


DOSE (Sv)
0.0001
0.001
0.01
0.1
1
10
100
100k
Ed Lewis's "Control Group"
ZONE E
(NON-IRRADIATED)
PLUS
ZONE D
(LIGHTLY IRRADIATED)
C
B
A
10k
LEWIS
1000
LNT model
AVG CASES
273
1950-57 JAPAN
100
UNSCEAR 1958
data
CUTTLER & WELSH 2015
DATA
Lewis 1957 data
10
0.01
0.1
1
10
100
1000
10k
DOSE (rem)


DOSE (Sv)
0.0001
0.001
0.01
0.1
1
10
100
100k
10k
1000
273
100
10
Actual
Control Group
ZONE E
Total Leukemia cases per million
ZONE D
C
B
A
NOT
LEWIS
LEWIS
LNT model
UNSCEAR 1958
data
CUTTLER & WELSH 2015
DATA
Lewis 1957 data
NO-DOSE
RANGE
LOW-DOSE RANGE
0.01
0.1
1
10
100
1000
10K
DOSE (rem)

LNT

QR code for *Fear of a Nuclear Planet*