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The Pseudo Pelger-Huët Cell as a Retrospective Dosimeter: Analysis of a Radium Dial Painter Cohort

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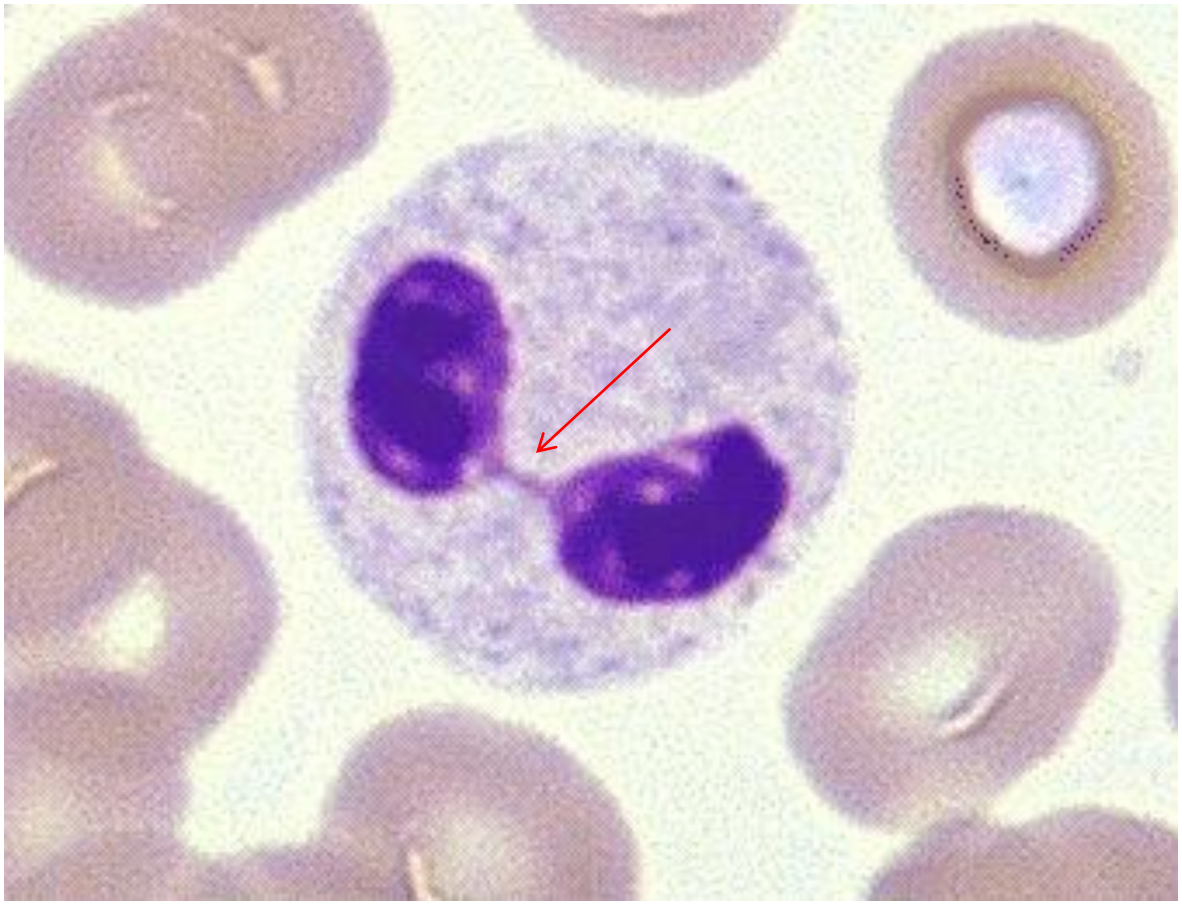
"Learning from Plutonium and Uranium Workers"

Pelger-Huët Cell – Permanent Biodosimeter



Pelger-Huët Anomaly

- The Pelger-Huët anomaly (PHA) was first described by Karl Pelger in 1928, and defined as an autosomal dominant trait by G.J. Huët in 1931.
- The PH cell, mostly seen in neutrophils, is characterized by round, oval, bean–shaped or symmetric bilobed nuclei which are joined by a thin filament of chromatin or mitotic bridge.
- PHA is caused by a decreased amount of the lamin B receptor (LBR). The B-type lamins are the building blocks of the nuclear lamina (NL).
- The LBR gene is known to be located on the long arm of chromosome 1, 1q42.12.

Pelger-Huët Anomaly

- Recently the pseudo-Pelger Huët anomaly (PHA) in peripheral blood neutrophils was described as a new radiation-induced, stable biomarker (Goans *et al*. Health Phys 108(3), 2015).
- Using archival peripheral blood slides obtained from patients in the 1958 Y-12 criticality accident, we showed that the pseudo-Pelger Huët anomaly (PHA) in neutrophils is a new radiation-induced biomarker.
- From that work there is good evidence that PHA is a permanent biomarker (up to 17 years), making the cell potentially useful in retrospective dosimetry.

PHA in Y-12 patient A; 4.61 Gy-Eq; 17 June 1958, 19 h post accident

USTUR Collaboration

- In this study, we have examined PHA in peripheral blood slides from a cohort of 166 former radium dial painters, 35 of whom had zero marrow dose.
- The slides were made available in collaboration with the US Transuranium and Uranium Registry (USTUR).
- Members of the radium dial painter cohort had ingestion of ^{226}Ra and ^{228}Ra at an early age (average age 20.6 ± 5.4 y; range 13-40 y) during the years 1914-1955.
- Exposure duration ranged from 1-1820 weeks with marrow dose 1.5-6787 mGy. The peripheral blood slides were prepared 1960-1965 and 1970-1975 during medical follow-up.

FISHERbrand
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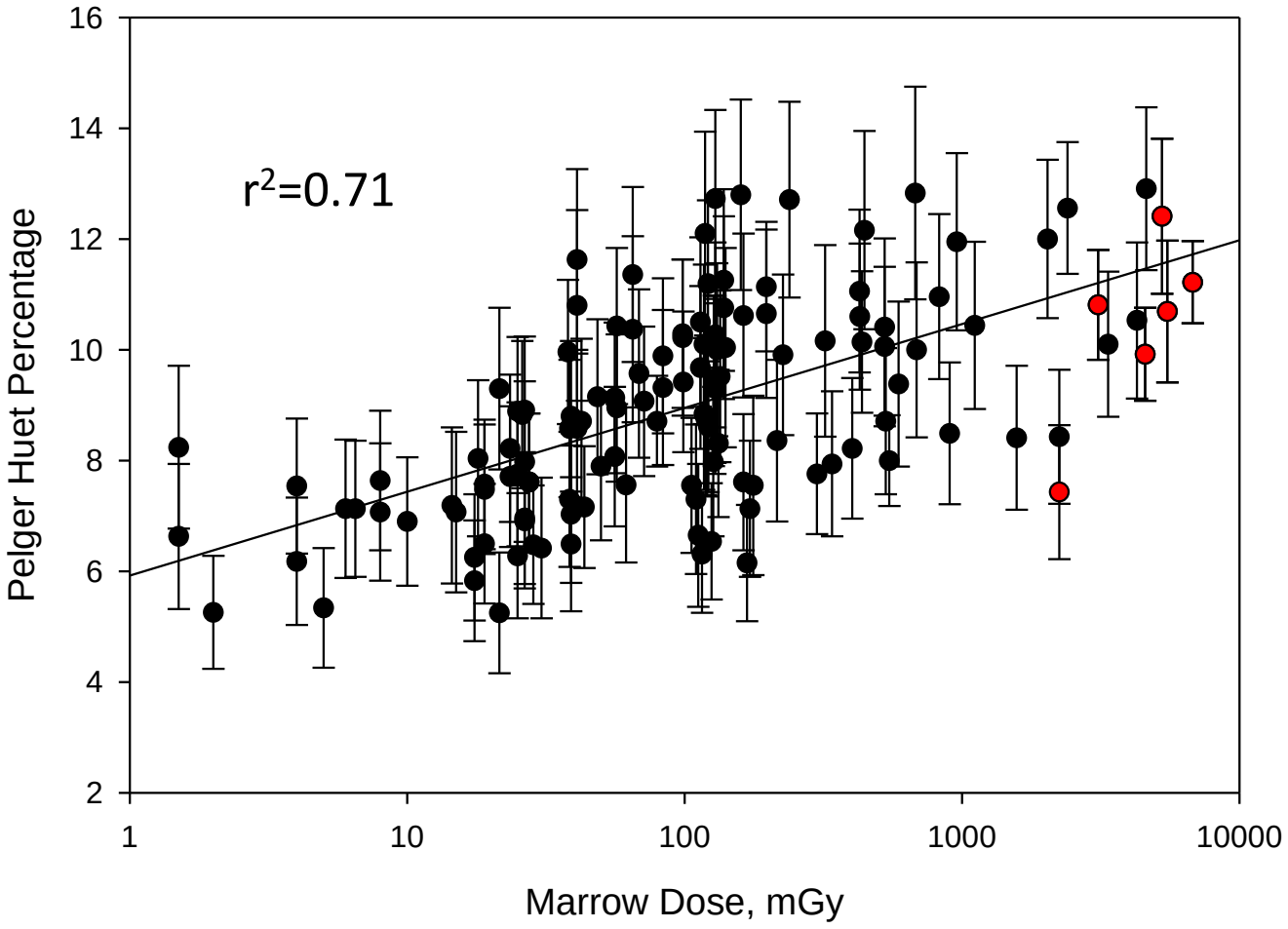
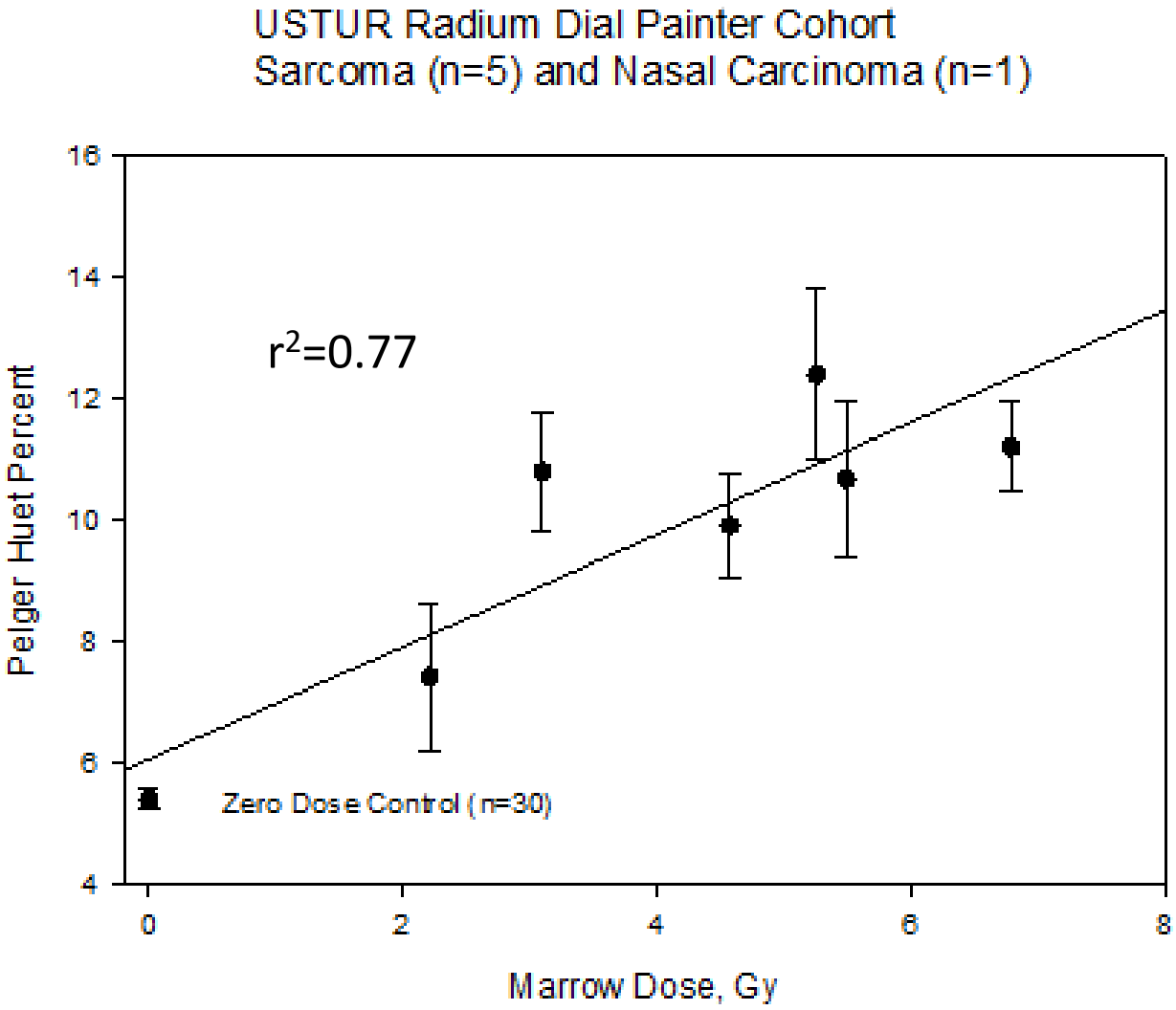
43	5-22-74	93	
44	5-27-74	94	
45	6-4-74	95	
46	6-5-74	96	
47	6-6-74	97	
48	6-11-74	98	
49	6-11-74	99	
50	6-11-74	100	

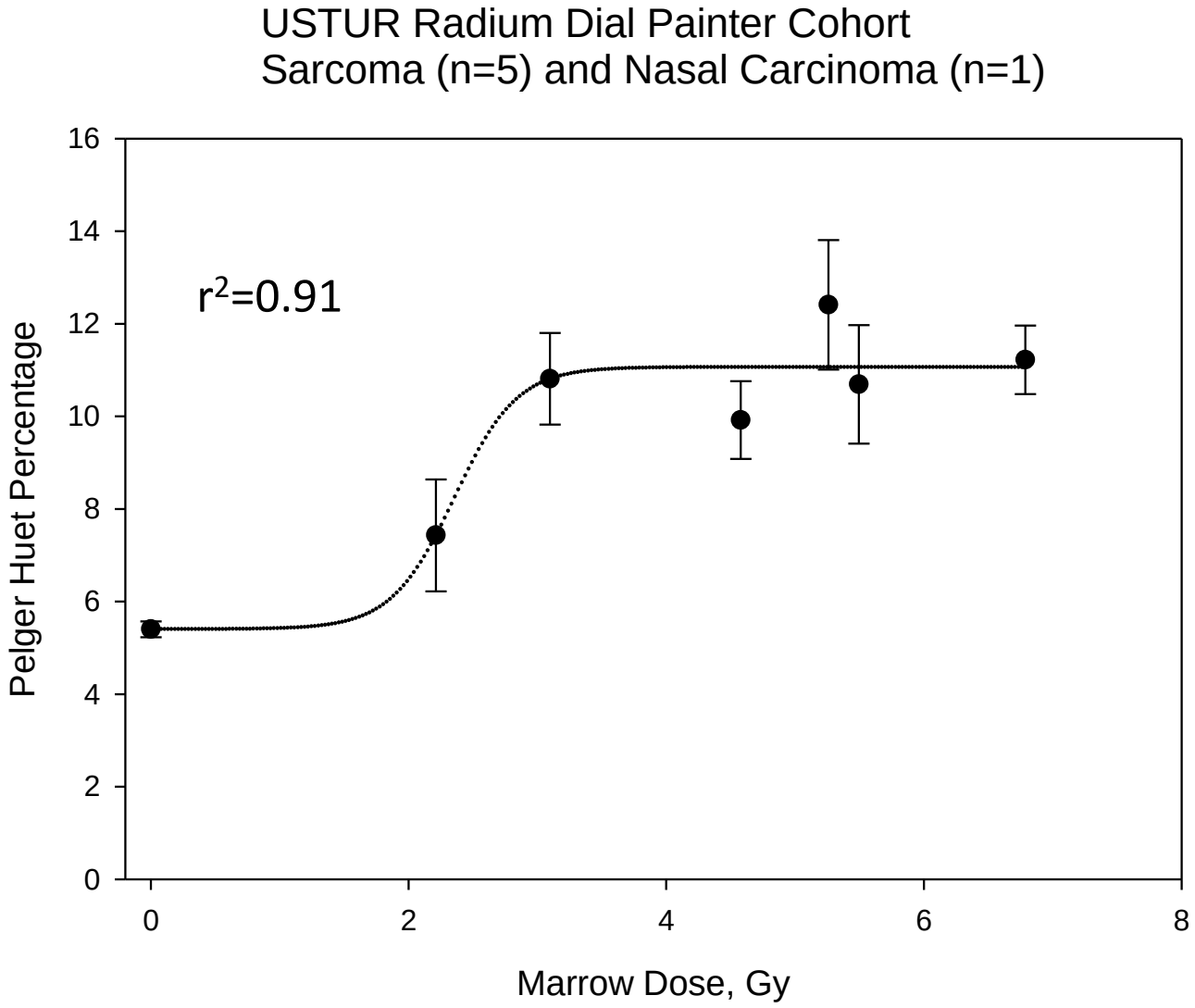
MADE U.S.A.

RDP 09-064
Started 1916; exposed for 9 weeks

USTUR Radium Dial Cohort




USTUR Radium Dial Painter Cohort
Sarcoma (n=5) and Nasal Carcinoma (n=1)
r2=0.77
Zero Dose Control (n=30)
Pelger Huet Percent
Marrow Dose, Gy
16
14
12
10
8
6
4
0
2
4
6
8

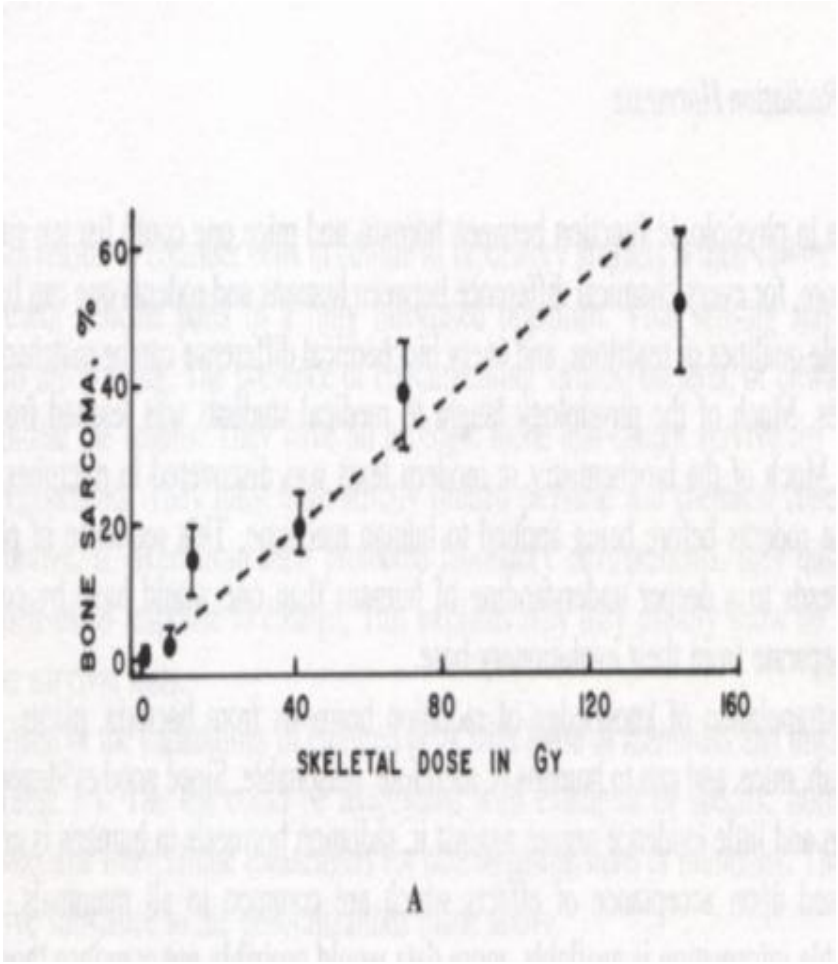

USTUR Radium Dial Painter Cohort
Sarcoma (n=5) and Nasal Carcinoma (n=1)
r2=0.91
Pelger Huet Percentage
Marrow Dose, Gy
0
2
4
6
8
10
12
14
16

Fit to Sarcoma Data

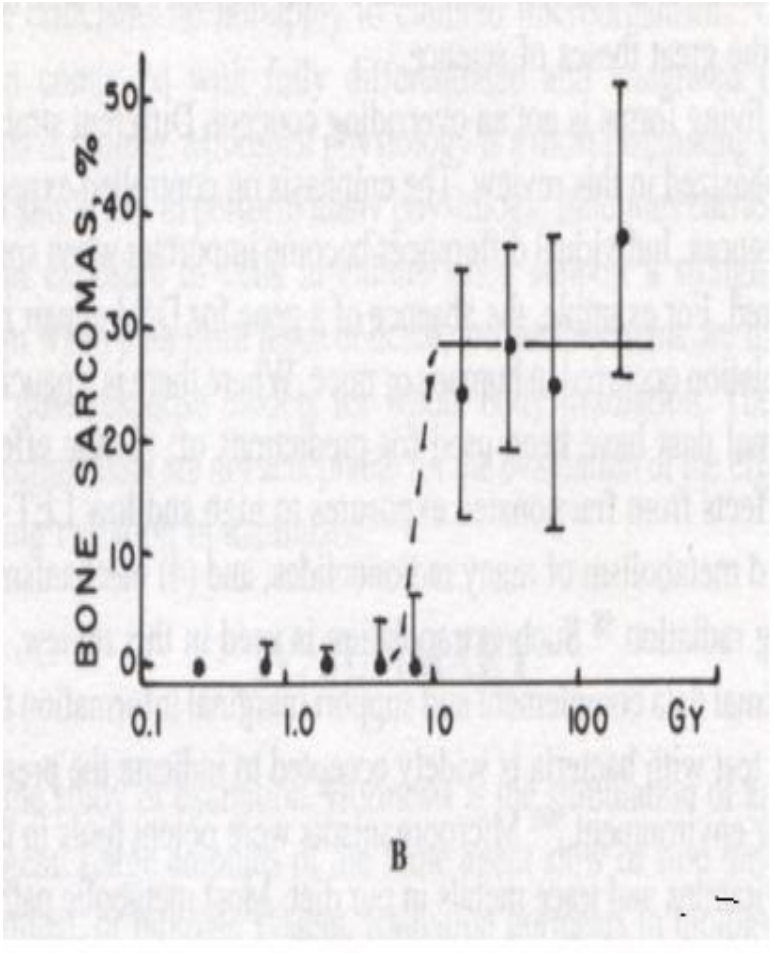
Linear fit $r^2 = 0.77$

Sigmoid fit $r^2 = 0.91$

Evidence for a threshold effect



Linear scale



Log scale

Bone sarcoma in Radium dial painters

Conclusion

- PHA from peripheral blood is therefore a reasonable dose surrogate to evaluate historic alpha dose to bone marrow.