

**DRASTIC INCREASE OF BACKGROUND IN THE GLIWICE
RADIOCARBON LABORATORY DURING LATE APRIL, 1986,
AND ITS TIME CHANGES***

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ABSTRACT. Preliminary observations of changes of the background of three proportional counters during May and June, 1986, are presented. Some isotopes contributing to the rise of background were identified on the basis of their half-life determinations.

Starting from April 29, 1986, a significant increase of the background of proportional counters in the Radiocarbon Laboratory in Gliwice, caused by damage to a nuclear power plant in Chernobyl near Kiev, USSR, was noted. An analysis of this increase during the first three months is presented for different proportional counters.

Three proportional counters are used for natural radiocarbon measurements in our laboratory. Each counter forms a separate unit with its own anticoincidence and material shielding. All units are located in the same semi-underground room. Basic parameters of the units are given in Table 1 (see also Pazdur *et al.*, 1982). An increase of the background counting rate was noted on counter No. 1 (L1) late morning, April 30. This counter was filled a day before with inactive CO₂ for routine background counting rate measurement. The same gas was left in this counter till the end of May. Two others were filled with inactive CO₂ a few days later. The resulting record of background counting rate changes is shown in Figure 1. A rapid increase of background of counter No. 1 on April 29 and 30 should be noted with the rate exceeding 1.5 cpm per hour. The maximum of this peak was not detected, but it occurred perhaps on May 1. Mean counting rate recorded from April 30 to May 2 was equal to ca 42cpm, *ie*, ca 6 times greater than before contamination. Ca 10% of partial results were rejected as outliers by a statistical microcomputer program gathering the data (Walanus, 1986). Thus, we conclude that the peak value was greater, but not more than by some 10–20% of the recorded mean value. Maximum increase of background of counters No. 2 and 3 was estimated at ca 6cpm and 1.2cpm, *ie*, ca 100% and 60% of the pre-contamination levels, respectively. Possible explanation of these differences is in the fact that counters No. 2 and 3 have internal shielding made of a layer of old lead (counter No.

TABLE 1
Parameters of the proportional counters

Counter no.	Total volume (dm ³)	CO ₂ pressure (mm Hg)	Cathode	Position	Background (cpm)
1	2.9	1700	Steel	Vertical	7.014 ± 0.050
2	4.5	1700	Copper	Horizontal	6.030 ± 0.050
3	1.5	760	Copper	Horizontal	1.896 ± 0.030

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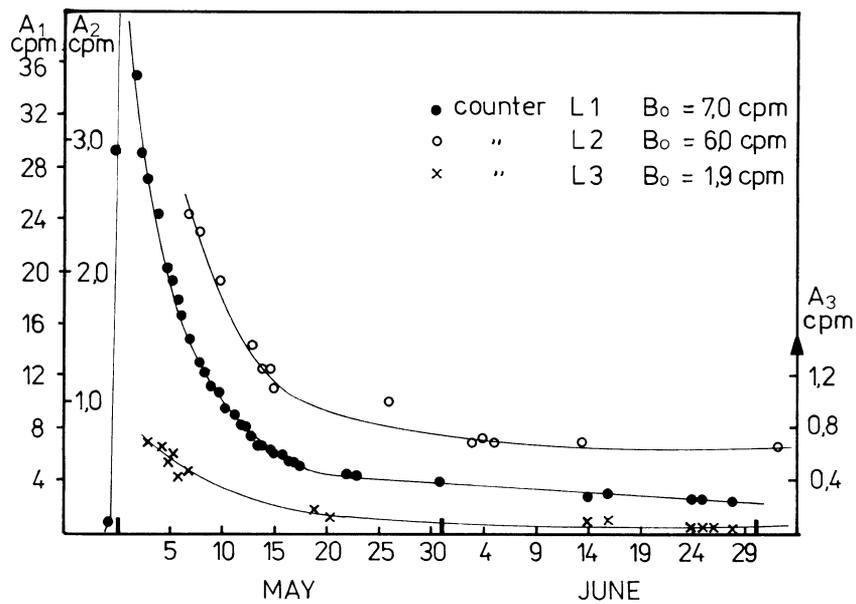


Fig 1. Increase of background above the pre-contamination level

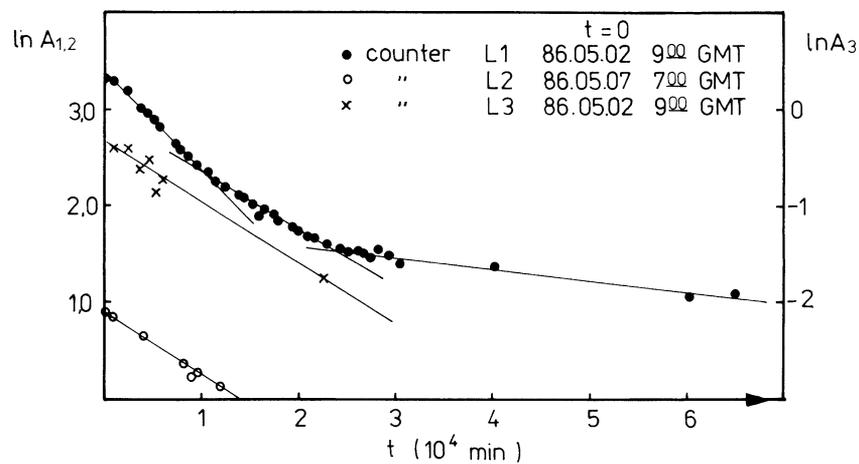


Fig 2. Semilogarithmic plot of post-contamination changes of background counting rate in different counters

2) and of purified mercury (counter No. 3), and moreover, both units are tightly covered with plastic foil.

Post-contamination decrease of background counting rate of all units is shown in Figure 2 in a semilogarithmic plot. Three different time constants can be clearly distinguished in the plot of counter No. 1, corresponding to the half-life values equal to 4.7d, 8.7d, and 37.0d. Decrease of background of units No. 2 and 3 in May can be described by a single decay law with half-life values equal respectively to 7.4d and 7.8d. The contamination of units No. 2 and 3 and the medium-term contamination of unit No. 1 should thus be ascribed to ^{131}J with a half-life equal to 8.1d, produced in fission of ^{235}U with yield $r = 2.9\%$ (Kimel & Mashkovich, 1966). The short-term component in unit No. 1 was probably caused by ^{133}Xe with a half-life equal to 5.3d and $r = 1.9\%$ and ^{132}Te (half-life 3.2d, $r = 4.4\%$). There are four products of induced fission of ^{235}U with half-lives ranging from 1 to 2 months, which could be responsible for the long-term component in unit No. 1. These nuclides include ^{89}Sr , ^{91}Y , ^{95}Zr , and ^{103}Ru , their total abundance in products of ^{235}U fission is close to 20%.

Systematic measurements of the background counting rate of counter No. 3, after careful cleaning of the whole unit, indicate that it was stable during June and July, at the level of $2.10 \pm 0.05\text{cpm}$. Preliminary measurements of the total gamma radioactivity of dust from an electrostatic dust collector installed near the counters have shown high radioactivity of dust particles. Most likely the large increase of background in counter No. 1 was caused by dust particles trapped at the HV connections at the end of the proportional counter.

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