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TECHNICAL NOTE

CRIMINALISTICS

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Isotope Evidence to Link a Suspect with a Pipe Bomb Multimurder in Austria 1995*

ABSTRACT: A bomb attempt in Oberwart, Austria, on February 4, 1995, was the culmination of several pipe and letter bomb attempts mainly in Austria. The pipe bomb had been mounted on a self-made gypsum (plaster of Paris) pedestal and exploded when touched, killing four persons. With a level of 200 tritium units (TU), the water extracted from the gypsum pedestal was unusually enriched in tritium (^{3}H) compared to an environmental level of about 20 TU at that time. Investigation of the ^{3}H content of air moisture in the living room of an arrested suspect showed values of about 1000 TU (normally, 50 TU is not exceeded). Additionally, water used as sealing liquid in a glass with nitroglycerine found in the living room was also significantly enriched in ^{3}H (>400 TU). The living room therefore offered the high ^{3}H level environment necessary to lead to elevated ^{3}H concentrations in the gypsum pedestal.

KEYWORDS: forensic science, isotope tracing, tritium, pipe bomb, water, plaster of Paris

A letter bomb is an explosive device sent via the postal service and designed to injure or kill the recipient when opened. A pipe bomb is an improvised explosive device, a tightly sealed section of a pipe filled with an explosive material. In many countries, the manufacture or possession of either of these types of bombs is a serious crime, regardless of its intended use. The use of these bombs is considered to be a terrorist act. One of the best-known letter bomb attacks occurred from the late 1970s to early 1990s in the U.S.A. The so-called Unabomber killed three persons and injured more than 20. A rare example where letter bombs have been used by official institutions was the bomb attempt on a Nazi war criminal by the Israeli intelligence.

Starting in 1993, several campaigns of letter-and-pipe bombings took place in Austria (one case in Germany), killing four persons and wounding 15. Because of the messages claiming for responsibility, the perpetrator was assumed to be a xenophobe Austrian, but he (or she) could not be identified. On February 4, 1995, four Romanies were killed by the explosion of a pipe bomb in Oberwart, Austria. The bomb trap consisted of a pipe bomb mounted on a self-made gypsum (plaster of Paris) pedestal (Fig. 1), with a road sign on top "Roma zurück nach Indien" (Romanies back to India). It had been placed on a road near a Romany settlement in Oberwart in the late evening. The explosion happened when four Romanies tried to remove the sign and touched it.

All of the components of the pipe bomb trap were investigated and found to be quite common materials that could be obtained inconspicuously in any shop selling building materials. The gypsum of the pedestal, for instance, showed the same chemical characteristics (including trace elements) as a product widely used in Austria. Only the water used for pouring the gypsum pedestal seemed to be a candidate for providing some information about the place where the pedestal had been made. This was extracted and analyzed for its tritium (^{3}H) content, a routine procedure applied in our isotope laboratories for most of the meteoric water samples. In this special case, we found ^{3}H levels that exceeded the prevailing environmental concentrations by one order of magnitude. On October 1, 1997, a suspect (Franz Fuchs) was arrested and tried to kill himself with a bomb during his seizure. By this fact, the aim of the investigation was modified: instead of the initial goal to trace the origin of the water, it was now the task to investigate whether the high ^{3}H content of the gypsum pedestal from Oberwart was compatible with the ambient conditions in the house of Franz Fuchs at Gralla (Styria).

Materials and Methods

Water from the pedestal and gypsum commercially available in Austria was extracted by vacuum distillation at 180°C. Gypsum contains two molecules of water of crystallization ($CaSO_4 \cdot 2H_2O$), technical plaster powder (gypsum powder) contains half a molecule ($CaSO_4 \cdot \frac{1}{2}H_2O$ [calcium sulfate semihydrate]); e.g., [1]). To investigate the homogeneity of the ^{3}H content in the pedestal, a part of the gypsum pedestal was cut in layers, the water of crystallization was extracted, and analyzed for ^{3}H (Fig. 2). The ^{3}H content of commercially available gypsum brands in Austria was investigated by extracting the water of crystallization in the same way as described earlier for the pedestal.

For an initial investigation of the ^{3}H concentration in the suspect's house at Gralla (Styria), five 400-mL beakers (Schott Duran, Mainz, Germany; diameter 80 mm, height 100 mm) with 350 mL of "dead water" (^{3}H content below detection limit) were exposed in several rooms for 46 h. In rooms with significant ^{3}H contamination, an increase in ^{3}H concentration of the water in the beakers would be expected because of isotope exchange between air moisture and exposed water. For subsequent more accurate measurements, air moisture was collected by sucking air through three gas-washing

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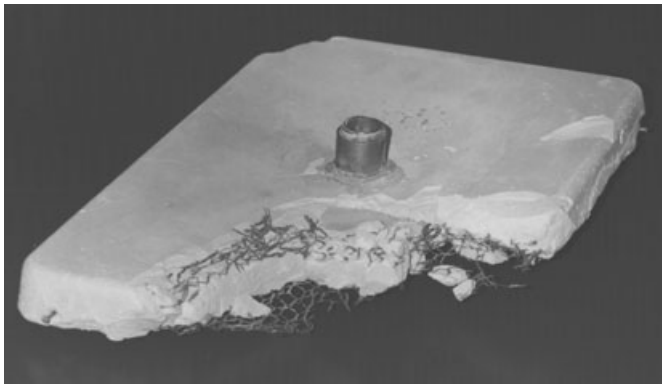

FIG. 1—*The structure of the gypsum pedestal of the Oberwart pipe bomb; the missing part was used for a previous investigation.*

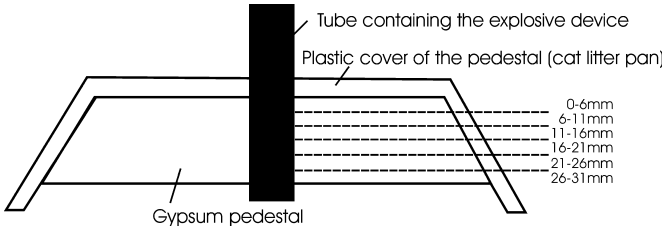

FIG. 2—*Sectional drawing of the gypsum pedestal of the Oberwart pipe bomb. The individual layers that were investigated separately are indicated.*

bottles filled with a molecular sieve for 4 days (2). In the laboratory, the water was extracted from the molecular sieve by heating. Collection of air moisture was repeated 2 months later to verify the first results. Air moisture samples collected in other houses and flats were investigated for ^{3}H to gain a range of normal ^{3}H concentrations in houses of similar age to the suspect's home. Water used as sealing liquid in a glass with nitroglycerine found in the living room of the suspect was also analyzed for its ^{3}H content. The ^{3}H content of water was measured by either gas counters (small samples) or liquid scintillation counters (Quantulus, Packard; Perkin Elmer, Waltham, MA) for larger water samples. The ^{3}H results are expressed in tritium units (TU), 1 TU = 0.119 Bq/kg for water.

Results

The extracted water from the gypsum pedestal showed a ^{3}H content of about 200 TU (Table 1). Gypsum powder as a mining product contains water of crystallization with ^{3}H values below about 80 TU (Table 2). Beakers with "dead water" exposed in several rooms of the house of the suspect for 46 h showed a ^{3}H value of 24.5 TU in the living room, but low or undetectable ^{3}H levels in other rooms (Table 3). Air moisture collected in October and December from the living room gave ^{3}H values of 959 and 1110 TU, respectively. ^{3}H levels of air moisture collected in several rooms in public and other private buildings were with one exception below 200 TU (Table 4). Water from the pumping well of the suspect's house, sampled in October 1997, had a ^{3}H content of 13.4 TU (Table 4). Water used as sealing liquid in a glass with nitroglycerine found in the living room in December 1997 had a ^{3}H content of 419 TU (Table 4).

Discussion

The ^{3}H content of water extracted from the gypsum pedestal was 200 TU compared to the normal environmental level of around

TABLE 1—*Investigation in layers of the gypsum pedestal from Oberwart: isotope data of the extracted water (investigation period: January and February 1998. Layer 0–6 mm is the nearest to the plastic trough which the perpetrator used for pouring the gypsum pedestal, layer 26–31 mm is the uppermost layer).*

Layer (mm)	^{3}H (TU) ± 1σ
0–6	207.3 ± 6.7
6–11	191.0 ± 4.6
11–16	180.0 ± 3.6
16–21	174.7 ± 3.5
21–26	178.1 ± 4.7
26–31	176.8 ± 5.4

TU, tritium units.

TABLE 2—*^{3}H content of water extracted from commercially available technical plaster powder (investigation period: December 1997–January 1998).*

Trade Name	^{3}H (TU) ± 1σ
Rigips	25.8 ± 2.8
Knauf	73.6 ± 3.7
Puchberg	47.3 ± 3.2
Moldan	76.3 ± 6.4
Schretter	83.2 ± 5.0

TU, tritium units.

20 TU for the last 10 years before the bomb attempt ([3]; Fig. 3), giving evidence that for the gypsum pedestal either ^{3}H-enriched water has been used, or the assemblage of the bomb was made in a ^{3}H contaminated atmosphere. The gypsum powder brands investigated (calcium sulfate semihydrate) contain water of crystallization with a ^{3}H content below 80 TU (Table 2). If one takes into account that only one-quarter of the water of crystallization in the final product has initially been present in the gypsum powder (75% of the water would have been added to the gypsum during production of the pedestal), the gypsum raw material can be excluded as the source of the elevated ^{3}H content. If we eliminate a conscious ^{3}H labeling, we can conclude that the components of the pedestal (water, gypsum powder) either were exposed to an atmosphere strongly enriched in ^{3}H before or during pouring the gypsum pedestal or the water used for preparing the gypsum was enriched in ^{3}H. The latter reason, however, seems very unlikely, as water enriched in ^{3}H is only abundant as waste water from nuclear power plants. As there is no working nuclear power plant in Austria, this source of ^{3}H is very unlikely. Thus, only the scenario of the pedestal production in a ^{3}H contaminated atmosphere seems plausible. This could, for instance, be possible in laboratories with ^{3}H handling or also in rooms where instruments with luminous figures are intensively used or handled (e.g., [4,5]). To exclude the possibility that the ^{3}H contamination of the gypsum pedestal from Oberwart had occurred during storage after the bomb attempt, the water of crystallization from six layers of the pedestal was investigated (Fig. 2). A later contamination would produce a much higher ^{3}H concentration on the surface of the pedestal than in the central parts. However, the investigations showed a more or less homogenous ^{3}H content within the pedestal, thus excluding the possibility that the ^{3}H contamination had occurred after production of the pedestal (Table 1). The slightly higher concentrations in the lower layers could be an indication that the pedestal had possibly been poured in several steps.

The "dead water" samples exposed in the suspect's house for 46 h had ^{3}H contents below the limit of detection except for the living room (24.5 TU, Table 3), pointing to this room as a place with an

TABLE 3—*^{3}H content of water exposed in the home of Franz Fuchs at Gralla (Styria); duration of exposure: 46 h (October 14–16, 1997).*

Location	^{3}H (TU) ± 1σ
Living room	24.5 ± 2.5
Bath room	0.0 ± 2.3
Storage room	1.5 ± 2.3
Workshop (separate building)	0.0 ± 2.3
Cellar	0.0 ± 2.3

TU, tritium units.

TABLE 4—*^{3}H content of air moisture sampled in the living room of Franz Fuchs at Gralla (Styria) and several rooms in other public and private buildings; ^{3}H content of water from the pumping well of the house of suspect at Gralla and of water used as sealing liquid over nitroglycerine found in the living room.*

Location	Sampling Period	^{3}H (TU) ± 1σ
House of suspect at Gralla (living room)	23.10.–27.10.1997	959 ± 22
House of suspect at Gralla (living room)	18.12.–22.12.1997	1110 ± 21
ÖFPZ Arsenal, ^{3}H laboratory	28.11.–01.12.1997	39.0 ± 6.0
ÖFPZ Arsenal, ^{14}C laboratory	09.01.–12.01.1998	52.1 ± 2.4
Riedlingsdorf (family house)	21.11.–23.11.1997	113 ± 3
Sattendorf (flat)	21.11.–23.11.1997	18.6 ± 2.0
Felixdorf (family house)	05.12.–08.12.1997	25.8 ± 1.5
Vienna, Albertgasse (flat)	24.12.–28.12.1997	214 ± 5
Vienna, Breitenfurterstrasse (terrace house)	14.11.–17.11.1997	654 ± 13
SOKO (police), Vienna (vestibule)	05.01.–08.01.1998	190 ± 7
House of suspect at Gralla, water from pumping well	14.10.1997	13.4 ± 0.7
House of suspect at Gralla, water used as sealing liquid over nitroglycerine	01.12.1997	419 ± 8

TU, tritium units.

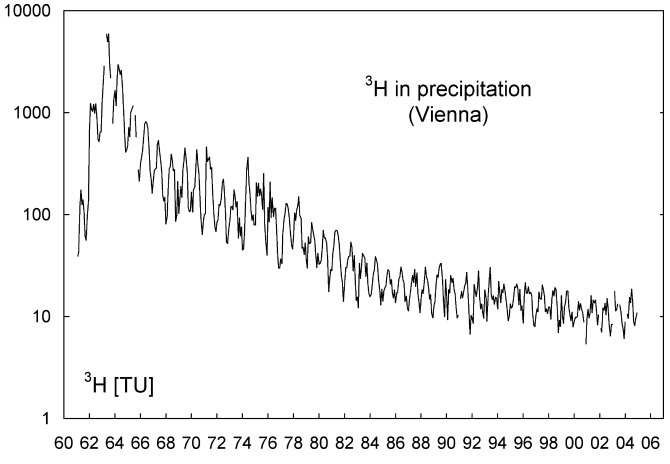

FIG. 3—*Environmental ^{3}H level in Central Europe: long-term record of ^{3}H in precipitation in Austria 1961–2004 (3).*

elevated ^{3}H background. The ^{3}H analysis of air moisture collected there yielded an unusual high value of 959 TU (Table 4), which suggests that ^{3}H-containing materials were handled in this room. In private houses, the handling or dismantling of watches or alarm clocks with ^{3}H bearing luminous dials is the first candidate for such a contamination. Measurement of air moisture collected 2 months later showed a similar result (Table 4), and the fact that the ^{3}H concentration did not decrease during this period is proof of permanent contamination of the room. Furthermore, it can be concluded that during the handling of ^{3}H-containing materials (e.g., dismantling of watches or alarm clocks), the ^{3}H concentration in the room must have been significantly higher—probably by some orders of magnitude—to end up with such a high level of ^{3}H contamination some 2 years later. The high ^{3}H content (419 ± 8 TU) of water used as sealing liquid in a glass with nitroglycerine found in the living room—the glass was covered with an aluminum foil and stored in a closed cupboard—was further proof of the fact that a high ^{3}H concentration had prevailed in the room for a longer time. No objects containing ^{3}H dials were found in the room at the time of the investigation.

It is well known that in a room once contaminated by ^{3}H, it takes many years to reduce the ^{3}H level of air moisture to the natural level. The room remains "impregnated" with ^{3}H, which is gradually released to the air. Even taking into account that the handling of the ^{3}H-containing materials in the house of the suspect had happened more than 2 years previously (bomb attempt: February 1995, investigation: October 1997), the ^{3}H contamination in the rooms was still detectable.

The results of the air moisture measurements in the suspects's house were also compared with the ^{3}H content in air moisture from several rooms in other public and private buildings (Table 4). None of these rooms had ^{3}H values that were as high as in the living room of the house at Gralla. In this investigation, two flats were included where ^{3}H-containing alarm clocks were permanently in use (Albertgasse and Breitenfurterstrasse, Vienna, Austria) and continuously releasing ^{3}H into the ambient air. Even in the flat Breitenfurterstrasse where an alarm clock with an exceptionally high ^{3}H releasing rate had been used for more than 10 years, the ^{3}H concentration in the air was much lower than in the house at Gralla, where no objects containing ^{3}H luminous compounds had been present during the measurements. Usually, the ^{3}H concentration in the air moisture does not exceed 50 TU in flats and buildings where no handling with ^{3}H-containing material has occurred.

All these results led to the conclusion that handling of ^{3}H-containing watches or alarm clocks in the living room of the suspect's house at Gralla exceeded normal use, e.g., opening of an alarm clock (removing of the sealing glass) causing an increased ^{3}H release to the ambient air.

Conclusions

The water of crystallization extracted from the gypsum pedestal of a pipe bomb showed an unusually high ^{3}H content (200 TU) compared to an environmental level of about 20 TU at that time. This led to the conclusion that the pedestal had been made in a ^{3}H contaminated environment. Investigation of the ^{3}H content of air moisture in the living room of the arrested and eventually convicted perpetrator showed values about 1000 TU. The high ^{3}H content of >400 TU of water used as sealing liquid in a glass with nitroglycerine found in the living room was further proof of the fact that a high ^{3}H concentration had prevailed in the room for a longer time. This contamination was probably attributed to the dismounting of ^{3}H-containing alarm clocks, parts of which had been used as timers for the bombs. The living room therefore offered the high ^{3}H level environment necessary to lead to elevated ^{3}H concentrations like those found in the gypsum pedestal.

Conflict of interest: The authors have no relevant conflicts of interest to declare.

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References

1. Holleman AF, Wiberg N. Lehrbuch der Anorganischen Chemie. Berlin: de Gruyter, 2007.
2. Paulus LR, Walker DW, Thompson KC. A comparison of desiccant materials used for monitoring atmospheric tritium concentrations in a semi-arid climate. Health Phys 2003;85(3):348–56.
3. Rank D, Papesch W. Isotopic composition of precipitation in Austria in relation to air circulation patterns and climate. Vienna (Austria): International Atomic Energy Agency, 2005. Report No: IAEA-TECDOC-1453:19-35.
4. Schönhofer F, Pock K. Incorporation of tritium from wrist watches. J Radioanal Nucl Chem 1995;197:195–202.
5. IAEA. Behaviour of tritium in the environment. Proceedings of a Symposium; 1978 Oct 16–20; San Francisco, CA. Vienna: International Energy Agency, 1979.

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