

VIENNA RADIUM INSTITUTE RADIOCARBON DATES IV

HEINZ FELBER and EDWIN PAK

Institut für Radiumforschung und Kernphysik der
Österreichischen Akademie der Wissenschaften, Vienna, Austria

Measurements have continued with the same proportional counter system, the same procedure in sample pretreatment, methane preparation and measurement, and the same age calculation using a half-life of 5568 ± 30 yr as described previously (R., 1970, v. 12, p. 298-318).

Uncertainties quoted are single standard deviations originating from the statistical nature of radioactive decay including standard, sample, background, and half-life. No C^{13}/C^{12} ratios were measured.

The following list presents most samples of our work in the last year. Sample descriptions have been prepared in cooperation with submitters.

ACKNOWLEDGMENTS

We express many thanks to Ing. L. Stein for excellent work in sample preparation, and to A. Rasocha for careful operation of the dating equipment.

SAMPLE DESCRIPTIONS

I. GEOLOGY, GEOGRAPHY, SOIL SCIENCE, AND FORESTRY

A. Austria

Klopeinersee-Kleinsee series, Kärnten

Sediment from Lake Klopeinersee (46° 36' N Lat, 14° 35' E Long), Carinthia, and from neighboring Lake Kleinsee from similar depths below ground near shore outside of lakes. Coll. 1971 by H. Löffler; subm. by A. Preisinger, Inst. f. Min. u. Kristallog., Univ. Vienna.

General Comments (A.P.): similar sample ages could support hypothesis of a former unit of both lakes and later separation. (H.F.): no humic acid separation was used due to small sample sizes. Different ages cannot be explained by unequal contents of younger humic acids as can be seen by calculation: for 9000-yr-old sample, an admixture of ca. 67% recent material would be necessary to get a fictitious age of 2000 yr.

VRI-294. Kleinsee

**2140 $\pm$ 730
190 B.C.**

Peat-like lake sediment with calcite admixture from depth 3.14m below soil, E side of lake. *Comment* (H.F.): large statistical uncertainty is due to small sample size.

VRI-295. Klopeinersee

**9190 $\pm$ 230
7240 B.C.**

Peat-like lake sediment with calcite admixture from depth 3.50m below soil, 10m from shore E of lake.

Rax series, N.Ö.

Peat from dried pond, regularly water-filled up to 50 yr ago, at plateau of Mt. Rax near former shelter "Alte Seehütte" (47° 42' 30" N Lat, 15° 44' 15" E Long), Lower Austria, alt. 1650m. Coll. 1968 by K. Zukrigl and K. H. Ballik; subm. by F. Kral, Inst. f. Waldbau, Hochschule f. Bodenkultur, Vienna.

General Comment (K.Z.): pollen diagram suggests mixing down to 40cm depth, presumably by cattle.

VRI-227. Alte Seehütte, 45 to 55cm Recent

Peat from depth 45 to 55cm. *Comments* (K.Z.): according to pollen diagram sample covers time immediately after beginning of pasture clearing. Plentiful recent rootlets. (H.F.): clearly influenced by bomb produced C¹⁴; 108% modern.

VRI-228. Alte Seehütte, 80 to 90cm Recent

Peat from depth 80 to 90cm. *Comment* (K.Z.): according to pollen diagram sample covers time before pasture clearing. Pollen of grain observed. No recent rootlets observed in macrostructure.

Mt. Dachstein series, O.Ö.

Organic samples and calcium carbonate sinter from cave Dachstein-Mammuthöhle (37° 32' 10" N Lat, 13° 42' 39" E Long), O.Ö. Coll. and subm. by R. Seemann, Mineralog.-Petrograph. Inst., Univ. Vienna.

General Comment (R.S.): should help date cave pyrite and iron ore in Nördliche Kalkalpen (Seemann, 1970).

VRI-255. Sinter MaP 5 >36,000

Calcium carbonate sinter with limonite, quartz, and clay from layer of pyrite conglomerate in cave. Coll. 1970. *Comment* (H.F.): date based on assumption of recent value 85% modern (Münnich and Vogel, 1959).

**VRI-257. Sample MaP 45 2230 ± 80
280 B.C.**

Carbonic substance in clay-calcic cave sediment. Coll. 1971.

**VRI-284. Rostocker Hütte-43, 1600 ± 70
Venediger Gruppe, Osttirol A.D. 350**

Peat from depth 43cm of undisturbed peat profile 130 to 160cm thick, covered by series of loamy-sandy sediments 30 to 50cm thick. Site near shelter Rostocker Hütte (47° 03' 19" N Lat, 12° 18' 07" E Long), alt. 2200m, Simonykees glacier (Patzelt, 1967), Venediger Group, E-Tyrol. Coll. 1971 and subm. by G. Patzelt, Geog. Inst., Univ. Innsbruck. *Comment* (G.P.): part of series from 2 profiles 5m apart. VRI-54 (base; R., 1970, v. 12, p. 304), VRI-179 (depth 90cm; R., 1971, v. 13, p. 132, see Correction: R., 1972, v. 14, p. 504) and VRI-284 from peat layer, Profile R-II; VRI-178 (depth 35cm; R., 1971, v. 13, p. 131) and VRI-243 (depth 42 cm; R., 1972, v. 14, p. 502) from sediment layer, Profile R-III. Sample

dates drift-in of sediments by advancing Simonykees, and palynologically detected glacier maximum.

Badgastein series, Salzburg

Hydrothermal wart sinter (wart-shaped sinter) of organic genesis (Grabherr, 1949); Scheminzy and Grabherr, 1951) from former thermal watercourse discovered by slope slide of Kirchbachlehne (Scheminzy, 1968) in Badgastein (47° 07' N Lat, 13° 08' E Long), Salzburg. Coll. 1967 and subm. by F. Scheminzy, Forschungsinst. Gastein.

General Comment (H.F.): date based on study (Felber, 1972) of C¹⁴ concentration in recent wart sinters (VRI-219, -274, -275) that were shown to equal that of atmospheric C¹⁴ and not that of water (VRI-218, -335) that sinters grew from. This is different from common limestone encrustations of inorganic genesis, of which recent C¹⁴ concentration equals that of water (Münnich and Vogel, 1959).

VRI-146. Kirchbachlehne **7460 ± 110**
5510 B.C.

Wart sinter.

VRI-218. Fledermaus-Spring X/3 **27.1 ± 1.1% modern**

Barium carbonate precipitated from bicarbonate in thermal water (37°C; Mutschlechner, 1963) of Spring X, Fledermausquelle, Badgastein, immediately from Outlet X/3. Precipitated 1970 by H. Felber. *Comment* (H.F.): agrees with measurements of Florkowski and Job, 1969, on Springs I/23-24 (Franz-Josef-adit) and IX/8-12 (Elisabeth-adit), Badgastein.

VRI-335. Fledermaus-adit, pond **36.2 ± 1.8% modern**

Barium carbonate precipitated from bicarbonate of thermal water from localized spring outlets X/1,2,4,5 and several diffuse outlets on rock walls in ca. 12m long Fledermaus-adit, Badgastein. Water from ca. 25cm deep pond on base of adit collecting these spring waters. During transfer to pond, and on its surface (ca. 2m²), carbon exchanges between water and atmosphere. From inflows of 5.8L/min and pond volume of 530L (both determined by G. Mutschlechner) an average sojourn time for water in pond of ca. 90 min follows. Precipitated 1972 by G. Mutschlechner. *Comment* (H.F.): C¹⁴ concentration in pond raised by exchange by ca. 30% compared with water taken immediately from spring outlet X/3 (VRI-218).

VRI-219. Fledermaus-adit, sinter **120.1 ± 1.2% modern**

Wart sinter on gneiss rock along littoral zone of pond (VRI-335) in Fledermaus-adit, Badgastein. Growth period of sinter: 1930 to 1970. Coll. 1970 by G. Mutschlechner. *Comment* (H.F.): atmospheric C¹⁴ concentration influenced by atomic bomb explosions (Felber, 1972).

VRI-274. Franz-Josef-adit, Sinter 1 **100.0 ± 0.9% modern**

Wart sinter from border of basin of Spring I/2, Franz-Josef-adit,

Badgastein. Thermal water stopped 1929/30 nearly completely when N adit was driven in, opening new springs. Growth period of sinter: 1855/56 to 1929/30. Coll. 1971 by G. Mutschlechner and F. Scheminzky. *Comment* (H.F.): atmospheric C¹⁴ concentration. Proves growth stopped before atomic bomb era.

VRI-275. Franz-Josef-adit, Sinter 2 100.5 ± 1.1% modern

Wart sinter from walled roof of Franz-Josef-adit, 19m behind opening. Sinter fallen down and picked up from bottom. Beginning of growth after 1855, end unknown. Coll. 1971 by G. Mutschlechner. *Comment* (H.F.): atmospheric C¹⁴ concentration. Growth stop before atomic bomb era.

Baumkirchen series, Tirol

Fossil wood from banded silt and clay in pit Baumkirchen (Fliri *et al.*, 1970, 1971) (47° 18' 25" N Lat, 11° 34' 19" E Long), Inn Valley, Tyrol. Subm. by F. Fliri, Geog. Inst., Univ. Innsbruck.

**VRI-273. Find No. 18 25,500 ± 600
23,550 B.C.**

Wood (prob. *Pinus silvestris*, det. by H. Hilscher); find No. 18 from 661m level in W part of pit. Coll. 1971 by F. Fliri. *Comment* (F.F.): date too young compared with VRI-173, -193, -226 (R., 1971, v. 13, p. 130; 1972, v. 14, p. 500; Fliri *et al.*, 1971) from same level.

**VRI-334. Find No. 22 28,300 ± 1000
26,350 B.C.**

Wood (*Alnus viridis*, determined by H. Hilscher), from 667m level, in undisturbed banded silt and clay. Coll. 1971 by E. Hellriegel. *Comment* (F.F.): date according to VRI-161, -173, -193, -226 (R., 1971, v. 13, p. 130 and R., 1972, v. 14, p. 500).

**VRI-338. Find No. 23 11,300 ± 170
9350 B.C.**

Stem wood, ca. 25cm diam, 80 rings at alt. 776m in blueish gray clay colluvium colored by intrusion of organic substance. Site overlies undisturbed clay of primary sedimentation, and is overlain by 3m slightly weathered slopewash clay, and by 1m gravel. Coll. 1972 by F. Fliri. *Comment* (F.F.): date according to VRI-94 (R., 1970, v. 12, p. 309) and VRI-194 (R., 1972, v. 14, p. 500).

VRI-270. Baumkirchener Tal, Tirol <450

Wood (*Alnus incana*) in slopewash silt on surface of banded silt and clay deposit of Baumkirchen (47° 18' 18" N Lat, 11° 33' 25" E Long), Tyrol, 1250m W of clay pit. Coll. 1971 and subm. by F. Fliri. *Comment* (F.F.): Alleröd was expected (VRI-94; R., 1970, v. 12, p. 309; VRI-194, R., 1972, v. 14, p. 500) or young age. Date proves latter.

VRI-307. Breitenbach, Tirol **7390 ± 120**
5440 B.C.

Wood from oldest soil of alluvial cone Heuberg near Breitenbach am Inn (47° 29' N Lat, 11° 58' E Long), Tyrol. Soil covered by periglacial colluvium and main mass of alluvial cone with several soils embedded. Coll. 1971 and subm. by F. Mayr, Dépt Géol., Univ. Montréal, Canada. *Comment* (F.M.): new trial to determine age of 1st plant growth after retreat of Würm glacier. Sample younger than hoped.

Gurgler Zirbenwaldmoor series, Tirol

Cyperaceae peat from different depths of bog Zirbenwaldmoor (46° 51' 20" N Lat, 11° 01' E Long), Obergurgl, Ötztal, Tyrol. Coll. 1970 and subm. by S. Bortenschlager, Inst. f. Botan. Systematik u. Geobot., Univ. Innsbruck.

General Comment (S.B.): geochronologic determination of palynologically determined climate fluctuations.

VRI-216. 288 to 295cm **8600 ± 150**
6650 B.C.

Comment (S.B.): date agrees with studies in Venediger area.

VRI-217. 325cm to rock **8540 ± 130**
6590 B.C.

Comment (S.B.): date too young; sample supposedly contaminated by water intrusion in depth 3m. Water could not be removed by continuous pumping at 900L/min. Sample coll. under water.

VRI-236. Hopfgarten, Tirol **>36,000**

Driftwood found with Schieferkohle in uppermost layer of alluvial sands and lacustrine silt overlain by Inn-eisstromnetz till. Sediment rests on gravel of Hall Valley fill. Site 20m below present surface, alt. 730m. Hopfgarten (47° 26' 32" N Lat, 12° 08' 36" E Long), Tyrol. Coll. 1970 and subm. by F. Mayr. *Comment* (F.M.): expected result.

VRI-271. Imst, Tirol **10,580 ± 140**
8630 B.C.

Wood (*Pinus silvestris*) in slopewash silt on surface of banded silt and clay, 1st find in pit of Imst (47° 11' 45" N Lat, 10° 45' 12" E Long), Oberinntal, Tyrol. Coll. 1970 by F. Fliri and H. Heuberger; subm. by F. Fliri. *Comment* (F.F.): expected date.

VRI-309. Kufstein, Tirol **Recent**

Wood (*Picea*) found in Pendling cave, Cut II, depth 40cm, with cave-bear bones; near Kufstein (47° 34' 20" N Lat, 12° 06' 40" E Long), Tyrol, alt. 1484m. Coll. 1971 and subm. by W. Kneussl, Solbad Hall i.T. *Comment* (H.F.): wood not contemporaneous with bones.

VRI-301. Mils, Tirol **<850**

Wood (root of *Pinus*) ca. 0.5m above base of Würm ground moraine ca. 7m thick. Gravel pit N of Mils near Solbad Hall (47° 18' 21" N Lat,

11° 31' 48" E Long), Tyrol. Coll. 1971 by H. Crepaz; subm. by F. Fliri. *Comment* (F.F.): sample covered by ca. 6m till. If primary deposition in moraine, onset of last great advance of Würm glaciation in Inn Valley is dated by sample. Date proves young vegetation also suggested by absence of pressure marks.

7950 ± 160

VRI-240. Moetz-Klammbach, Tirol

6000 B.C.

Plant chaff in thin lens half-way up bluffs facing last houses in Klammbachgraben, 1.5km N Moetz (47° 17' 42" N Lat, 10° 57' 18" E Long), Inn Valley, Tyrol, alt. 705m. High bluffs, 15m, expose structure of late glacial valley fill: gravel followed by sand interbedded with several layers of banded silt. Coll. 1970 and subm. by F. Mayr. *Comment* (F.M.): sediment sequence indicates rapid changes from alluvial fan to alluvial plain to lake and vice versa. Moraines and ice-marginal terraces near Moetz support conclusion that valley fill and lakes were caused by Oetz Valley glacier advance (Steinach I ?).

VRI-231. Roppen North 3, Tirol

Recent

Needles (*Pinus* and *Larix*) from exposure by bulldozer near forest road, alt. 900m, SSE above Roppen (47° 13' N Lat, 10° 50' E Long), mouth of Oetz Valley, Tyrol. Samples found upon buried soil of Roppen beneath block of Wetterstein dolomite in left lateral moraine (distal side) of former Oetz Valley glacier (moraine of Tschirgant landslide). Coll. 1970 and subm. by H. Heuberger, Geog. Inst., Univ. Innsbruck. *Comment* (H.H.): submitter hoped to date soil of Roppen formed between 2 late glacial advances of Oetz Valley glacier, not later than Alleröd as H.H. supposes.

8970 ± 140

VRI-239. Trins, Tirol

7020 B.C.

Charcoal, conifer wood, id. by H. Hilscher, 10m below surface of steep (20°) alluvial cone burying N branch of Type-Gschnitz-Moraine, 2km upstream from terminus. Irregular and oversteepened bedding of debris indicates deposition on ice. Site, few meters above ground moraine, near Trins, (47° 04' 19" N Lat, 11° 23' 40" E Long), alt. 1240m, Tyrol. Coll. 1970 and subm. by F. Mayr. *Comment* (F.M.): sample perhaps somewhat younger than Type-Gschnitz-Moraine. But time-lag should be short, since retreat of Gschnitz glacier and melting of buried ice on steep S slope may not have taken too long.

Sellrain Tal series, Tirol

Samples from vicinity of St. Sigmund, Sellrain Tal, Tyrol; subm. by I. Neuwinger, Forstliche Bundesversuchsanstalt, Imst.

General Comment (I.N.): dates provide chronology for forest history.

930 ± 190

VRI-278. Paidaer Sonnberg

A.D. 1020

Amorphous charcoal from burning horizon ca. 50cm below recent

A-horizon of iron-humus-podsol changed by use as pasture land. Under-sized sample. Paidaer Sonnberg (47° 13' N Lat, 11° 07' E Long), 1950m. Coll. by G. Heiss.

1680 ± 110

VRI-279. Haggener Sonnberg 1

A.D. 270

Charcoal from burning horizon 60cm below O_t of iron-podsol on block heap. Haggener Sonnberg (47° 13' N Lat, 11° 05' 30" E Long), ca. 1950m. Coll. by G. Heiss.

VRI-280. Haggener Sonnberg 2

Recent

Root (*Pinus cembra*) ca. 20cm below recent A-horizon of iron-podsol changed by use as pasture land. Haggener Sonnberg (47° 12' 20" N Lat, 11° 06' E Long), ca. 1800m. Coll. by W. Hensler.

Untermieming series, Tirol

Material from area gravel pit Untermieming (47° 17' 50" N Lat, 10° 58' 39" E Long), near Telfs, Inn Valley, Tyrol. Coll. 1970 and subm. by F. Mayr.

VRI-237. Untermieming-See I

Recent

Wood from buried pine stumps, upright, 1 to 3m tall, 110 to 120m NNE of entry to pit, 5 to 7m below surface of alluvial cone. Unlike today, trees rooted in lenses of loamy sand only. Heartwood perfectly preserved; outer parts of stumps moldy. *Comment* (F.M.): submitter hoped for evaluation of long-range activity of an alpine alluvial cone.

VRI-238. Untermieming-See II

Recent

Charcoal at base of fine sands overlying foot of alluvial cone near entry of pit. Sands form terrace ca. 2m high. *Comment* (F.M.): submitter hoped to date birth of lake at "See" and activity of alluvial cone, together with VRI-237.

800 ± 80

VRI-327. Donau, Wien

A.D. 1150

Wood, -6 to -7m in canal shaft near crossing Mitterweg-Weissenböckstrasse, Vienna 11 (48° 10' N Lat, 34° 27' E Long). Coll. 1971 by Plachy; subm. by J. Fink, Geog. Inst., Univ. Vienna. *Comment* (J.F.): sample embedded between alluvial sediments and gravel zone of Prater terrace. Dates Prater terrace in this area and fine sediment accumulation by R. Danube.

B. Germany, Greece

Törwang series, Bayern, Germany

Samples from basin of Törwang in area of Samerberg-Gritschen (47° 44' 53" N Lat, 12° 11' 53" E Long), Bavaria, alt. 1630m. Coll. 1970 and subm. by F. Mayr.

General Comment (F.M.): in late glacial for ca. 1000 yr, basin had ice-dammed lake (moraines at Kirchwald, above Nussdorf). Waning of lake means end of piedmont glaciation in Inn R. basin of Bavaria.

VRI-232. Samerberg-Gritschen I**12,560 ± 190****10,610 B.C.**

Dwarf willow wood (e.g., *Salix herbacea*) from 1 to 3cm thick soil horizon 1.5m below present surface. *Comment* (F.M.): 1st late glacial vegetation in basin of Törwang.

VRI-233. Samerberg-Gritschen II**12,560 ± 190****10,610 B.C.**

Moss peat from 1 to 2cm thick peat band 30cm above dwarf willow horizon (VRI-232) separated by sand and colluvium. *Comment* (F.M.): short peat growth following last short expansion of Inn glacier.

VRI-234. Samerberg-Gritschen III**5420 ± 100****3470 B.C.**

Wood from root-stock (presumably *Juniperus* sp.) with strongly reduced parenchyma, id. by H. Hilscher, 0.5 to 0.7m below present surface. Sample from cluster of old and young root-stocks, tops of which were found 1m above oldest soil (VRI-232). Mud flows buried plants while growing and frost action disturbed bedding and thin soil as soon as plants died. *Comment* (F.M.): root-stocks date 1st settlement of Törwang basin by alpine dwarf shrubs. Suggested by VRI-232, submitter expected older age.

VRI-326. Driskos, Greece**27,000 ± 800****25,050 B.C.**

Pieces of fossil wood in undisturbed primary sedimentation in weathered siltstone of mud flow sealing slope to R. Arachthos, near Driskos (39° 40' 40" N Lat, 21° 00' 00" E Long), NE Greece. Sample from 40m below surface, 126m behind entrance of horizontal adit, alt. 430m. Coll. 1971 and subm. by G. Riedmüller, Inst. f. Bodenkde., Hochschule f. Bodenkultur, Vienna. *Comment* (G.R.): wood dates mud flow.

II. ARCHAEOLOGIC SAMPLES

*A. Austria***Attersee series, O.Ö.**

Wooden piles from bottom of Lake Attersee at depth 3 to 4m, Sta. Misling III, Gde. Unterach am Attersee (47° 49' N Lat, 13° 30' E Long), Upper Austria. Coll. 1970 and subm. by H. Offenberger, Bundesdenkmalamt, Vienna. Wood determined by J. Kisser.

General Comment (H.O.): no artifacts; possibly remnants of Neolithic settlement. Dates refute supposition.

VRI-251. Misling III/1**<400**

Hard wood (*Picea abies*) pile consisting of 5 rings. N part of Sta.

VRI-252. Misling III/2**<400**

Hard wood (*Abies alba*) pile consisting of 18 rings. Middle part of Sta.

VRI-253. Misling III/3

<450

Hard wood (*Picea abies*) pile consisting of 7 rings. S part of Sta.**Mondsee series, O.Ö.**

Wood piles from bottom of Lake Mondsee at depth 2 to 5m, Gde. Innerschwand, Mooswinkl (47° 48' 50" N Lat, 13° 23' 40" E Long), Upper Austria. Coll. 1970 and subm. by H. Offenberger. Wood determined by J. Kisser.

General Comment (H.O.): no artifacts; possibly remnants of Neolithic settlement.

VRI-249. Mooswinkl 1

<220

Hard wood (*Picea abies*).**4560 ± 100****VRI-250. Mooswinkl 2****2610 B.C.**

Soft kneadable wood (probably *Populus*). *Comment* (H.O.): part of Neolithic lake dwelling.

350 ± 110**VRI-254. Pichl-Auhof, Mondsee, O.Ö.****A.D. 1600**

Wooden pile (*Picea abies*) from bottom of Lake Mondsee at depth 1 to 2m, Gde. Innerschwand, Pichl-Auhof (47° 48' 55" N Lat, 13° 24' 15" E Long), O.Ö. Coll. 1970 and subm. by H. Offenberger. *Comment* (H.O.): date disagrees with supposition of prehistoric settlement remnants.

*B. Turkey***2300 ± 90****VRI-222. Ephesos, Turkey****350 B.C.**

Charred wood found together with fragments of ceramics and bones 10m below level (contact with underground water) beside place of archaic sacrifice of altar of temple of Diana (Artemis) in Ephesos (Bammer, 1966-67; Vetters, 1971) (37° 57' N Lat, 27° 20' 10" E Long), Turkey. Coll. 1969 and subm. by A. Bammer, Österr. Archäolog. Inst., Univ. Vienna. *Comment* (A.B.): dating by ceramics points to middle of 6th century B.C. Origin of discrepancy unknown.

REFERENCES

- Bammer, A., 1966-67, Tempel und Altar der Artemis von Ephesos: Österr. Archäol. Inst. Jahresh., v. 48, p. 21.
- Felber, Heinz, 1970, Vienna Radium Institute radiocarbon dates I: Radiocarbon, v. 12, p. 298-318.
- , 1971, Vienna Radium Institute radiocarbon dates II: Radiocarbon, v. 13, p. 126-134.
- , 1972, Über die Datierung hydrothermaler Warzensinter aus Badgastein nach der Radiokohlenstoffmethode: Tscherma's Min. Petrol. Mitt., v. 17, p. 222-231.
- Felber, Heinz and Pak, Edwin, 1972, Vienna Radium Institute radiocarbon dates III: Radiocarbon v. 14, p. 498-505.
- Fliri, F. *et al.*, 1970, Der Bänderton von Baumkirchen (Inntal, Tirol)—Eine neue Schlüsselstelle zur Kenntnis der Würm-Vereisung der Alpen: Zeitschr. Gletscherkde. Glazialgeol., v. 6, p. 5-35.

- Fliri, F., Hilscher, H., and Markgraf, V., 1971, Weitere Untersuchungen zur Chronologie der alpinen Vereisung (Bänderton von Baumkirchen, Inntal, Nordtirol): *Zeitschr. Gletscherkde. Glazialgeol.*, v. 7, p. 5-24.
- Florkowski, T. and Job, C., 1969, Origin and underground flow time of thermal waters in crystalline basements complexes: *Steirische Beitr. Hydrol. (Graz)*, v. 21, p. 37-50.
- Grabherr, W., 1949, Thermale Warzensinter pflanzlicher Herkunft an den Thermen von Bad Gastein: *Bad Gasteiner Badeblatt*, v. 9, p. 13-14.
- Münnich, K. O. and Vogel, J. C., 1959, C-14-Altersbestimmungen von Süßwasserkalk-Ablagerungen: *Naturwissenschaften*, v. 46, p. 168-169.
- Mutschlechner, G., 1963, Lage und Namen der Gasteiner Thermalquellen, 2. Teil: *Bad Gasteiner Badeblatt*, v. 23, p. 257-259.
- Patzelt, G., 1967, Die Gletscher der Venedigergruppe: Doctoral thesis, Univ. Innsbruck.
- Scheminzky, F., 1968, Tätigkeitsbericht des Forschungsinstitutes Gastein der Österreichischen Akademie der Wissenschaften im Jahre 1967, 1. Teil: *Badgasteiner Badeblatt*, v. 28, p. 439-442.
- Scheminzky, F. and Grabherr, W., 1951, Über Uran anreichernde Warzen- und Knöpfchensinter an österreichischen Thermen, insbesondere in Gastein: *Tschermaks Min. Petrol. Mitt.*, v. 2, p. 257-282.
- Seemann, R., 1970, Neue Funde von Bohnerzen und Pyrit in der Dachstein-Mammut-Höhle: *Höhlenkd. Mitt. Landesvereines Höhlenkde. in Wien u. N.Ö.*, No. 1970.
- Vetters, H., 1971, Die österreichischen Ausgrabungen in Ephesos im Jahr 1970: *Anz. Österr. Akad. Wiss., Wien, phil.-hist. Kl.*, v. 1971.