

CO₂ Sampling Stations - Chemical Methods 1800-1960

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Note: Montsouris 1877-1910; all stations listed with their first year

year	Station	Method
97 409 samples used at 901 stations		
1809	<p>•Investigator: Theodore de Saussure, Prof. mineralogy, geology University Geneva (Switzerland)</p> <p>•Location: Meadow near the village of Chambesy near Geneva (Switzerland), slightly inclined, 250 m from the Lake of Geneva, well ventilated, soil: clay, , rural area;</p> <p>•Lat 46,15N. Lon: 6,8 E.</p> <p>•Elevation: 1,3 m above ground, 16 m above sea level of Lake Geneva, 388m masl</p> <p>•Mountains around Chambesy 900 – 1300m height</p> <p>Sampling time: 1809-1816, at noon 1826-1830</p> <p>Samples: 225 since 1809, since 1826 205; 8 samples at mountains</p> <p>Meteorolog. Parameters: daytime, precipitation, weather Station 1, 2</p>	<p>•Gravimetric determination of Barium carbonate (sulphate)</p> <p>•Sampling: Simultaneous measurements day/night -city/rural area-water/land, vegetation, mountains, rain, winter, summer; 6 times sampling in one location, 225 single samples since 1826</p> <p>•Duration of analysis: 24 hours.</p> <p>•Methodical details: 35-45 Litre round flask with fixed lock, stop cocks and seals, air pumping by air pump; measurement of temperature, air pressure and humidity; 100 g baryta water, absorption time 1 h. (60-80 x shaking/minute); Barium carbonate in baryta water was separated after absorption to wash flask; Elution with HCl several times rest of baryta in flask (1mass unit HCl on 15 mass units water = about. 0,8M), joining precipitations and precipitation with Na₂SO₄.;Sufficient absorption time of solutions (-24 hours). Resulting dry barium carbonate was weighed (mg scales) and mass of bound CO₂ was calculated.</p> <p>Remarks and Errors:</p> <p>•Results relatively stable on a high level compared to later series 1830-1850; minimum 0,2 mg weighing error because of variable mass of absorption equipment [Warburg 1905; Hlasiwetz 1856 p.9]; 3rd procedure according to Thenard: weight of Ba(CO₃): 0,966g ; 391 ppm CO₂; min. ~21% error, seals in leather is a cause of erroneous high values after Müntz (1880); max. 2,5% error by hygroscopic glass walls; resulted weights of CO₂ by using around 30 l is in the order of about 30 mg using 330 ppm. Weight errors of glass apparatuses are in then same error range up to 32 mg [Hlasiwetz 1856]</p> <p>Estimated error: 20%</p>
1839	<p>Investigator: Jean-Baptiste Boussingault, Prof. chemistry Lyon, Paris</p> <p>Location: Paris (48N 2E), periphery, Alsace Pechelbronn (Alsace, France) lat 48,93N, 7,83E Liebfrauenberg (Alsace) lat 48,23N 7,38E Andilly lat 49N 2,3E, rural area</p> <p>Elevation: 1-2 m Paris: 129 masl Pechelbronn: masl 153-199 m Liebfrauenberg: masl 222m Andilly: masl 278</p> <p>Sampling time: 1839-1843; at Paris 1839-1841 during 142 days In Alsace Nov.- 1839-March 1840 during 49 days; at Andilly and Paris, College de France 1843 Sept—</p>	<p>• Gravimetric determination of Sodium sulfate Citation from Hlasiwetz 1856: Method after Carl Emmanuel Brunner, Professor of chemistry in Bern (Switzerland)</p> <p>•About 25 Litre air flows through tubes with H₂SO₄ on pumice, then through tubes with KOH, then again through tubes with H₂SO₄. Amount of CO₂ was calculated by rise of mass in the tubes with KOH and H₂SO₄.</p> <p>Citation from Brunner, M. 'Determination de l'acide carbonique'; Annales de Chimie, 3, 1841, p. 312</p> <p>Remarks and errors:</p> <p>•U-tubes containing H₂SO₄ absorb CO₂, therefore resulting in too low values (~20 ppm according to Spring 1885, 7-10% according to Hlasiwetz</p>

	<p>Nov. Samples: Alsace 19, Paris 190, Paris/Montmorency 1843: 22; total: 231 Meteorolog. Parameters: daytime, precipitation, weather</p>	<p>1856); Amount of CO₂ too small for accurate weighing; min. 0,2mg error [Warburg 1902]; max. 2,5% error by hygroscopic glass walls; resulted weights of CO₂ by using around 30 l is in the order of about 30 mg using 330 ppm. Weight errors of glass apparatuses are in then same error range up to 32 mg [Hlasiwetz 1856]; large fluctuation of values (-100%) shown by most series done by several authors</p> <p>Estimated error: 50%</p>
1847	<p>Investigator: Bernhard Carl Lewy, (Danmark), Prof. chemistry, Bogota Location: France, Atlant. Ocean, Caribbean, Colombia, rural area Sept. 1847 at Paris (48N 2E), Nov./Dec. 1847 Le Havre (49N, 0,1E) Atlantic Ocean Dec. 1847: 47,3N, -8,5E, 47N, -11E, 33,4N, -18,35E, 21,45N, -39,3E, 21,9N, -40,25E, 20,35N, -41,35E, 15,49N, -62,48E, 14,6N, -68,4E, 12,5N, -76E Colombia: Rio Magdalena San Bernardo 4,4N, -74,2, Ambalema 4,78N, -76,7E, Esperanza 7,39N, -73,37E, Santa Ana 7,14N, -73,29E, Honda 7,28N, -73,25E, Guaduas, 5,7N, -74,5E, Bogota 4N, Elevation: Paris, 30 masl, Le Havre 8 masl, Rio Magdalena 38 masl, Ambalema 282 masl, Esperanza 396 masl, Honda 242 masl, Guaduas 996 masl, Santa Ana 998 masl, Bogota 2645 masl Sampling time: Sept 1847-Aug 1848, High amount of volcanoes in the Rio Magdalena area, high CO₂ low O₂ Samples: Paris 5, Le Havre: 4, Atlantic Ocean: 11, Colombia: 11; Bogota 14: total: 45 Meteorolog. Parameters: daytime, temperature, pressure, precipitation, weather</p>	<p>Volumetric determination according to Regnault/Reiset Part of samples in flasks are analysed 18-20 months after sampling at Paris</p> <ul style="list-style-type: none"> • Hydrogen Eudiometer; air flow trough tubes with pumice and KOH, then baryta water. Adding H₂SO₄ the potassium carbonate is transformed to potassium sulphate liberating CO₂, after that measuring change of volume. • <p>Remarks and errors: Open system using long connections between CO₂ absorption and Eudiometer, partly consisting of caoutchouc; no control of heat of absorption temperature (approx. 20,000 cal/g Mol; Schuftan 1933): Temperature change gas of 1° = change of vol/pressure by 0.34 %; [Schuftan 1933]. Further methodical errors by absorption of CO₂ in H₂SO₄ resulting in too low values (about -20 ppm). (Using H₂SO₄ for drying air see Regnault/Reiset, Annales de chimie, 24, 1871 p.258 [Regnault 1871]) Standard dev. of samples from Columbia= 641,3</p>
1848	<p>Investigator: Richard F. Marchand, Prof. chemistry at Halle (Germany) Conditions not researchable Sampling time 1848-1850 Samples: 150 No further details researchable</p>	<p>Gravimetric method similar Brunner Several samples showing very high and low levels Estimated error: >20-50%</p>
1851	<p>Investigator: Ch. Mène Location: Paris (48N 2E), Sampling time: Aug 1851 Samples: 12 Meteorolog. Parameters: daytime, temperature, No further details researchable</p> <p>Investigator: Adolf Schlagintweit, Prof. geography Munich (Germany) Location: Swiss/Italian Alps (45N, 7,51E), rural area Elevation: 1370-1862 masl Sampling time: Sept 1851 Samples: 16 (Alps+ Berlin) Meteorolog. Parameters: daytime, temperature, pressure, weather</p>	<p>Mène: Method according to Boussingault and titrimetric Remarks and errors: Drying air by sulphuric acid, -20 ppm error according to Spring and Hlasiwetz Estimated error: selected data >20 % No further details researchable</p> <p>Schlagintweit: gravimetric; passing air through tubes of sulphuric acid or CaCl₂ solution for drying; absorption in 3 tubes with KOH;. Weighing the absorbed solution; Remarks and errors: Drying air by sulphuric acid, -20 ppm error according to Spring and Hlasiwetz; weighing errors, gravimetric see Brunner (Boussingault). Estimated error: selected data >20 %</p>

1854	<p>Investigator: August Vogel jun., Prof. organic chemistry Munich (Germany) Location: Munich (48N, 11,35E), city free place Elevation: 519 masl Sampling time: Aug. 1854 Samples: 11 Meteorolog. Parameters: -</p>	<p>Gravimetric after Brunner see above Remarks and errors: Drying air by sulphuric acid, -20 ppm error according to Spring and Hlasiwetz; weighing errors, gravimetric see Brunner (Boussingault. Estimated error: selected data about 20 % using selected data</p>
1856	<p>Investigator: Hugo v. Gilm., Prof. chemistry Innsbruck (Austria) Location: Innsbruck (Austria) (47N, 11,39E) garden of the university Elevation: 573 masl Sampling time: Nov. 1856- March 1857 Samples: 19 Meteorolog. Parameters: temp. pressure, state of the atmosphere</p> <p>Station 16</p>	<p>Gravimetric/volumetric, Aspiration of approx. 60 L air and absorption in baryta water; dilution of filtrated Barium carbonate in HCl, drying of produced Barium chloride. Subsequent determination of Chlorine by titration after Mohr; amount Chlorine = CO₂. Calibration: Determination of a weighed amount of BaCO₃ in a CO₂ free flask. Decomposition of BaCO₃ by H₂SO₄, measurement of deliberated amount of CO₂, result: Remarks and errors: weighing errors, gravimetric see Brunner/ Boussingault. Estimated error: 10%; about 2,8 % using selected data</p>
1863	<p>Investigator: Franz Schulze., Prof. chemistry Rostock (Germany) Location: western balcony of university of Rostock (54N, 12,06E) , free ventilation Elevation: about 19 masl Sampling time: Oct. 1863- Dec 1864 Samples: 431 Meteorolog. Parameters: daytime, temp. pressure, Wind direction, precipitation, state of the atmosphere</p> <p>Station 18</p>	<p>Pettenkofer titrimetric •Flask method/tube method; approx. 25 Litre air per analysis by using 2 l flasks/tubes; baryta water for absorption of CO₂ and oxalic acid for titration of CaCO₃; indicator for showing endpoint of titration; about 30 minutes per analysis. Remarks and errors: Independent on temperature, easy design, fast speed, (30 min) high accuracy possible (1-3% Kauko 1935), errors possible by sampling air, contamination of baryta water during titration and too small air volume for testing. Schulze had used max. 25 l air for one analysis . Estimated error: +--10%</p>
1864	<p>Investigator: Agnus Smith., Dr. chemistry Manchester (UK) Location: various places Scotland, (56,1-3N, - 3,23E) rural areas, hills 1 Elevation: 250-1400 masl Sampling time: 1864-1865 Samples: 200 London/Manchester, 158 Scotland total: 358 Meteorolog. Parameters: daytime, temp. pressure, wind, state of the atmosphere Station-57</p>	<p>Pettenkofer flask method as Schulze Baryta water, Oxalic acid, titration Estimated error: +--10%</p>
1865	<p>Investigator: T.E Thorpe, Prof. chemistry Leeds (UK) Location: along the coasts, (54,21N, -2,11E) Irish sea Elevation: 2 masl Sampling time: summer 1865-summer 1866 Samples: 77 Irish channel; 31 in tropical Brasil (Letts&Blake) Meteorolog. Parameters: daytime, temp. pressure, wind direction, speed, state of the atmosphere</p>	<p>Pettenkofer flask method as Schulze 5l flasks,modified Baryta water, Oxalic acid, titration Estimated error: +--3%</p>

	Station 157	
1868	<p>Investigator: Franz Schulze., Prof. chemistry Rostock (Germany) Location: university of Rostock (54N, 12,06E), direction Blücherplatz, periphery of the city, free ventilation Elevation: about 19 masl Sampling time: Oct. 1868- July 1871, 2 samples daily Samples: 1600 Meteorolog. Parameters: daytime, temp. pressure, wind direction, precipitation, state of the atmosphere station 158</p>	<p>Pettenkofer flask method , titrimetric, modified 25 l flasks, 66 l Aspirator Baryta water, Oxalic acid, titration</p> <p>Estimated error: +--3%</p>
1872	<p>Investigator: J.A Reiset., Prof. chemistry Paris Location: 8m from Dieppe (France) (49N, 1,07E), agricultural station, rural area, free ventilation Elevation: about 96 masl Sampling time: Sept. 1872 – Oct. 1873, Samples: 92 field, 27 young forest, 14 clover/alfalfa Meteorolog. Parameters: daytime, temp. pressure, wind direction, precipitation, state of the atmosphere station 161</p> <hr/> <p>Investigator: Eugène Risler., Prof. agronomie, Paris Location: Calèves (Nyon, Switzerland) (46N, 6,63E), rural area, free ventilation Elevation: 420 masl Sampling time: Aug. 1872 – July 1873 Samples: 365 Meteorolog. Parameters: not known Station 162</p> <hr/> <p>Investigator: Wilhelm Henneberg., Prof. chemistry Göttingen (Germany) Location: Weende (Germany) (51,5N, 9,95E), agricultural station, rural area Elevation: about 237 masl Sampling time: May - July 1872, Samples: >17 Meteorolog. Parameters: temperature Station 163</p>	<p>Reiset: Pettenkofer variant mobile analyser, 600 l aspirator (Reiset's tower); drying by sulphuric acid, absorption in barium hydroxide; titration by resulting carbonate by sulphuric acid. Remarks and errors: Sulphuric acid error of about 20-30 ppm according to Hlasiwetz [1848] and Spring (1883); Bunsen absorption coefficient H₂SO₄ at 25°C = 0,96; H₂O at 25°C=0,759 [IUPAC NIST Solubility database]</p> <p>Estimated error: correction by +20 ppm; error+--3%</p> <hr/> <p>Risler: Pettenkofer variant no more details researchable</p> <hr/> <p>Henneberg, Weende: Pettenkofer flask method as Schulze 5l flasks,modified Baryta water, Oxalic acid, titration</p> <p>Estimated error: +--3%</p>
1873	<p>Investigator: Pierre Truchot., Prof. chemistry, Clermont-Ferrand Location: some kms from Clermont-Ferrand, (45N, 1,05E), rural area, free ventilation Elevation: near Clermont Ferrand 395 masl; Sampling time: July-Aug. 1873, day/night Samples: 49 Meteorolog. Parameters: temp., pressure Station 164</p>	<p>Pettenkofer method 10-20l air absorbed in baryta water, titration the carbonate with sulphuric acid</p> <p>Estimated error: +--3-10%</p>

1874	<p>Investigator: Franz Farsky., Dr. chemistry, director of the agricultural station at Tabor, Czech Republic Location: agricultural station outside Tabor, (49,25N, 14,6E), rural area, free ventilation, 4,48m above ground NNW Elevation: 423 masl; Sampling time: Oct. 1874 -Aug. 1875 Spring /summer afternoon, autumn/winter at noon Station 165 Samples: 295 Meteorolog. Parameters: temp., pressure, wind direction, precipitation, weather</p> <p>Investigator: P. Hässelbarth, Dr. chemistry, J. Fittbogen Prof. chemistry, director agricultural station Dahme Location: Dahme (Prussia) lat 51N, 11,04 lon; agricultural station, rural area Elevation: 87 masl, sampling height: 2,85m Sampling time: Sept. 1874-Aug 1875 Samples: 347 Meteorolog. Parameters: temp., pressure, wind direction, precipitation, weather Station 166</p>	<p>Pettenkofer variant of Fittbogen Air passing from outside (4,48m elevation) NNW in CaCl₂ tubes (drying) and then in a absorption tube with baryta water then in a Brunner 30 l aspirator. Absorbing time 4 h. Titration was done with hydrochloric acid or oxalic acid.</p> <p>Estimated error: +--3%</p> <p>Pettenkofer variant of Fittbogen Air passing from eastern, outside of laboratory (2,85m elevation) in CaCl₂ tubes (drying) and then in a absorption tube with baryta water then in a 32 l aspirator. Absorbing time 5 h. Titration was done with oxalic acid.</p> <p>Estimated error: +--3%</p>
1875	<p>Investigator: Gaston Tissandier, Location: Paris : 890 masl 1000 masl during balloon flight (Zenith) Elevation: 87 masl, sampling height: 2,85m Sampling time: March. 1874 Samples: 2 Meteorolog. Parameters: temp., pressure, wind direction, weather Station 167</p> <p>Investigator: Peter Claesson, Dr. chemist Location: Lund (Sweden) lat 55, 13,12E lon Elevation: 47 masl Sampling time: Nov/Dec. 1875 Samples: 31 Meteorolog. Parameters: - Station 168</p>	<p>Volumetric determination according to Regnault/Reiset •air flow trough tubes with pumice and KOH, then baryta water. 22 l Aspirator. Adding H₂SO₄ the potassium carbonate is transformed to potassium sulphate liberating CO₂, after that measuring change of volume. Using 66 l air</p> <p>Remarks and errors: Open system using long connections between CO₂ absorption and Eudiometer, partly consisting of caoutchouc; no control of heat of absorption temperature (approx. 20,000 cal/g Mol; Schuftan 1933): Temperature change gas of 1° = change of vol/pressure by 0.34 %; [Schuftan 1933]. Further methodical errors by absorption of CO₂ in H₂SO₄ resulting in too low values (about -20 ppm).</p> <p>Estimated error: +--8%</p> <p>Claesson Pettenkofer method 50 air passed through CaCl₂, absorbed in baryta water, titration the carbonate</p> <p>Estimated error: +--3-10%</p>
1876	<p>Investigator: E.L. Moss, Dr. physician Location: Arctic, Greenland lat 82,7, -20E lon Elevation: - Sampling time: Dec 1875, Jan/Feb. 1876 Samples: 3 Meteorolog. Parameters: temp., pressure, weather Station 169</p>	<p>Pettenkofer method 47, 95, 19 l samples of air absorbed in baryta water, titration the carbonate</p> <p>Estimated error: +--3-10%</p>

1877	<p>Investigator: Hippolyte Marié-Davy, Prof. physicist, Montpellier; Albert Lévy, Dr. physicieste</p> <p>Location: Paris 48,58N, 2,27E Montsouris observatory</p> <p>Elevation: 75 masl</p> <p>Sampling time: daily 1877-1912, noon</p> <p>Samples: 12 000</p> <p>Meteorolog. Parameters: temp., pressure, wind, precipitation, weather</p> <p>Station 170</p>	<p>Pettenkofer method Absorption of dry air in baryta water /sodium hydroxide, titration with HCl (since 1892 H₂SO₄) Changing method in July 1890 leads to a shift of + 18,5 ppm in SEAS</p> <p>Remarks and errors: First years 1877-July 1890 values too low, corrected by +18,5</p> <p>Estimated error: +--3%</p>
1879	<p>Investigator: J.A Reiset., Prof. chemistry Paris</p> <p>Location: 8km from Dieppe (France) (49N, 1,07E), agricultural station, rural area, free ventilation, the North Sea in NE direction</p> <p>Elevation: about 96 masl +4m sampling height</p> <p>Sampling time: June – Nov. 1879, day/night, June-Aug. 1880</p> <p>Samples: 91 (1879), 37 (1880),</p> <p>Meteorolog. Parameters: daytime, temp. pressure, wind direction, precipitation, state of the atmosphere</p> <p>station 171</p> <hr/> <p>Investigator: George F. Armstrong, Prof. engineering, Leeds (UK)</p> <p>Location: village of Grasmere 54,45N, -3,0E , rural area at Lake Grasmere surrounded by hills, meadow</p> <p>Elevation: 61 masl +1,50 sampling height</p> <p>Sampling time: July - Oct. 1879, day/night</p> <p>Samples: 115 (53 day, 62 night)</p> <p>Meteorolog. Parameters: temp., pressure, wind, precipitation, weather</p> <p>Station 172</p> <hr/> <p>Investigator: Ippolito Macagno, Prof., chemistry, director of the royal agricultural station of Palermo (Silcilia))</p> <p>Location: Palermo, astronomical observatory 38,6N, 13,21E ,</p> <p>Elevation: 72 masl</p> <p>Sampling time: Feb - Aug. 1879</p> <p>Samples: 21 (3 per month)</p> <p>Meteorolog. Parameters: temp., pressure, O₂, precipitation</p> <p>Station 173</p>	<p>Reiset: Pettenkofer and volumetric variant according to Regnault mobile analyser, 600 l aspirator (Reiset's tower); , drying by sulphuric acid, absorption in barium hydroxide (12 hours); titration the resulting carbonate by sulphuric acid. Furthermore volumetric determination.</p> <p>Remarks and errors: Sulphuric acid error of about 20-30 ppm according to Hlasiwetz [1848] and Spring (1883); Bunsen absorption coefficient H₂SO₄ at 25°C = 0,96; H₂O at 25°C=0,759 [IUPAC NIST Solubility database]</p> <p>Estimated error: correction by +20 ppm; error+--3%</p> <hr/> <p>Armstrong: Pettenkofer variant 4 x 10l jars; air passed through Baryta water titrated with sulphuric acid, quadruple sampling</p> <hr/> <p>Macagno: Assumption: Pettenkofer variant data measured in 100 l air</p> <p>Estimated error: -3-10%</p>
1881	<p>Investigator: Achille Müntz, Prof., chemistry, National Institute of Agronomy Paris</p> <p>Location: Paris, 48N, 2,14E, Plaines de Vincennes (rural area) 48,84N, 2,44E; Pic Midi 38,6N, 13,21E ,</p> <p>Elevation: Paris:129 masl , Pleines des Vincennes 52 masl, Pic Midi: 2877 masl</p> <p>Sampling time: Dec. 1880. - Dec. 1881</p> <p>Samples: Paris: 42, Plaine d. V.: 35, Pic Midi: 14</p> <p>Meteorolog. Parameters: temp., pressure, weather, precipitation</p>	<p>Volumetric after Regnault 300l air dried by sulphuric acid was absorbed in KOH; addition of sulphuric acid set free CO₂, volume measured by manometer.</p> <p>Remarks and errors: Open system, no means of controlling heat of absorption; sulphuric acid absorbed parts of CO₂, error of about 20-30 ppm according to Hlasiwetz [1848] and Spring (1883); Bunsen absorption coefficient H₂SO₄ at 25°C = 0,96; H₂O at</p>

	Station 174-176	25°C=0,759 [IUPAC NIST Solubility database] Estimated error: correction : + 20 ppm , after correction: +--3%
1882	<p>Investigator: Achille Müntz, Prof., chemistry, National Institute of Agronomy Paris</p> <p>Location: Venus expedition: Haiti 18N, -72E, Florida 29,9N, -81E, Martinique 14N, -61E, Mexico 26N, -111E, Santa Cruz 34,35S, -71,74E, Chubut 43,18S, -65E, Cerro Negro 36,9S, -72,5 E</p> <p>Elevation: Haiti 355 masl , Florida 4 masl, Martinique 1masl , Mexico, Santa Cruz 520 masl, Chubut 50 masl, Cerro-Negro 153 masl</p> <p>Sampling time: Haiti Nov. 1882. - Jan. 1883; Florida Nov-Dec. 1882, Martinique Oct. –Dec. 1882, Mexico Nov.-Dec. 1882, Santa Cruz Patagonia Oct-Dec. 1882, Chubut Nov.-Dec 1882,, Cerro-Negro Dec 1882</p> <p>Samples: Haiti: 8, Florida: 7, Martinique: 5, Mexico 3, Santa Cruz 10, Chubut 2, Cerro Negro (Chile) 5; total 38 (1882); 2 at Haiti 1883</p> <p>Meteorolog. Parameters: temp., pressure, wind, weather, precipitation</p> <p>Station 177-183</p> <p>The French expedition to Cap Horn Sept 1882-1883</p> <p>Investigator: Sampling by Dr. Paul Hyades, physician of the expedition; A. Müntz, Prof. chemistry, Paris</p> <p>Location: Orange Bay Hoste Island, 55,3N, - 68,05E</p> <p>Elevation: 6 masl</p> <p>Sampling time: Sept. 1882-Sept. 1883</p> <p>Samples: 6 (1882), 39 , + 6 (=44 in 1883) on the ship in south Atlantic, 1 islands of Cape Verde</p> <p>Meteorolog. Parameters: temp., pressure, wind direction, precipitation, weather</p> <p>Station 184, 185</p>	<p>Volumetric after Regnault</p> <p>Trained persons on the ships of the expedition sampled air by passing it through prepared flasks filled with KOH. They had been analysed back in Paris by a modified apparatus since 1881 with a 160 l aspirator,</p> <p>Remarks and errors:</p> <p>Sulphuric acid error, values too low; correction + 20 pp (according to Spring 1883). Blocked upwelling, by ice, therefore too low values, not used (Poisson et al. 1987, Deep Sea Research, Vol 34, no. 7, p. 1255); possible absorption or decomposing error in glass vessels stored for max. 1 year by reaction to potassium silicate, changing solution equilibrium and freeing CO2.</p> <p>Estimated error: correction : + 20 ppm , after correction: +--3%</p> <p>French expedition to Cap Horn</p> <p>Air was sampled in glass flasks filled with KOH, locked and stored in a metal closing. Analysis was done later in 1883 in Paris using the Müntz volumetric gasometer (see above).</p> <p>Remarks and errors:</p> <p>See above</p>
1883	<p>Investigator: Walthère Spring et al., Prof., mine engineering, chemistry, university of Liege (Belgium)</p> <p>Location: Chemical institute at Liege, 50,3N, 5,5E , direction the river of Meuse</p> <p>Elevation: 63 masl + 5 m sampling height</p> <p>Sampling time: Feb. 1883 –Feb. 1884</p> <p>Samples: 266</p> <p>Meteorolog. Parameters: temp., pressure, wind speed/direction, weather</p> <p>Station 186</p> <p>E. Ebermayer see 1884</p> <p>Location: Tölz, Forsthaus 47,8N, 12,5E,</p> <p>Samples: june 1883 - December: 29</p>	<p>Pettenkofer variant</p> <p>Passing air through baryta water and an aspirator of 114,6 l, titration by hydrochloric acid without drying. Checking for optimal passage, absorption speed of air stream, absorption of CO2 by caustic, and absorption if using sulphuric acid for drying.</p> <p>Remarks and Errors:</p> <p>Calibrated apparatus and carefully controlled conditions, enhanced CO2 level in the city by winds from the industrial centres, enhanced levels by carbon oxidation from coal in the soil</p> <p>Estimated error: +--2-3%</p>
1884	<p>Investigator: Ernst Ebermayer, Prof. agricultural chemistry, university of Munich</p> <p>Location: Bavarian forests, 47,6N, 12,5E ,</p> <p>Elevation: 813 masl + 1,5 m sampling height</p> <p>Sampling time: Oct. 1883 –Nov. 1884</p> <p>Samples: 68 (40 in 1884)</p> <p>Meteorolog. Parameters: temp., pressure, wind speed/direction, weather</p>	<p>Pettenkofer method</p> <p>Estimated error: +- 3%</p>

	<p>Station 187 Investigator: Walther Hempel, Prof. chemistry, university of Dresden Location: Dresden, 51,3N, 13,7E , Elevation: 111 masl + 15 m sampling height Sampling time: Oct. 1884 –Dec. 1884 daily Samples: 63 Meteorolog. Parameters: temp., pressure, wind speed/direction, weather Station 188</p>	<p>Hempel Volumetric Constant volume, constant temperature 15°C, variable pressure, Air from the roof of the laboratory or 100ccm glass flasks; Measurement of gases in H2O saturated state In parallel check of 1 l air with Pettenkofer-Hesse method Estimated error: +--3%</p>
1885	<p>Investigator: William Marcet, Dr. physician, Edinburgh/London Location: Geneve, 46,3N, 1E , Elevation: 388 masl + mountains Sampling time: Aug. 1885 –Sept. 1885 Samples: 51 Meteorolog. Parameters: temp., pressure, wind speed/direction, weather Station 189 Investigator: Reinhart Blochmann Prof. chemistry, University of Koenigsberg Location: Koenigsberg /East Prussia, 53,7N, 20,5E Elevation: 15 masl Sampling time: 1885 Samples: 1345 (1200 on land, 44 over sea) Station 703</p>	<p>Volumetric Absorption in KOH and volumetric determination of change of air volume after absorption, Heat control by placing the absorbing vessel in temperature controlled bath Estimated error: +--2-3%</p> <p>Blochmann Pettenkofer variant Air is absorbed in baryta water and titrated Estimated error: +- 3%</p>
1886	<p>Investigator: Thomas van Nuys Prof. chemistry, University of Indiana Location: University park near Bloomington /Indiana, 39,10N, -86,5E Elevation: 228 masl + 50 cm Sampling time: April 1886 10:00 am Samples: 18 Meteorolog. Parameters: temp., pressure, wind speed/direction, weather Station 190 Investigator: Giorgio Roster Prof. chemistry, University of Florence Location: Florence, 43N, 11,15E Elevation: 38 masl + 18 m Sampling time: Jan-Dec 1886 Samples: 9 Station 191</p>	<p>Pettenkofer variant Absorption of air in baryta water</p> <p>Roster Pettenkofer variant Remarks and Errors: Inverted SEAS (summer high, winter low) Estimated error: +--3% in summer</p>
	<p>Investigator: Julius Uffelmann Prof. physician, University of Rostock, director of the institute of hygiene Location: Rostock, 54N, 12E court of the university 20 cm above pavement, outside the city, shore of Baltic Sea Elevation: 19 masl + 6 m Sampling time: Oct 1886 – Sept 1887 daily 11:00 am Samples: 92 in 1886; total 420 (26 in rural area) Meteorolog. Parameters: temp., pressure, wind speed/direction, weather Station 193 Investigator: Nils Edvard Selander Dr. physician, Karolinska University Solna (Sweden) Location: Stockholm, 59N, 18,3E , fortress vaxholm directly at the sea side</p>	<p>Uffelmann Pettenkofer method Air passed through 4l glass flasks, shaking for 1minute and leaving flasks for 24 hours before titration with oxalic acid. Checking time before titrating: ½ hour 330 ppm, 8 hours 342 ppm (+3.6 %)</p> <p>Selander Not researched, Pettenkofer or volumetric Petteson Estimated error: +- 2-3%</p>

	<p>Elevation: 10 masl Sampling time: Oct 1887 – June 1888 Samples: total 263; 92 in 1886 Meteorolog. Parameters: temp., pressure, wind speed/direction, weather Station 194</p>	
1887	<p>Investigator: Victor Feldt Dr. physician, University of Tartu Location: Tartu, 55N, 26,7E Elevation: 38 masl + 36 m place of the church “Domplatz” Sampling time: Feb – May 1887 several times a day Samples: 377 Meteorolog. Parameters: temp., pressure, wind speed/direction, weather Station 195 Montsouris see above</p>	<p>Pettenkofer method Air stream passed baryta water, , three 6l flasks were filled, shaken for ½ hour, titration by oxalic acid without waiting for a precipitate 20 l aspirator, titration directly in unclear baryta water Remarks and Errors: Too low values (- 187 ppm) 16th April 1887) because of small air volume, titration directly in the unclear baryta water without waiting; methodical problems see the same values day and night. Correction +40 ppm Estimated error: +--3 after correction</p>
1888	<p>Investigator: Jacob Heimann Dr. physician, University of Tartu Location: Tartu, 55N, 26,7E Elevation: 38 masl + 36 m place of the church “Domplatz” Sampling time: June – Sept 1888 several times a day Samples: 350 Meteorolog. Parameters: temp., pressure, wind speed/direction, weather</p> <p>Investigator: Eugen v. Frey Dr. physician, University of Tartu Location: Tartu, 55N, 26,7E Elevation: 38 masl + 36 m place of the church “Domplatz” Sampling time: Oct – Jan 1889 several times a day Samples: 556 (104 outside the city at Ratshof rural area) Meteorolog. Parameters: temp., pressure, wind speed/direction, weather Station 196</p> <p>Investigator: Dr. F. Nansen /Augusta Palmqvist/. assistant of O. Pettersson teacher in natural science Location: travel over the Atlantic to Greenland, 59,48,5N, -3 – 66,8N, -25,2E Elevation: 6 masl + 5 m over sea Sampling time: May 1888 – June 1888 sea, Sept 1888 Greenland (2300 masl) Samples: 35 over sea, 3 over Greenland in 1888, 395 1888 -1890 Meteorolog. Parameters: temp., pressure, wind speed/direction, weather Station 229</p>	<p>Pettenkofer method Air stream passed baryta water, , three 8-10l flasks were filled, shaken for ½ hour, filtration of the precipitation, titration by oxalic acid 20 l aspirator, titration directly in unclear baryta water Remarks and Errors: Too low values (- 187 ppm) 16th April 1887) because of small air volume titration directly in the unclear baryta water without waiting; methodical problems see the same values day and night. Correction +40 ppm Estimated error: +--3 after correction</p> <p>Pettenkofer as Feldt and Heimann</p> <p>Remarks and Errors: Too low values (- 187 ppm) 16th April 1887) because of small air volume titration directly in the unclear baryta water without waiting; methodical problems see the same values day and night. Correction +40 ppm Estimated error: +--3 after correction</p> <p>Pettersson volumetric Flask samples done by F. Nansen on his expedition 1888, analysed by A. Palmqvist in laboratory of O. Pettersson Absorption of CO₂ in KOH, subsequently measurement of volume change of CO₂-free gas by mercury. Absorbing vessels in tempered water bath ; Temperature control of heat of absorption (H₂CO₃ approx. 20 000 cal/gMol; [Schuftan 1933]) much better than older systems (open e.g. Müntz, Regnault); Remarks and Errors: result dependent on temperature and pressure after v. Slyke [van Slyke 1932]. Estimated error: +- 1-2%</p>

1889	<p>Investigator: Arthur Petermann Prof. acgricultural chemistry, director of the agricultural station at Gembloux (Belgium) Location: near Gembloux, 50,5N, 4,41E agricultural station Elevation: 150 masl + 5 m over a meadow Sampling time: May 1889 – April 1891 daily from 9 am Samples: 525 Meteorolog. Parameters: temp., pressure, wind speed/direction, weather Station 230</p> <p>Investigator: Augusta Palmqvist/. assistant of O. Pettersson, teacher in natural science Location: Stockholm, 59,17,5N, 18,3E Elevation: 20 masl + 2 m Sampling time: July 1889 – May 1890, Sept 1888 Greenland Samples: 77 in 1889 experimental station Meteorolog. Parameters: temp., pressure, wind speed/direction, weather Station 231</p>	<p>Pettenkofer variant (Schlösing-Reiset) Air was passed trough washing flasks (sulphuric acid) and then absorbed by baryta water in a Pettenkofer tube and titrated by oxalic acid.</p> <p>Remarks and Errors: Sulphuric acid error of about 20-30 ppm according to Hlasiwetz [1848] and Spring (1883); Bunsen absorption coefficient H₂SO₄ at 25°C = 0,96; H₂O at 25°C=0,759 [IUPAC NIST Solubility database]</p> <p>Estimated error: correction by +20 ppm; error+--3%</p> <p>Pettersson volumetric See above Remarks and Errors: result dependent on temperature and pressure after v. Slyke [van Slyke 1932]. Very accurate Estimated error: +- 1- 2% [Johansson 1898, Skand. Arch. Phys. Bd. 8, p. 93]</p>
1890	<p>Investigator: Augusta Palmqvist/. assistant of O. Pettersson, teacher in natural science Location: Stockholm, 59,17N, 18,3E Tromsö: Husa: 63,48N, 13,11E Skagerak:57,8N, 13,58E Maseskär: 58,5N, 11,05E Kristineberg: 59,17N, 18E Elevation: 20 masl + 2 m Sampling time: Jan 1890 – May 1890, Tromsö: Feb- March 1890 Husa: Feb- March 1890 Maseskär: Feb- March 1890 Skagerak: Feb 1890 Kristineberg: June –Aug 1890 Samples: 120 in 1890 experimental station Tromsö: 23, Husa: 29, Maseskär: 38, Skagerak: 7, Kristineberg: 64; 1888 -1890: 395 samples Meteorolog. Parameters: temp., pressure, wind speed/direction, weather Station 236 Investigator: Arsenius Lebedinzeff, Dr. chemist, University of Odessa Location: Odessa, 46,48N, 30,7E Elevation: 50 masl Sampling time: April-May 1890</p> <p>Samples: 7 Meteorolog. Parameters: temp., pressure, weather Station 704</p>	<p>Pettersson volumetric See above Remarks and Errors: result dependent on temperature and pressure after v. Slyke [van Slyke 1932]. Very accurate Estimated error: +- 1-2%</p> <p>Pettenkofer variant Air was passed trough baryta water and titrated by oxalic acid.</p> <p>Estimated error: error+--3%</p>
1893	<p>Investigator: Salomon August Andrée, engineer Location: over Stockholm, 59,17N, 18,3E , Elevation: 0-3830 masl (0, 380, 1200, 2370, 3200, 3830) Sampling time:. 15th July 1893 Samples: 6 Meteorolog. Parameters: temp., pressure, wind,</p>	<p>Volumetric determination , Pettersson gas analyzer Remarks and Errors: see above; first vertical profile by balloon flight Estimated error: +- 1-2%</p>

	weather Station 237	
1896	<p>Investigator: Carleton Williams, Prof. chemistry, university of Sheffield</p> <p>Location: garden 2,4 km west of Sheffield (UK), 53,4N, 1,5E ,</p> <p>Elevation: 110 masl</p> <p>Sampling time: Dec 1896-April 1897</p> <p>Samples: 142, + 21 in the city of Sheffield</p> <p>Meteorolog. Parameters: temp., pressure, wind, weather</p> <p>Station 238</p>	<p>Pettenkofer variant according to Smith</p> <p>Air passed in 10l flask and the for absorption in baryta water, filtration of unclear baryta water, titration with oxalic acid</p> <p>Estimated error: +--3%</p>
1897	<p>Investigator: E.A. Letts, Prof. chemistry, Queens university of Belfast</p> <p>Location: 53,55N, -2.4333E, garden of university</p> <p>Elevation: 0 masl +2m</p> <p>Sampling time: March July 1887</p> <p>Samples: 46</p> <p>Meteorolog. Parameters: : temp., pressure, wind, weather</p> <p>Station 239</p>	<p>Pettenkofer variant</p> <p>20 l air were absorbed in baryta water and titrated with HCl</p> <p>Estimated error: +--3%</p>
1898	<p>Investigator: Horace Brown, Dr. chemistry, Jodrell Lab. Kew Gardens London</p> <p>Location: Kew Gardens lat 51,5N; 029W</p> <p>Elevation: 15 masl + 1, 5 m</p> <p>Sampling time: July 1898 July 1901</p> <p>Samples: 91 (16 in 1898, 18 in 1899, 29 in 1900, 28 in 1901)</p> <p>Meteorolog. Parameters: : weather</p> <p>Station 240</p>	<p>Pettenkofer variant according to Reiset</p> <p>100- 200 l air was passed trough washing flasks (sulphuric acid) and then absorbed by NaOH and double titrated by sulphuric acid.</p> <p>Remarks and Errors:</p> <p>Sulphuric acid error of about 20-30 ppm according to Hlasiwetz [1848] and Spring (1883); Bunsen absorption coefficient H₂SO₄ at 25°C = 0,96; H₂O at 25°C=0,759 [IUPAC NIST Solubility database]</p> <p>Estimated error: correction by +20 ppm; error+--3%</p>
1902	<p>Investigator: August Krogh, Prof., zoology university of Kopenhagen, Nobel awardist 1920</p> <p>Location: Disko Island and coast of Greenland 69,75N, -53,5E, Kuganguak 70,28N, -53,9E, Ingnagnak, Napisiligsuak 70,3N, -54,48E, Igdlorpait 60,45N, -45,33, Avatarpait 70,08N -54,8E, Nordfjord 69,95N -54,5E, Ivisarkut 69,73N, -54,78E, Mellemfjord 69,75N, -54,6E, Dikofjord 69,4N, -53,9E, Sioranguak 69,4N, -53,9E, Uvivak 63,0N, -41,4E</p> <p>Elevation: 0 -670 masl + 1, 5 m</p> <p>Sampling time: July – August 1902</p> <p>Samples: 59</p> <p>Meteorolog. Parameters: : pressure, wind direction/speed, weather</p> <p>Station 251</p>	<p>Volumetric using a modified Haldane apparatus</p> <p>air in flasks was connected to an absorption vessel with KOH , the volume change of the system was determined by a capillary manometer, heat control is maintained by placing vessels for analysis in water bath.</p> <p>Double determinations</p> <p>Remarks and Errors:</p> <p>Original Haldane analyser was modified to get better accuracy as normal of about +- 8-16,6 %</p> <p>Upwelling of warmer water with high phyto/zooplankton bloom in June/July/August at Disko island explains high CO₂ values. Moss 1875 using the Pettenkofer method received the same high values in Greenland 1875/76 (642, 483, 536 ppm)</p> <p>Winds with highest CO₂ from N,W,S</p> <p>Oxygen values about constant, conclusion: CO₂ from water</p> <p>Estimated error: modified +--3,3 % or +- 10 ppm (300 ppm; +- 1,6% 600 ppm)</p>
1906	<p>Investigator: René Legendre, Prof. biology, director biological station at Concarneau</p> <p>Location: Concarneau (Normandie) 47,5N, -3,85E</p> <p>Elevation: 15 masl</p> <p>Sampling time: Aug/Sept, 1906, July/Aug. 1907</p> <p>Samples: 12 in 1906, 12 in 1907, (total 24)</p>	<p>Pettenkofer variant used at Montsouris Observatory Paris see above</p> <p>Remarks:</p> <p>Data sampled in July /Aug.1907 directly from the roof of the laboratory at the front of the Atlantic sea</p>

	<p>Meteorolog. Parameters: : temperature, pressure, wind direction, weather Station 252</p>	<p>Estimated error: +--3 %</p>
1907	<p>Investigator: Jens P. Lindhard, Dr. physiology, Danish North East Greenland expedition Location: Greenland Denmarkshavn 76°46'N, 18°46'W Elevation: 11 masl Sampling time: 1907-1908 Samples: 23 Meteorolog. Parameters: : temperature, pressure, wind direction, weather Station 253</p>	<p>Haldane volumetric variant , same as Krogh 1902</p> <p>Remarks: Same upwelling on some days found as Krogh Normal average 350 ppm, 2 days <300 ppm, 5 days >400 ppm, max 620 ppm (cited in Benedict 1912) Estimated error: modified +--3,3 % or +- 10 ppm (300 ppm; +- 1,6% 600 ppm)</p>
1908	<p>Investigator: Jean Charcot, Dr. physician, 2nd French Antarctic Expedition 1908-1910 CO₂ Analysis: A. Müntz, Paris Location: Cape Horn-Antarctic coast 58S -70S, -65- -121E Elevation: 3-10 masl Sampling time: 1908-1910 Samples: 10 (1 in 1908) Meteorolog. Parameters: : temperature, pressure, wind direction, weather Station 263</p>	<p>Volumetric after Müntz Trained persons on the ships of the expedition sampled air by filling it in prepared flasks (5 l). They had been analysed back in Paris by a modified apparatus. The flask air was passed through KOH and the connected to a volumeter which measures the volume of freed CO₂ by adding sulphuric acid. Remarks and errors: Sulphuric acid error, values too low ; correction + 20 pp (according to Spring 1883). Blocked upwelling, by ice, therefore too low values, not used (Poisson et al. 1987, Deep Sea Research, Vol 34, no. 7, p. 1255); Not used because of strong ocean absorption near ice shields (see Buch) Estimated error: correction : + 20 ppm , after correction: +--3%</p>
1909	<p>Investigator: Francis G. Benedict, Prof. physiology, Director Boston Nutrition Laboratory Location: Boston, west side of nutrition laboratory 42,3N, -71E, ocean, Pikes Peak Elevation: Boston 13 masl +10 m; Pikes Pike 4312 masl Sampling time: 1909-1912 Samples: Boston :212, ocean air 43, Pikes Peak 9 (1909: 42 samples, 1910: 248, 1911, 297, 1912: 17) total 604 Meteorolog. Parameters: : temperature, pressure, wind direction, weather Station 265</p>	<p>Pettersson – Sonden volumetric See above Remarks and Errors: result dependent on temperature and pressure after v. Slyke [van Slyke 1932]. Very accurate Estimated error: +- 1-2%</p>
1911	<p>Investigator: James Kendall, Prof. chemistry, Columbia University New York Location: Edinburg 55,5N, -10E, Petrograd 54,38N, 62,42E, Stockholm 59,2N, 18E, Columbia University 42,8N, -74,5E Elevation: Petrograd 180, Edinburgh 32, Stockholm 20, New York 9 masl Sampling time: Edinburg Mar 1911 Petrograd Jan 1913, Nobel institute Stockholm June 1913, Columbia University July 1915 Samples: 18 Edinburg, 10 Petrograd, 8 Stockholm, 24 New York, total: 60 Meteorolog. Parameters: : not available Columbia Institut fresh breeze from the Hudson river Station 269</p>	<p>Pettenkofer method, Walker modification (Walker, J., Estimation of atmospheric carbon dioxide; Chem. Soc, Trans. 77, 1110 (1900)) see Letts and Blake p 219-229 double determinations</p> <p>Remarks: No meteorological and station conditions available Lowest value March 1911:356 ppm, near the city Lowest value Jan 1913: 356 ppm, near the city Lowest value June 1913: 321ppm rural area Lowest value July 1915 :326 ppm Winds from Hudson River</p> <p>Estimated error: at least +- 3%</p>

	<p>Investigator: August Krogh, Prof., zoology university of Kopenhagen, Nobel awardist 1920 Location: Kopenhagen Elevation: 6 masl Sampling time: April 1911- Jan 1912, Samples: 200 Meteorolog. Parameters: : pressure, wind direction/ speed, weather</p>	<p>Volumetric using a modified Haldane apparatus See 1902</p>
1912	<p>Investigator: Albert Wigand, Prof. meteorology, Hamburg Location: Bitterfeld (Germany) 51,6N, 12,3E Elevation: 3260, 4990, 6350, 9100 masl Sampling time:. Aug. 1911-Sept 1912 Samples: 4 (CO₂) Meteorolog. Parameters: : temperature, pressure, wind, weather</p> <p>Station 270</p>	<p>Fractionated Condensation (Erdmann 1910) (Erdmann et al. Berichte der deutschen chemischen Gesellschaft, 43, (1910), p. 1702/1708 Air was sampled during ballon flights in 2 l flasks and analysed in the chemical laboratory of Halle (Germany) Remarks: CO₂ in upper troposphere much lower than expected, possible problem of the condensation method by Erdmann correction by +15 ppm</p> <p>Estimated error: at least +- 5%</p>
1917	<p>Investigator: August Krogh, Prof., zoology university of Kopenhagen, Nobel awardist 1920 Location: Kopenhagen lat 55,7 N, 12,5E Elevation: 6 masl Sampling time:. May. 1917 - June 1918, Samples: 76 Meteorolog. Parameters: : -</p> <p>Station 271</p>	<p>Volumetric similar Haldane /Pettersson</p> <p>3 gas burettes each for O₂/N₂/CO₂, one measuring burette for saturing with H₂O, reading of volume change before and after absorption of moist air in KOH</p> <p>Remarks: Air in Kopenhagen is between 310 -370 ppm 2 very accurate values after calibration: 305, 300 ppm (average: 302,5 ppm) Temperature constancy in laboratory Error: O₂/N₂/CO₂ = <= 0,001% Standard deviation in double determinations for CO₂ is 0,00025 %; +-2,5 %.</p>
1920	<p>Investigator: Henrik Lundegardh, Prof., botany Central institute for agricultural research Stockholm Location: Hallands Väderö, lat 55,5N, 12,55E Elevation: 8 masl Sampling time:. 1920 - 1926, May - Sept Samples: > 3000 Meteorolog. Parameters: : - temperature, pressure, wind , weather</p> <p>Station 272</p>	<p>Pettenkofer variant Automatic absorption of moist air in baryta water, titration by HCl controlled by phenolphthalein. Temperature control; result CO₂ concentration in mg/l</p> <p>Remarks: Half -automatic apparatus Additional volumetric analysis of soil air and air over crop fields Error: +-1% or +-0,0003 Vol %</p>
1921	<p>Investigator: Bruno Schulz, Prof., hydrography University Hamburg, institute of oceanography Location: North Sea, Baltic sea, 55N, 12,4E Elevation: 8 masl Sampling time:. 1921, July- August 1921 Samples: 25 Meteorolog. Parameters: : - temperature, most important oceanographic parameters Station 297</p>	<p>Volumetric apparatus by Krogh see 1917</p> <p>Remarks: Surface water of Baltic Sea supersaturated with CO₂ more than North Sea Error: +-2,5%</p>
1924	<p>Investigator: Theodor Meinecke Jr., Dr.phil., Dr., forestry science, University Hannover,</p>	<p>Pettersson – Sonden volumetric See above</p>

	<p>Location: Eberswalde, 52,8N, 13,7E Elevation 5 masl Sampling time:. 1924, June- October Samples: >334 Meteorolog. Parameters: temperature, wind, weather Station 298</p>	<p>Remarks and Errors: result dependent on temperature and pressure after v. Slyke [van Slyke 1932]. Very accurate selected data 5-32 m over ground after rain Estimated error: +- 1-2%</p>
1925	<p>Investigator: Erich Reinau, Prof., ecologic agriculture Location: Davos, 46,8N, 9,7E Elevation: 2 masl Sampling time:. August 1925 Samples: 53 Meteorolog. Parameters: : - temperature, weather Station 299 Investigator: Hermann Wattenberg, Prof. Dr., chemist, Hydrography Location: southern Atlantic ocean 0S-72S, Elevation: 0 masl Sampling time:. June 1925 – May 1927 Samples: >10 000, 312 calculated CO₂ values over sea surface Meteorolog. Parameters: : - temperature, weather oceanographic parameters Station 611</p>	<p>Pettersson – Sonden volumetric See above Remarks and Errors: result dependent on temperature and pressure after v. Slyke [van Slyke 1932]. Very accurate selected data after rain Estimated error: +- 1-2%</p> <p>Volumetric apparatus by Krogh modified by Buch see 1917 Buch, K. Über die Alkalinität, Wasserstoffionenkonzentration, Kohlensäure und Kohlensäureretension im Wasser der Finland umgebenden Meere, Helsingfors : Societas scientiarum fennica, 1917.</p> <p>Remarks: Measured values higher according to Buch Error: +-1-2 %</p>
1926	<p>Investigator: D. Florentin, Dr., chemist, Laboratoire municipale de Paris Location: Paris, Laboratoire de Villejuif, 48N, 2,19E Elevation: 120 masl Sampling time:. Jan 1926 – Nov 1927 Samples: 27 (one selected: 4th Dec 1926, strong wind) Meteorolog. Parameters: : - temperature, wind, weather Station 612 Investigator: August Krogh, Prof., zoology university of Copenhagen, Nobel awardist 1920; Dr. Odum Location: Greenland /Danmark Elevation: - Sampling time:. summer 1926 Samples: - Meteorolog. Parameters: : - Station 613</p>	<p>Pettenkofer variant after Vandenberghe Passing air though baryta water and titration Remarks: Only one value selected : altitude 120 m, strong winds Error: +-1-2 %</p> <p>Pettenkofer variant Passing air though baryta water and titration by HCl Remarks: Error: +-3 %</p>
1927	<p>Investigator: Robert Gut, Dr., forest engineer Zurich Location: Zuerichberg, forests near Zurich, 4 stations, Elevation: 622, 619, 642, 646 masl, 34, 28, 23, 18, 13, 10, 5, 1 m altitude+ more altitudes Sampling time:. July 1927 – July 1928 Samples: 5000 Meteorolog. Parameters: : - temperature, wind, weather Station 617</p>	<p>Volumetric apparatus by Gut similar to Haldane apparatus absorption of air in KOH, manometric reading of changed air volume over solution temperature and pressure controlled as Krogh apparatus Remarks: Temperature sensible, too low levels at higher temperature errors in CO₂ absorption heat, large diurnal variation the same as measured in modern with somewhat higher CO₂ levels; no calibration against Pettenkofer Error: +-2-3%</p>

	<p>Investigator: Donald D. van Slyke, Prof. Dr., biochemist Location: Rockefeller Institute laboratory , New York Elevation: Sampling time:. 1927 Samples: >2 Meteorolog. Parameters: : - temperature Station 618</p>	<p>Volumetric apparatus by Van Slyke (manometric) Absorption of air in NAOH Manometric reading of pressure change</p> <p>Remarks: Comparison with the Haldane apparatus Error: +-1 %</p>
1930	<p>Investigator: Paul Lehmann, Dr., Klimatologie der Hochschule für Bodenkultur Location: Lunz, biological station Seehof lat 47,8N, 15E Elevation: 1280 masl + 2m Sampling time:. 1927 Samples: >44 soil and air (29) Meteorolog. Parameters: : - temperature , pressure, wind, weather Station 619</p>	<p>Pettenkofer variant Krogh/ Rehberg 1928 Passing air though baryta water and titration by HCl</p> <p>Remarks: Measurements over crops, 2, over Topinambur; photosynthesis absorption reduction: Error: +-3 %</p>
1931	<p>Investigator: Donald D. van Slyke, Prof. Dr., biochemist Location: Rockefeller Institute laboratory , New York lat 40,30N, -45,10E</p> <p>Elevation: 8 masl Sampling time:. 1931 Samples: >2 Meteorolog. Parameters: : - temperature Station 620</p>	<p>Volumetric apparatus by Van Slyke (manometric) Absorption of air in NAOH Manometric reading of pressure change</p> <p>Remarks: Comparison with the Haldane apparatus Error: +-1 %</p>
1932	<p>Investigator: Kurt Buch, Prof. Dr., chemistry Institute of ocean research, Helsingfors</p> <p>Location: northern Atlantic ocean lat 56,41N 5,5E, 55,56N, -6,21E, 59,07N, -6,14E, 62,01N, -5,3E, 64,5N, -10,4E, + locations at the northern icelandic coast</p> <p>Elevation: 8 masl Sampling time:. summer 1932 (7th July – 9th Sept) Samples: 28 (double determinations) Meteorolog. Parameters: : - temperature, weather Station 632</p>	<p>Pettenkofer variant Krogh/ Rehberg 1928 Variant by Buch</p> <p>Passing air though baryta water and titration by HCl</p> <p>Remarks: Sampling over sea surface:</p> <p>Error: +-2 %</p>
1933	<p>Investigator: Kurt Buch, Prof. Dr., chemistry Institute of ocean research, Helsingfors</p> <p>Location: Liinahamari, Petsamofjord (now Russian) lat 69° 38' 29 N, Longitude: 31° 20' 36 E Elevation: 8 masl Sampling time:. 31 October 1933 – 4 May 1935 Samples: weekly, 52 (double determinations) Meteorolog. Parameters: : - temperature, wind, weather Station 633</p> <p>Investigator: Thomas Moyer, Dr., chemistry AMERICAN SMELTING AND REFINING COMPA.NY, Utah , USA Location: 5 km out of Salt Lake City, Utah, lat 69°</p>	<p>Pettenkofer variant Krogh/ Rehberg 1928 Variant by Buch</p> <p>Passing air though baryta water and titration by HCl</p> <p>Remarks: Sampling over sea surface:</p> <p>Error: +-2 %</p> <p>Thomas Moyer Autometer Absorption of CO₂ from air stream with 300 ccm/min in 0,005N NaOH; measuring the electrical conductance of the solution at constant temperature</p>

	<p>40 N, Longitude: -111 E Elevation: ~1900 masl Sampling time: 19 Jan 1933 – 13 Feb 1933 Samples: >135 (continous air stream) Meteorolog. Parameters: -</p> <p>Station 634</p>	<p>with a recording Wheatstone bridge, making use of the fact that sodium hydroxide solution has about twice the conductance of the equivalent sodium carbonate solution. Temperature thermostat controlled Source: Air pollution and plant life J. N. B. Bell, Michael Treshow, p.7; Wiley 2002 Remarks: One of the first automatic systems, calibration against Pettenkofer titrimetric method: difference max+0,3-0,6%</p> <p>Error: +-1 %</p>
1934	<p>Investigator: John.G. Waugh, Dr., physicist Cornell university Ithaca , USA Location: Ithaca, Plant science building, roof, rural area Elevation: 135 masl Sampling time: 11 April 1934 – 11 Oct 1934 Samples: >37 Meteorolog. Parameters:</p> <p>Station 635</p>	<p>Thomas Moyer Autometer variant Absorption of CO₂ from air stream with 350 ccm/min in 0,00488N NaOH; measuring the electrical resistance of the solution at constant temperature with a recording Wheatstone bridge. 2,5 l air samples in flasks, 2-3 determinations/hour Remarks: Double determination in outside air</p> <p>Error: average +-1 %</p>
1935	<p>Investigator: Yrjö Kauko, Prof. Dr., chemist University of Helsinki Location: over Helsinki, by aeroplane, vertical profile Elevation: 0-1500 masl Sampling time: 20 Feb 1935, 7 Dec 1935, 13 Dec 1935 Samples: 15 Meteorolog. Parameters: Temperature, wind, weather</p> <p>Station 636</p> <p>Investigator: J.B.S. Haldane, Prof. Dr., chemist University of Helsinki Location: Scotland rural and coast, Elevation: 1,2-21 masl Sampling time: July - December 1935 August: Cloan (Perthshire) day/night Samples: 1500 153 samples at Cloan (Perthshire)= 324 ppm day/386ppm night; samples coast of Ayreshire (Aug/Sept)= 370 ppm wind from the sea; night air at Oxford in October to Nov= 330 ppm av and 380 av; Meteorolog. Parameters: wind, weather Station 639</p>	<p>Kryogenic Condesation Method 30 l air was passed through conc. H₂SO₄, stream of 10l/std measured by difference manometer, passed though cooling coils, and sampled in flasks filled with CaCl₂ and determined by weighting the volume of the displaced solution.</p> <p>Remarks: Most accurate method Calibration against potentiometric method (+-1%) and Pettenkofer Error: average +-0,33 %</p> <p>Haldane volumetric, improved See above Remarks: All pipettes in the same water bath Also measurements of CO₂ from soils and combustion (London) Estimated error: modified +-2,5 %</p>
1936	<p>Investigator: Kurt Buch, Prof. Dr., chemistry Institute of ocean research, Helsingfors</p> <p>Location: travel to Spitsbergen lat 69° N - 80N, lon 0°E- 20 E Elevation: 8 masl Sampling time: 14 Aug – 24 Aug 1936 Samples: 13 in flasks Meteorolog. Parameters: : - temperature, wind, weather Station 652</p>	<p>Pettenkofer variant Krogh/ Rehberg 1928 Variant by Buch</p> <p>Passing air though baryta water and titration by HCl</p> <p>Remarks: Sampling over sea surface:</p> <p>Error: +-2 %</p>

	<p>Investigator: Johann Ulrich Duerst, Prof. Dr., veterinary science Institute veterinary hygiene University of Bern (Switzerland)</p> <p>Location: Ins (near Bern Switzerland) lat 47° N, lon 7,1 E , rural area Elevation: 499 masl Sampling time:. 1936-1938, max. 6 samples/day Samples:, 1000 Meteorolog. Parameters: : temperature, wind, weather Station 653</p>	<p>Pettenkofer variant Hesse Calibration with Pettesson Sonden analyser Passing air though baryta water and titration by HCl</p> <p>Remarks: Sampling 1m over meadow surrounded by:shrubs and trees</p> <p>Error: +-3 %</p>
1938	<p>Investigator: Kurt Buch, Prof. Dr., chemistry Institute of ocean research, Helsinfors Location: Baltic sea, lat 65 -50, lon 17-29 ; see separate file Elevation: 0 masl Sampling time:. 1927-1938, day night Samples:, 185 at 185 different stations Meteorolog. Parameters: : temperature, oceanographic parameters Station 838</p>	<p>Pettenkofer variant Krogh/ Rehberg 1928 Variant by Buch</p> <p>Passing air though baryta water and titration by HCl</p> <p>Remarks: Sampling over sea surface:</p> <p>Error: +-2 %</p>
1939	<p>Investigator: Wilhelm Kreutz, Dr., chemistry Director of the weather station at Giessen (Germany), Reichswetterdienst</p> <p>Location: Giessen periphery, near rural area Elevation: 499 masl Sampling time:. August 1939- January 1941, 16 samples per day, otherwise samples at 7:00, 14:00, 21:00 at 4 altitudes; (total 550 days) Samples:, >30 000; > 25 000 used soil samples: 1647, special CO2/temperature analyses: 1098 + analysis in higher air layers + 2176 diurnal sampling every 1,5 hours+ preexaminations at Heidelberg; 7054 in 1939, 16773 in 1940, 1429 in 1941 Meteorolog. Parameters: : temperature, wind, precipitation, radiation, pressure, humidity, cloud coverage, weather Station 839</p> <p>Investigator: J. Verduin, Dr., botany; IOWA state university Location: IOWA Agricultural experimental station; cornfield, lat 42,024N, -93,6E</p> <p>Elevation: 299 masl, 1 m Sampling time:. July/Aug 1939/40 Samples:1939: 53; 1940: 203 Meteorolog. Parameters: - Station 840</p>	<p>Manometric Riedel C gas analyser designed by Schuftan 0,5 l flask sampling , Pressing air sample through KOH by turning vessel by 90 degree, reading volume change by capillary manometer Remarks: Sampling in 4 altitudes: 0, 0,5, 2, 14 m; monitoring radiation, precipitation, cloud cover, wind speed, pressure, humidity. Temperature, CO2 Analysis in temperature controlled room</p> <p>Error CO2: +-1,5 %</p> <p>Pettenkofer according to Heinicke and Hoffmann, modified Absorption of CO2 in NaOH, precipitation in BaCl2, titration with HCl, phenolphthalein</p> <p>Remarks: 25% absorption at 1 m over cornfield from normal level Error: 3%</p>
1940	<p>Investigator: Wilhelm Bazett, Prof. Dr., physiology; University of Pennsylvania, Philadelphia Location: Philadelphia Elevation: 105 masl Sampling time:. 1940 Samples: 9 Meteorolog. Parameters: - Station 841</p>	<p>Haldane volumetric gas analyser variant See above Remarks: No date and other parameters available Estimated error: modified +-13 %</p>
1941	<p>Investigator: Ernest Earl Lockhart, Dr.,</p>	<p>Haldane volumetric portable gas analyser</p>

	<p>physiologist, Harvard university, Boston USA, Arnold Court, meteorologist, US weather Bureau Location: Antarctica, West Base 78,29S, -163,5 E Elevation: 244 masl Sampling time: July 1940 –Jan 1941 Samples: 26 Meteorolog. Parameters: wind, temperature, pressure, weather, O2 Station 842 Investigator: Harry J. Fuller, Prof., botanist, University of Illinois Location: Campaign county forest and grassland, Illinois, Urbana 40,1N, -88,1 E Elevation: about 214 masl Sampling time: 22 June 1941 –9 July 1941, 1pm Samples: 144 (4 locations) Meteorolog. Parameters: - Station 846</p>	<p>See above Remarks: Calibrated according to van Slyke Estimated error: +-5% Haldane volumetric gas analyser 100ml glass tubes, analysed in laboratory Remarks: Quadruple determinations Estimated error: +-2,5%</p>
1943	<p>Investigator: R.K. Misra, Dr., chemist, Central Agricultural Meteorological Observatory Poona , India Location: experimental fields near Poona, rural area; lat 18,5N, 73,8 E Elevation: about 555 masl Sampling time: Dec 1941 –Nov 1943, Samples: atmosphere >1532; soil > 1500 Meteorolog. Parameters: temperature, wind, precipitation Station 847</p>	<p>Pettenkofer Passing air through baryta water and titration by oxalic acid, Phenolphthalein as indicator Remarks: Flask samples analysed in laboratory Double determinations, difference in the 3rd decimal Error: +4 %</p>
1944	<p>Investigator: Eugen Gluckauf, Dr., chemist, University Science Laboratories Durham (UK) Location: 4-10km over England; Kew garden; lat 51,5N; 0,29W Elevation: about 4000-1000 masl; Kew Garden 15 masl Sampling time: winter/spring 1944, Samples: 12 in troposphere, several near ground London Meteorolog. Parameters: - Station 849</p>	<p>Condensation method Freezing out CO₂ and H₂O by liquid air, measuring the pressure of CO₂ Remarks: Author states CO₂ in water was negligible, no check Error: 10% (see reference p. 621; 0,001% CO₂)</p>
1946	<p>Investigator: Per F. Scholander, Prof. Dr., botanist, 1946 at Edward Martin Biological Laboratory, Swarthmore College Swarthmore Location: Swarthmore lat 39.90N, -75.35E , rural area Elevation: Edward Martin laboratory 77 masl Sampling time: 1946 Samples: >3000 Meteorolog. Parameters: - Station 850</p>	<p>Manometric Scholander Analyser Absorption of air in KOH, automatically measuring pressure change Remarks: checked against Haldane analyser: same accuracy Error: paper 1946 +- vol 0,015% stddev of tests 58 (mean 349)=16,5% improved analyser=</p>
1947	<p>Investigator: Per F. Scholander, Prof. Dr., botanist, 1947 at Location: Point Barrow Arctic Laboratory lat 71,3N, -156,64W, Elevation: 2 masl Sampling time: Oct 1947 – March 1949 Samples: : ~350 Meteorolog. Parameters: O₂ Station 851</p>	<p>Manometric Scholander Analyser Absorption of air in KOH, automatically measuring pressure change Remarks: checked against Haldane analyser: same accuracy Error: paper 1946 +- vol 0,015% stddev of tests 58 (mean 349)=16,5% improved analyser=</p>

1949	<p>Investigator: H. W. Chapman, Dr., botanist, University of Nebraska, Lincoln</p> <p>Location: near Alliance Nebraska, rural area lat 42,4N, -103E</p> <p>Elevation: 1220 masl</p> <p>Sampling time: June-Aug 1949 -1951</p> <p>Samples: :. 1949: 220 ; 1950: 148, 1951: 177</p> <p>Meteorolog. Parameters: temperature Station 852</p>	<p>Pettenkofer according to Heinicke and Hoffmann, modified; Absorption of CO₂ in KOH, precipitation in BaCl₂, titration with HCl, phenolphthalein</p> <p>Remarks: Control tower 10-30 cm over potato plants; 28% variability in CO₂ absorption by potato leaves Absorption by potato plants: average 14%,</p> <p>Error: 3%</p>
1950	<p>Investigator: Hal R. de Selm, Prof., botanist, Ohio state university; later University of Tennessee, Knoxville</p> <p>Location: near Blacklick Creek Ohio, rural area lat 40,1N, -82,4E</p> <p>Elevation: 327 masl, 0,9m, 9,m, 12m above ground</p> <p>Sampling time: April - July 1950 , 4 hourly at day</p> <p>Samples: :.>127</p> <p>Meteorolog. Parameters: temperature, pressure, humidity, wind Station 853</p> <p>Investigator: Karl Egle, Prof., botanist, Director of the institute of applied botany Hamburg, later on president of the botanical society of Germany</p> <p>Location: Frankfurt botanical institute lat 50,1N, 8,6E</p> <p>Elevation: 348 masl, + 6-10 m</p> <p>Sampling time: 19 may 1950, 5:00AM-1:30PM</p> <p>Samples: :.>1620,</p> <p>Meteorolog. Parameters: temperature, pressure, humidity, wind; rainy day Station 853</p> <p>Investigator: Siegfried Strugger, Prof., botanist, University Muenster (Germany)</p> <p>Location: botanical garden university Muenster, rural area, grassland lat 51,9N, 7,61E</p> <p>Elevation: 65 masl; 3-4m above ground</p> <p>Sampling time: 18/29 July-1950, 8:00am-6am</p> <p>Samples: :. > 2640</p> <p>Meteorolog. Parameters: weather Station 854</p>	<p>Pettenkofer according to Heinicke and Hoffmann, modified by Böhning 1948; http://www.plantphysiol.org/cgi/reprint/24/2/222</p> <p>Absorption of CO₂ in KOH, precipitation in BaCl₂, titration with HCl, phenolphthalein</p> <p>Remarks: Measurements in forest</p> <p>Error: 3%</p> <p>URAS continous sampling and plotting (NDIR),drying air by streaming through silica gel ; infrared absorption by CO₂</p> <p>Remarks: Continuous gas stream; sample analysis within every 30 sec</p> <p>Error: < +- 1% (0,0001 Vol%)</p> <p>URAS continous sampling and plotting (NDIR),drying air by streaming through silica gel ; infrared absorption by CO₂</p> <p>Remarks: Continuous gas stream; sample analysis within every 30 sec</p> <p>Error: < +- 1% (0,0001 Vol%)</p>
1951	<p>Investigator: Bruno Huber, Prof., botanist, forest and botanical institute, University Munic (Germany)</p> <p>Location: over wheat field in Duernast (48,4N, 11,691E) Freising agricultural faculty Weihenstephan TU Munic</p> <p>Elevation: 476 masl; 50cm-1,2m, 4,5m, 22,5 m beside the field, 50-100m balloon</p> <p>Sampling time: 15 May- 14 Aug 1951</p> <p>Samples: :. > 15 000</p> <p>Meteorolog. Parameters: weather, temperature, rain Station 855</p>	<p>URAS continous sampling and plotting (NDIR),drying air by streaming through silica gel ; infrared absorption by CO₂</p> <p>Remarks: Continuous gas stream; sample analysis within every 30 sec</p> <p>Error: < +- 1% (0,0001 Vol%)</p>
1952	<p>Investigator: H. W. Chapman, Dr., botanist,</p>	<p>Pettenkofer according to Heinicke and Hoffmann,</p>

	<p>Iowa state College, Ames, Iowa</p> <p>Location: cornfield, Iowa state college television tower, rural area lat 42,4N, -103E Elevation: 1220 masl; 1m, 20m above corn field ; TV tower 10m, 30m, 152m Sampling time: July-Oct1952, 3AM-midnight Samples: :. > 66 Meteorolog. Parameters: temperature, pressure wind Station 856</p>	<p>modified; Absorption of CO₂ in KOH, precipitation in BaCl₂, titration with HCl, phenolphthalein</p> <p>Remarks:</p> <p>Error: 3%</p>
1954	<p>Investigator: Stig Fonselius, Dr., meteorologist, Institute of marine research Helsingfors Finland</p> <p>Location: 15 stations throughout Scandinavia; data from Plönninge Sweden lat 56,8N, 12,9E and Tvärminne Finland 59,8N, 22,9E selected</p> <p>Elevation: Plönninge 59; Tvärminne 14,9 masl</p> <p>Sampling time: Nov 1954-Dec 1959, 1st, 10th, 20th of each month , 1PM</p> <p>Samples: > 2700</p> <p>Meteorolog. Parameters: temperature, wind, pressure, weather Station 851</p>	<p>Pettenkofer variant by Krogh/ Rehberg 1929 Passing a small amount of air through Ba(OH)₂; titration by HCl see above</p> <p>Remarks: air samples collected in flasks analysed in laboratories at Stockholm and Sweden 6 sampling location² in Sweden, 4 in Finland, 3 in Denmark, 2 in Norway; only data from Plönninge Sweden and Tvärminne (Finland seashore) used</p> <p>Error: +-3 %</p>
1955	<p>Investigator: Charles Keeling, Dr., chemist, California institute of Technology , Pasadena USA</p> <p>Location: see below</p> <p>Elevation: 1. 10 masl +1 m; 2. 1950 masl 1m 3. 2500 masl; 4. 3000 masl; 5. 3800 masl; 6. 4000 masl 7. 4300 masl; 8. 1900 masl 9. 0 masl; 10. 170 masl</p> <p>Sampling time: 1. Big Sur State Park: 18-19 May 55 2. Yosemite National Park, Tamarack: 2-3 June 1955 3. Yosemite National Park, Lake Tenaya: 3 June 1955 4. Yosemite National Park Tioga Pass: 3 June 1955 5. Inyo Mountains, Mt. Barcroft 8 July 1955 6. Inyo Mountains, Mountain divide: 8-9 July 1955 7. Inyo Mountains, white Mountain summit: 9 July 1955 8. Hart's Pass 1 Sept 1955 9. Olympic National Parc Beach trail: 6-7 Sept 1955 10. Olympic National Hoh River Ranger st.: 6-7 Sept 1955 11. Rock Lake 10-11 Sept 1955 + further locations see reference in 1956 Samples: 50</p> <p>Meteorolog. Parameters: temperature, wind,</p>	<p>Cryogenic condensation method Condensation of sample by liquid nitrogen, freeing the condensate from water by fractionated distillation and identifying gas by mass spectroscopy and determination quantity by a manometer.</p> <p>Remarks: air samples collected in 5 ltr. flasks analysed in laboratory, additionally determination of C¹³ isotope</p> <p>Error: +-1 %</p>

	pressure, humidity, weather Station 862	
1956	<p>Investigator: Charles Keeling, Dr., chemist, Scripps Institute of Oceanography, USA</p> <p>Location: see below</p> <ol style="list-style-type: none"> 1. Coastal Redwood Canyon, 6-7 June; 150 masl 2. Coastal Redwood Valley 5-6 June; 70 masl 3. Sierra Nevada Pine and Fir Forest California 10-11 June 1956; 1950 masl 4. Mogollan Rim Pine Forest Arizona; 16-17 May 1956; 2100 masl 5. Borrego desert; 02. Feb 56, 340masl 6. Inyo Mountains; 9-14 March 1956; 3800 masl 7. Sonora desert; 21-22 April 1956, 550 masl <p>Elevation: 1-7: 70 -3800 masl see above</p> <p>Sampling time: See above</p> <p>Samples: 51</p> <p>Meteorolog. Parameters: - Station 869</p>	<p>Cryogenic condensation method Condensation of sample by liquid nitrogen, freeing the condensate from water by fractionated distillation and identifying gas by mass spectroscopy and determination quantity by a manometer.</p> <p>Remarks: air samples collected in 5 ltr. flasks analysed in laboratory, additionally determination of C13 isotope</p> <p>Error: +-1 %</p>
1957	<p>Investigator: Ferdinand Steinhauser, Prof., meteorologist, Zentralanstalt für Meteorologie und Geodynamik, Vienna, Austria</p> <p>Location: weather station Hohe Warte Vienna, Austria, lat 48,25N, 6.35E</p> <p>Elevation: 205 masl +25 m tower</p> <p>Sampling time: Jan 1957- June 1958, daily 1PM</p> <p>Samples: 546</p> <p>Meteorolog. Parameters: wind, (temperature, pressure, weather: other data set) Station 870</p>	<p>Pettenkofer variant by Krogh/ Rehberg 1929 Passing a small amount of air through Ba(OH)₂; titration by HCl see above</p> <p>Remarks: Air collected from the tower of the institute and analysed in laboratory</p> <p>Error: +-2 %</p>
1959	<p>Investigator: Walter Bischof, Dr., engineer University of Stockholm,</p> <p>Location: near/ over Stockholm, Sweden lat 48,25N, 6.35E; Dalarö: lat 59.13N, 18.4E (island) Bryggan:, lat 59.78N, 14.13E, Golf course 1 km away, Djursholm</p> <p>Elevation: 100 m -3 km masl over Stockholm; Dalarö: 0 masl; Djursholm: 16 masl, Bryggan: 154 masl</p> <p>Sampling time: 28 October 1959 over Stockholm, 11-13 Aug and 15-17 Sept 1959 at Golfbanan, 15/16 Aug Dalarö , 28 July at Bryggan and a golf course 1km away (1 Sept, 8 Dec.)</p> <p>Samples: 92</p> <p>Meteorolog. Parameters: eastern winds Station 875</p>	<p>NDIR gas analyser</p> <p>Remarks: used since May 1959</p> <p>Error: +-1-4 %</p>

Note: Montsouris 1877-1910

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