Experimental review of the CO2 greenhouse effect

The false climate prophets

By Dr. Michael Schnell; June 2020

Abstract

Jean-Baptiste Joseph Fourier was the first to postulate a warming of the atmosphere by CO2 in 1827. Many years later, Hoimar von Ditfurth, Volker Quaschning and Albert Arnold "Al" Gore believed that they had experimentally proven the Fourier thesis since they observed considerable air warming in various CO2 experiments. A careful review of their experiments now shows that the public is being manipulated and deceived here. The temperature increases are not caused by the CO2 greenhouse effect, but by the decrease in heat conduction. Particularly strong effects are obtained when CO2 is injected as a “gas lake” under an air layer. However, if, as in the atmosphere, air and CO2 are mixed evenly, there is no warming and, in special circumstances, even a slight cooling can occur.

Introduction

Following the established mass media, the supposedly man-made climate change is scientifically proven and does not require further research. First of all, a contradiction in itself, because science does not provide absolute truths, laws set in stone, but only assumptions and hypotheses. Even if a thesis has proven itself in practice and has gained general recognition, a critical review is not a sacrilege but an indispensable duty of every scientist. Prohibitions on thinking and muzzles are methods and typical features of a dictatorship that degrades science to an unworthy servant of the powerful. How credible is a society that wants to be colorful but suppresses diversity of opinion (here).

It is very worrying that only former institute directors, retired professors and researchers speak out on climate change and contradict the doomsday scenarios. When only people resist who no longer have to worry about their career, reputation, or income. When in Germany the older generation is mocked by a public broadcaster ("Meine Oma ist `ne alte Umweltsau“. My grandma is an old environmental pig").

For an outsider, it is difficult to impossible to verify the forecasts of drought, heat, floods and species extinction. Unless you rummage in ancient newspapers and find dark prophecies in beautiful regularity such as the "unusual" Arctic warming in 1924 and 1934 (here, here). Perhaps it is the older people's life experiences that they do not fall for the sensational journalism and react rather calmly.

The doom predictions divide society into people who believe everything the media produces and people who prefer to form their own opinions. My experimental investigations are aimed at the latter group. Even if the complex occurrence of weather and climate in the laboratory cannot be reproduced, individual aspects and statements can be checked. The following article deals with spectacular laboratory experiments by prominent climate alarmists that should be critically examined. In the end, it will become clear why their experiments have failed and their warnings about the supposedly dangerous CO2 are unfounded.

1. The Hoimar von Ditfurth Experiment

There are a number of simple experiments on the Internet that link the CO2 greenhouse effect with air temperature. According to this, CO2 should behave like a glass pane that allows short-wave light to pass through but absorbs long-wave heat radiation. A significant warming after the addition of CO2 was considered to be proof of a greenhouse effect. The best known experiments are by Al Gore (here), Volker Quaschning (here) and Hoimar von Ditfurth (here). They have a very similar experimental setup and can be characterized as follows.

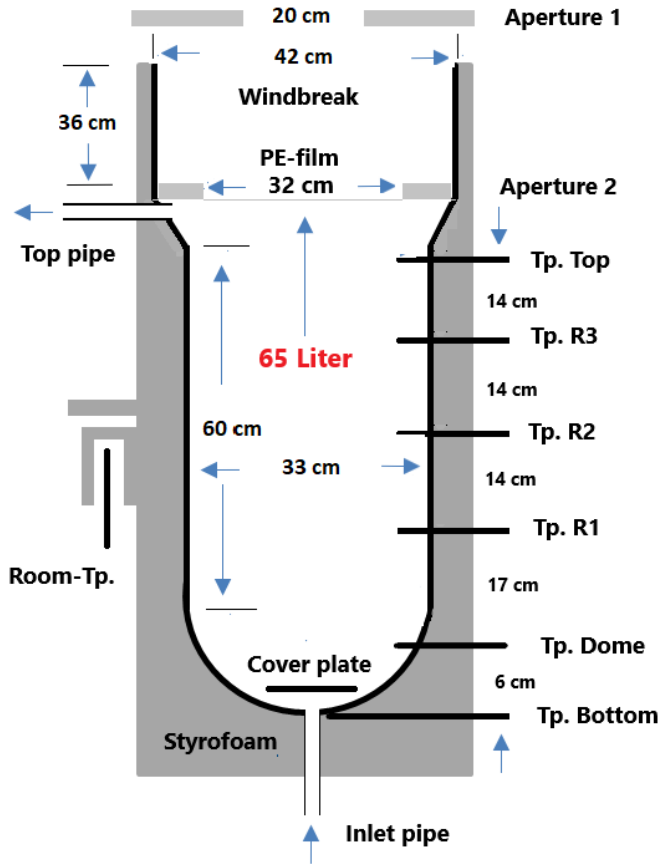
1. An incandescent lamp irradiates a vessel from the outside (simulation of solar radiation).
2. The vessel is filled with either normal or CO2-containing air (earth atmosphere).
3. A flat surface or a spherical body simulates the surface of the earth.

Probably the most spectacular experiment was conducted in 1978 by the author and television presenter Dr. Hoimar of Ditfurth†. This demonstration deserves some superlatives: Besides spectacular, it is the largest and most dangerous experiment, with the strongest temperature rise and most physical puzzles.

On a stage were two large cylinders with the approximate dimensions 2 x 3 m made of transparent plastic film, in which a test person observed a thermometer. Only in one cylinder in which Ditfurth stood, CO2 from several large CO2 bottles was injected very quickly from below.
The real essence of the experiment was two 'stage spotlights', which radiated from a short distance, from above into the open cylinders and thus heated them.
In the end it was found that the CO2-filled cylinder was 11.3 ° C warmer than the comparison cylinder. The YouTube video, which is still available on the Internet, conveys a message that is easy to understand even for the general public because of its simplicity: "Look, CO2 can warm our earth by 11 ° C or perhaps even more if you don't act immediately. But is this prophecy true?
The experiments of the prominent climate alarmists are pure demonstrations. Detailed descriptions, information on CO2 concentrations and control experiments are missing. Only a before-and-after analysis is provided. These omissions should be made up for by a thorough examination.

2. The experimental equipment

The test apparatus and first results were already presented at the alternative 13th Climate Conference (IKEK) in Munich November 2019 (*here*).
In the meantime, the apparatus was upgraded by installing a 7th sensor "Tp. Bottom" sensor, which measures the temperature of the dome wall. This allows air and soil temperatures to be compared.



All temperatures are recorded by data loggers at minute intervals. Except for "Tp. Bottom", all sensors measure the air or gas temperatures.

The dome is a stainless steel bowl, the tube and the conical extension are made of polished aluminum (0.6 mm), the windbreak is made of aluminum-coated Styrofoam wallpaper.

Optionally there is a open aperture 1 or closed aperture 2.

The cover plate allows the dome to be filled evenly with different test gases. The upper pipe is only open during experiments with aperture 2, during gas injection or pumping over.

The introduction of the gases is monitored with a rotameter. The concrete quantity is determined by weighing the gas cylinders. The pumping out is done with an aquarium pump with 1.5 l/min.

The apparatus is irradiated with a 100 W incandescent lamp from a distance of 60 cm.

Fig. 1: Scheme of the test equipment

The most important innovation is a PE film in the form of aperture 2 above the conical extension of the cylinder. PE has the advantage that the film allows heat radiation to pass through, but seals the test chamber gas-tight. This allows comparative experiments to be carried out with open (aperture 1) and closed apparatus (aperture 2).

Fig. 2: Left picture: The radiation apparatus with aperture 1
Middle and right: Radiation apparatus with aperture 2, irradiated with red or white light

2.1 Verification of the Ditfurth experiment

As in the Ditfurth experiment, the air-filled, open apparatus (Fig. 2, left picture) is irradiated with a 100 W red light reflector lamp. Due to the irradiation, the experimental apparatus is up to 10 °C warmer than the air in the room. This results in an unusual layering of air, warm air is at the bottom and cooler air is at the top (Fig. 3).
The explanation is the Lambert cosine law. The bottom, although furthest away from the lamp, receives the greatest radiation density from the red light lamp because of its parallel orientation to the radiation source. All other surfaces are only illuminated at an angle and therefore heat up less. The heat spreads mainly through heat conduction, as can be seen from the 4 °C difference between bottom and dome air (Fig. 3, Bottom vs. Dome).

After some time, 23 L CO2 are injected into the apparatus from below within 15 minutes. The temperatures in the apparatus react immediately to the CO2, but very differently. While the bottom and the dome air immediately warm up, the other sensors initially show a cooling down, only to report an increase after a certain delay (Fig. 3).

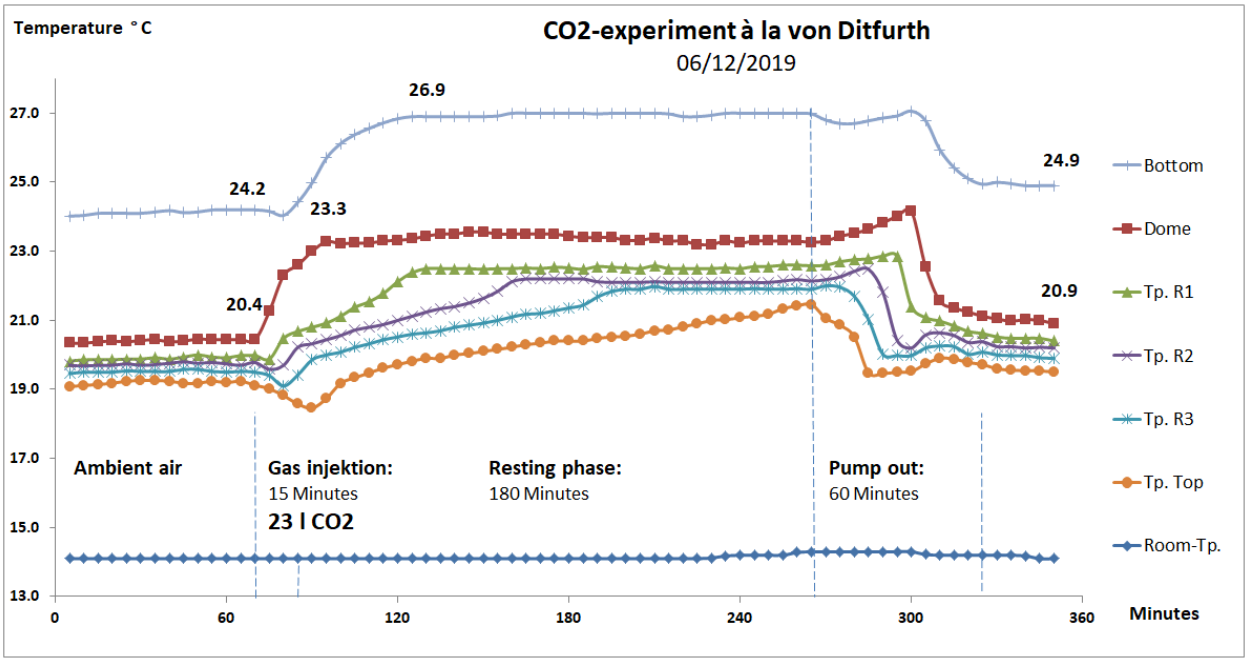


Fig. 3: Temperature data: Verification of the Ditfurth experiment.

The temperatures determined by the data logger are plotted over time in an Excel table. Each data point corresponds to a time interval of 5 minutes and is the temperature average of 5 measurements.

After an observation period of 180 minutes (resting phase) the gases are pumped out again through the "inlet pipe" in the ground. The pumping was intended as a control to prove that the temperature increases are actually caused by CO2.

A determination of the pumped-out CO2 amount showed that only a small amount of CO2 was present from the original 23 liters. Most of the CO2 had escaped unnoticed into the laboratory room during the experiment from the above-open apparatus (diffused). The steady temperature increase of the top position (yellow line) shows this diffusion.

2.2 The Argon Control Experiment

At first glance, the previous CO2 experiment seems to confirm the Ditfurth hypothesis. But doubt is the mother of all science and so this result must also be checked. Argon offers itself as an alternative control gas. Argon is like CO2 a heavy gas but not a greenhouse gas and should not cause a temperature change when introduced into the tube.

However, the control experiment is a big surprise: The IR-inactive argon causes exactly the same temperature increases as the greenhouse gas CO2 (Fig. 4).

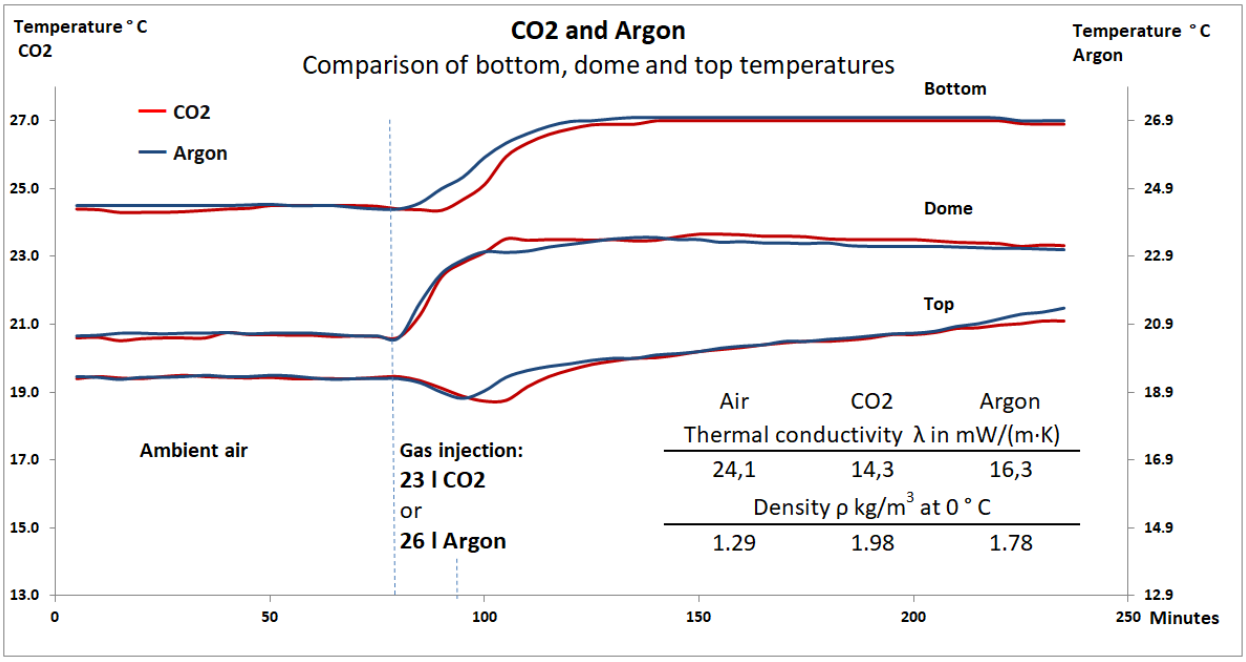


Fig. 4: Comparison of CO2 and Argon temperature rises

Since argon and CO2 have different specific thermal conductivities (ratio 1: 1.14), the amount of argon is increased by a factor of 1.14 as a compensatory measure (26 liters of argon vs. 23 liters of CO2).

2.3. Conclusions of the study

The noble gas argon is an IR inactive gas that can neither absorb nor emit thermal radiation. If CO2 and argon show the same heating effect, the cause must be sought outside of thermal radiation. Heavy gases have a lower specific thermal conductivity λ than air (the table in Fig. 4). If these gases are injected into the tube, they reduce the heat flow within the apparatus. The heavy gases act as an insulating layer. Thus it can be concluded:

The Ditfurth experiment does not show the greenhouse effect, but is a phenomenon of heavy gases.

This first finding confirms the skepticism of Helmut Krebs and Anthony Watts, who doubted the Ditfurth and Al Gore experiments as proof of the CO2 greenhouse effect (here, pp. 91,98).

3. Experiments in the closed apparatus

3.1 Verification of the Ditfurth experiment in the closed apparatus

Since CO2 could escape during the first investigation, the experiment of chapter 2 was repeated with a closed apparatus. For this purpose, aperture 2 was glued above the conical extension with silicone rubber. Aperture 2 is covered with a transparent PE foil (layer thickness: 11 µm), which allows thermal radiation to pass through but prevents CO2 from escaping (Fig. 1, the picture in the middle). Surprisingly, in this experiment, the temperatures returned to the initial values after only two hours, although no pumping was carried out (Fig. 5).

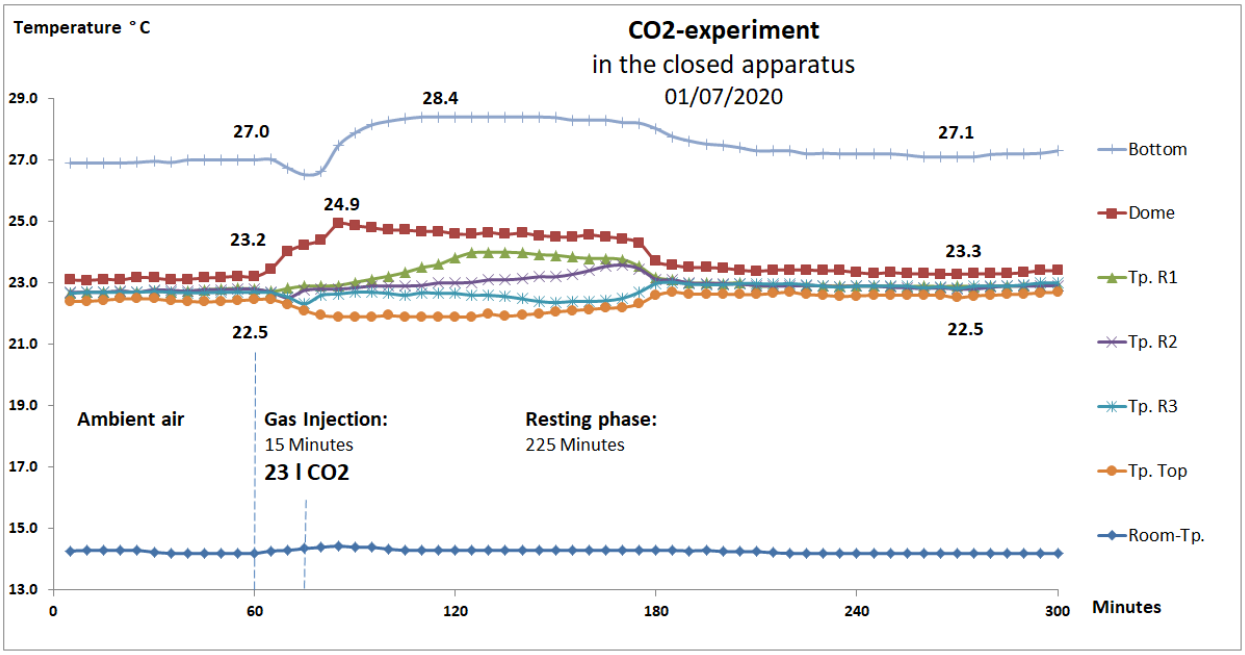


Fig. 5: Temperature decrease during the resting phase

The deviating behavior can be explained by a different course of CO2 diffusion with an open and closed apparatus. When CO2 is injected through the lower inlet pipe, a CO2 "lake" forms in the dome, which is comparable to a liquid that is filled into a bowl (the “cover plate” was installed in the dome for this type of gas filling). The CO2 then slowly spreads out upwards by diffusion. As it does so, the CO2 approaches the red light lamp and is heated more than in the lower layers, accelerating its ascent. In the open apparatus, this leads to CO2 escaping, but in the closed apparatus, it leads to mixing, homogenization with the internal air.

The homogenization process changes the ratio of CO2 heat conduction and CO2 heat radiation. The thermal conductivity of a CO2-containing layer depends on its composition and the CO2 concentration (here). Pure CO2 has the greatest insulating effect when it is injected into the dome, which means that the upper layers get less heat from the warmer bottom. When mixed with air, the insulating effect decreases with decreasing CO2 concentration. This explains the opposite temperature changes between bottom and top position in the first minutes shortly after injection of CO2.

In contrast, the radiant power of CO2 does not depend on its concentration, but on the number of CO2 molecules. The homogenization process reduces the CO2 concentration but not the number of CO2 molecules.
This correlation leads to the conclusion that the initial, strong temperature rise of 1 - 2 °C is mainly caused by a concentration gradient. In contrast, a homogeneous CO2-air mixture leads to only a slight warming of 0.1 - 0.2 °C (Fig. 5).

3.2 CO2 experiment with accelerated homogenization

The thesis of internal mixing of CO2 and air could be confirmed experimentally. After CO2 was injected, an aquarium pump sucked off the CO2 in the dome and injected it into the upper pipe. This pumping accelerated homogenization and lowered temperatures much faster than in the previous experiment (Fig. 6 and Table 1).

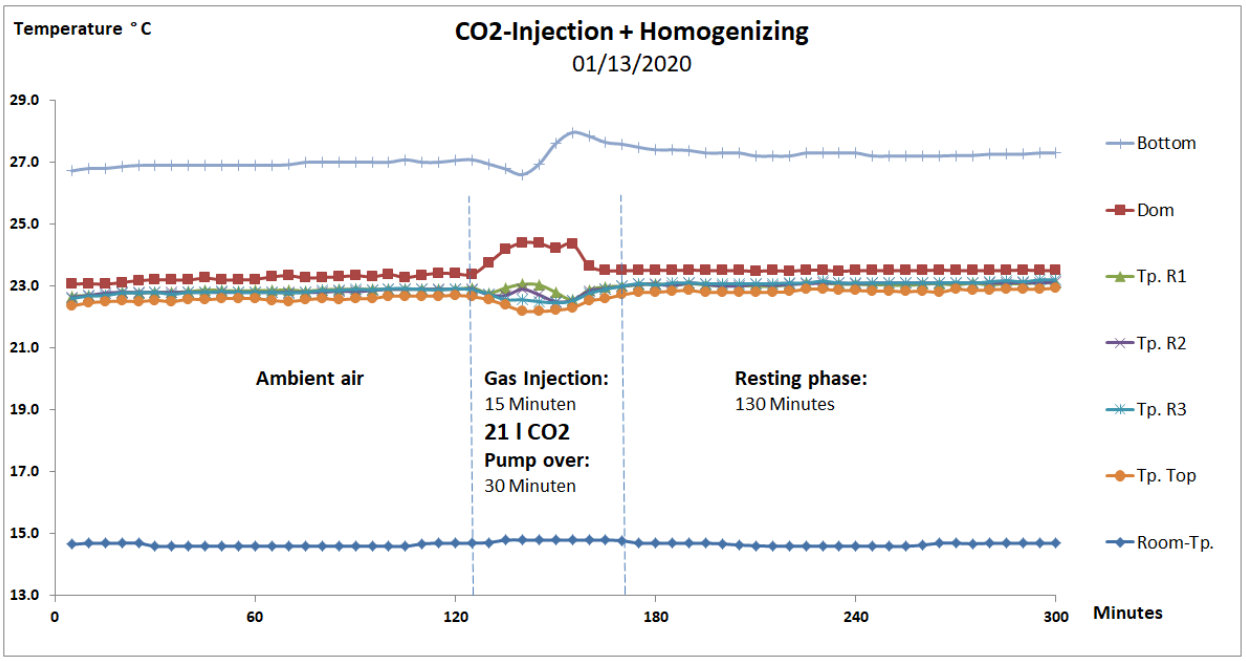


Fig. 6: Temperature curves at accelerated homogenization

3.3 Homogenization experiments with heavy gases

Further homogenization experiments with different amounts of CO2, Freon 134a and Argon always resulted in the same small temperature rises of 0.1 - 0.3 °C (Tab. 1). Even a CO2 control experiment with a colorless 100 W radiator (Fig. 2, right picture) did not lead to a different result.

Gas	Volume Liter	Temperature rise (° C) after homogenization					
		Bottom	Dome	Tp. R1	Tp. R2	Tp. R3	Tp. Top
CO2	21	0.2	0.2	0.1	0.2	0.2	0.2
CO2 *	21	0.2	0.2	0.1	0.1	0.1	0.2
CO2	8	0.2	0.2	0.1	0.1	0.2	0.1
Freon 134a	5	-0.1	0.0	0.0	0.1	0.1	0.1
Argon	27	0.3	0.2	0.2	0.2	0.1	0.1

CO2 * = 100 W colorless incandescent lamp

Tab. 1: Temperature rise of various gases after homogenization in air

3.4 Homogenization experiments in argon

In a final series of experiments, the air in the apparatus (the ambient air) was replaced by argon before the addition of greenhouse gases. This measure was intended to reduce the influence of the heat conduction. In fact, CO2 or Freon 134a did not cause measurable air warming in the dome position, while there was even cooling on the bottom (Table 2).

Gas	Volume Liter	Temperatur rise (° C) after homogenization in Argon					
		Bottom	Dome	Tp. R1	Tp. R2	Tp. R3	Tp. Top
CO2	21	-0.1	0.0	0.1	0.1	0.2	0.2
Freon 134a	5	-0.2	0.0	0.0	0.0	0.0	0.0

Tab. 2: Temperature rise after homogenization in argon

4. Conclusion and search for causes

The claims of Al Gore, Ditfurth und Quaschning that they have proven the CO2 greenhouse effect through air heating are false. If one eliminates special effects caused by the low specific heat conduction of heavy gases and by a concentration gradient, nothing remains of the postulated warming.

But why don't such experiments with external radiation work? In order to understand this, one has to take a closer look at the irradiation lamps, as the source of the energy supply. The glass bulbs of the colorless and red light lamps reach temperatures of 115 °C and 125 °C respectively and thus produce, in addition to their visible light, considerable thermal radiation. It is crucial that this heat radiation covers the same wavelength range $\lambda = 3 - 30$ µm that is also used by greenhouse gases.

To understand the importance of heat radiation, we first have to digress and answer the question of what the earth does with the heat it receives from the sun.
The earth has a whole range of different ways of transporting heat horizontally and vertically, which is researched by meteorology and is simply called weather. Most of this heat ends up in the atmosphere and only a very small part (40 W/m^2) is emitted directly from the earth's surface to space in the form of heat radiation. In fact, it is the atmosphere (at an altitude of about 5 to 10 km) and not the earth's surface that removes the sun's heat, only by radiation of about 200 W/m^2 towards space, based on Kevin E. Trenberth's energy scheme. (here).

Nitrogen, oxygen and argon, the main constituents of the atmosphere, are IR inactive, that means they can store and transport heat but cannot emit thermal radiation. Only clouds, aerosols and greenhouse gases have this function and ability. Without these small particles and the IR-active trace gases, the upper atmosphere would warm up in the long term, and only near the ground would there still be a certain heat exchange by heat conduction. Then there would only be a certain temperature gradient near the ground due to the day and night change and between the equator and the earth's poles.
The atmosphere is a huge heat engine that converts part of its heat into work. This work is the driving force of planetary circulation with its air currents (Passat winds, Polar winds, Jet streams) and the various flow cells (Hadley, Ferrel, Walker) and the lifting processes (convection). As with all heat engines, the efficiency of this energy conversion depends on the temperature difference between the warm and cold layers of the atmosphere. In an almost isothermal atmosphere, this would no longer be the case. The greenhouse gases, which until now have only been seen as an obstacle to terrestrial IR radiation (greenhouse effect), play an indispensable positive role here, as they cool the upper atmosphere with their IR radiation and thus ensure the necessary temperature difference.

The IR radiation of greenhouse gases, however, has no preferred direction, which leads to two opposite effects. On the one hand, the upper atmosphere is cooled by radiation in the direction of space (radiation) and on the other hand, the surface of the earth is heated by radiation in the direction of the earth (counter radiation).
It is controversial whether and to what extent additional CO2 contributes to warming the troposphere. In the second report "SAR" under the direction of Ben Santer, the IPCC had presented this thesis as the cause of global, man-made warming and cited real measurements between 1963 and 1968 as evidence. Very embarrassing, because shortly afterwards Michaels and Knappenberger were able to prove that the tropospheric "hot spot" disappear when the total period, the data available at that time from 1958 to 1995 is considered. The authors accused the IPCC of cherry picking and data manipulation (here).
The role of CO2 in global warming is also hotly debated. According to the model calculations, a doubling of the CO2 concentration (CO2 climate sensitivity) could lead to a warming in a range between 0.6 °C and 4.5 °C (here, here, here).
This considerable inconsistency arises from a different assessment of the cloud effect and from controversial feedback. If CO2 were the only greenhouse gas in the atmosphere, the CO2 climate sensitivity would be 1 ° C (hier). This value is widely accepted and would not have a serious impact. The dispute between "alarmists" and "skeptics" is therefore not the effect of pure CO2, but the complex interactions and overlaps of the various IR-active

substances in the atmosphere and, above all, the so-called CO2-water vapor feedback, which are evaluated differently. A positive feedback would increase the CO2 climate sensitivity but a negative feedback would reduce the effect of CO2.

The dispute sparked on a strange theory of alarmists that heating the Earth's surface (⅔ water!) by 0.065 ° C reduces the cloud cover by 1% (here)! Pardon, warmer water = more evaporation = less clouds? The alarmists are sure here, because the data were obtained from the ISCCP (International Satellite Cloud Climatology Project) observations of global warming. After that, sea surface temperature (SST) rose from 19.1 °C to 19.4 °C between 1986 and 2017 and cloud cover decreased from 72% to 67%.
This reveals the same dilemma as the Ditfurth experiment; data collection and data interpretation are two completely different shoes. It is therefore not surprising that a completely different interpretation has recently emerged, which even assumes negative feedback, if shorter periods are used in the ISCCP data. M. Jonas found that cloud cover and SST elevation show a positive correlation when looking at cloud coverage 1-6 months after the measured water temperature (here).
If this assessment were to prove true, the CO2 greenhouse effect as a climate killer would be over and could collapse like a house of cards. This should be a warning to all governments, business leaders and activists. Their justification for the "Great Transformation" and the associated renunciation of consumption hangs on a silken thread that can tear at any time.

But now back to the laboratory tests, here the heat radiation from the lamps overlaps the CO2 radiation. The radiation of the equipment by the external lamp has the same direction as the CO2 counter radiation. According to Planck's law, the red light lamp produces a radiation density of around 100 W/m^2 in the spectral range 14 - 16 µm (approximately CO2 band at 15 µm) at a temperature of 125 ° C. How much of it actually reaches the bottom of the apparatus is unclear, because the spherical spread of the lamp radiation reduces the radiation density before it enters the apparatus.
The CO2 in the gas phase absorbs the IR radiation from the lamp and emits its own radiation, which can be a maximum of 43 W/m^2 at an air temperature of 23 ° C in the 14 - 16 µm wavelength range. If the absorbed lamp radiation is greater than the emitted CO2 radiation, the radiation to the bottom is reduced and it cools down (Tab. 2). This process is comparable to an IR spectrometer, in which the attenuation of an IR beam by CO2 is measured.

But why is there no air heating when the CO2 has absorbed a certain part of the lamp radiation? The answer is the way CO2 emits IR radiation. If we consider the radiation axis lamp - bottom, we have two surfaces, direction lamp and bottom, through which CO2 can release the absorbed energy again. As long as the absorbed energy of the lamp radiation does not exceed the CO2 radiation on two surfaces, there is no air heating.
Whether or not air heating occurs depends on the intensity of the lamp radiation and the temperature of the CO2 layer, the ratio of absorption and emission. This can even be shown if you look at the individual measuring positions from bottom to top.
The IR radiation from the lamp initially hits the CO2 in the top position, which means that the absorption here has a maximum and slowly decreases towards the bottom. The absorption-emission ratio changes to the same extent, resulting in a temperature gradient and the upper sensors (R1 to Top) register a slight warming but the lowest (bottom) a slight cooling (Tab. 1).

Fourier was the first to formulate that CO2, as an absorber, contributes to the warming of the atmosphere and thus triggered a fundamental confusion that continues to this day. Apparently Al Gore & Co. were seduced by this statement to determine the greenhouse effect by measuring air temperatures. It overlooks the fact that atmospheric CO2 is not only an absorber but also an IR emitter, which can cause both cooling and heating.

To really understand the contribution of CO2 to the actual warming of the atmosphere, one has to integrate the Schwarzschild equation $ds = - I_\lambda + B_\lambda (T)$ with many thousands of lines and coefficients over the entire troposphere / stratosphere. The first term on the right refers to the reduction of the radiation intensity (air heating by absorption

of the soil radiation and the radiation of the upper layer), while the second term represents the increase in radiation intensity (air cooling) resulting from the IR emission within the layer (here).
H. Harde carried out these calculations in three climate zones (tropics, medium and high latitudes), for 228 sublayers and up to a height of 86 km, taking into account the water vapor superposition. It was shown that CO2 has a much greater impact on the ground temperature than on the air temperature. Also, additional CO2 only causes air warming up to a certain height in the atmosphere (here).
The air temperature is therefore only a weak indicator of the greenhouse effect and is also superimposed by external radiation, as stated above. All attempts to demonstrate the greenhouse effect based on the air temperature are questionable from the start or doomed to fail.

The decisive factor for the CO2 greenhouse effect is not the air temperature, but the IR radiation, which emits a specific amount of CO2 at a certain temperature. This is a certain challenge, since there is no test room for CO2 on Earth that does not also emit IR radiation and thus makes measurement difficult, if not impossible. The solution is a radiation measurement of warm CO2 against a cold background. One does not register the absolute CO2 radiation, but only the increase in the common radiation. This concept has the advantage that the near-earth greenhouse effect, the superposition of cloud and CO2 radiation, is simulated in a laboratory experiment in a realistic manner. The increase in IR radiation can be determined by a radiation sensor (thermal imaging camera) or by the temperature changes of an additional black surface that simulates the earth's surface.

If, in the latter case, the temperature of the black area is kept constant and its electrical heating varies, the radiation of the IR-active gases can be quantified. This method was used to determine the molar emissivity ε_m of various IR-active gases as a key figure for their radiant power. CO2 with a value of ε_m=0.043 proved to be a significantly weaker IR emitter than nitrous oxide (ε_m=0.055). Only methane was an even weaker IR emitter with ε_m = 0.029 (here). It is therefore incomprehensible that the IPCC claims that methane has a global warming potential 28 times greater than CO2.
Contrary to Fourier's assumption, the gas space was unremarkable and showed no significant rise in temperature. In these experiments, the test room may not have been sufficiently isolated to actually measure the weak warming effects of the air that are expected according to the model calculations.

Christoph and Matthias Marvan, who had examined warm CO2 against a cold background with a thermal imaging camera, succeeded in directly detecting the CO2 radiation (here).

Thus, two different measurement methods have experimentally confirmed that CO2 can emit measurable and quantifiable IR radiation at the usual temperatures of the near-earth atmosphere. An electromagnetic excitation by an external radiation source is not necessary for this. It can be concluded from the experiments that the CO2 molecules change into an excited oscillation or rotation state when they collide with other molecules and fall back into the original ground state by releasing a photon. The energy required for CO2 IR radiation therefore comes from the inner energy of the air layer in which the CO2 molecules are located. In this cycle, CO2 acts like a catalyst in chemical processes, which significantly increases its effectiveness. As a result, even small amounts of CO2 can affect the heat flows of the atmosphere.
With both investigation methods it was proven that at least the near-earth CO2 greenhouse effect is physically possible. But it has also been shown that the IR radiation from the clouds significantly reduces the greenhouse effect of CO2. The experiments confirm the position of the “skeptics” who see water vapor and clouds as a reduction in CO2 climate sensitivity and accuse the “alarmists” of an excessive exaggeration of an alleged CO2 hazard.