

## **Corona Regulations and the Monster of Loch Ness: What is it All About?**

**Jan M. C. Geuns**

Laboratory of Functional Biology, KULeuven  
Kasteelpark Arenberg 31, B3001 Heverlee

### **INTRODUCTION**

Dbouk and Drikakis (2020) suggested a holistic approach in combating the Corona crisis. That is why it is necessary that researchers from very different disciplines understand each other well so that they can work together creatively to combat Corona. Therefore, in this text pressure is expressed in bar (not in pascal) because a bar is more visually imaginable (1 bar = 1 kg/cm<sup>2</sup>; or 1 kg on a fingertip). Airspeed is expressed in Km/h because people are used to this unit.

Surgical masks, mandatory in many countries, were subjected to further examination. As an independent scientist, I am aware of having to stand up to a widely spread myth, but I feel supported by scientific facts and observations, and I am not dependent on "statistical evidence". At the same occasion, CO<sub>2</sub> meters, also mandatory in pubs, restaurants and concert halls in many countries were examined too. After the fifth Corona outbreak, nobody seems to know what to do to keep Corona under control. Politici have taken a number of decisions without considering the science behind the survival of Corona in aerosols. All life depends on water, and by considering the physical-chemical laws that influence life, it might be much easier to understand what has to be done to defeat the virus. If the citizens are well informed about all the measures required to eliminate the virus, they will better follow the guidelines than after some fickle decisions by politicians. This way, the life of citizen becomes much more pleasant without risks of spreading the virus. This communication also contains the results of some measurements done in marl quarries where the atmospheric conditions are very favorable for the spread of viruses. We also did some tests with CO<sub>2</sub> meters.

### **THE LOCH NESS MONSTER AND CORONA HEALTH MEASURES**

What is the relationship between the Loch Ness monster and some corona health measures? Scientifically spoken, it is impossible to give a negative proof for the non-existence of the monster. It is only possible to say that its probability is very low. The monster is a myth perpetuated for tourism. In the same way, a negative proof that surgical masks do not prevent the spread of viruses cannot be given. It is up to the believers to provide a positive scientific proof! Statistical evidence has not the same value as experimental scientific proof. That might be the reason why the spread of the virus is much faster than predicted by statisticians and politicians as their models probably rely on a myth that social distancing can be replaced by a surgical mask. Of course, we know that in some Asian countries many people are wearing a mask to protect them from air pollution (dust particles).

Since the start of the pandemic in 2019, a huge number of papers appeared, but so far no experimental scientific proof seems to exist that social distancing can be replaced by a surgical mask, although Talic et al. (2021) claimed about 52 % less spread of Corona by surgical masks (statistical evidence). Earlier, Kisielinski et al. (2021) and Delanghe L. (2021) and many cited references in their work, found that surgical masks did not prevent the spread of Corona. On the contrary, the masks led to a false sense of security, as can also be seen in shops, pubs or restaurants where people with masks claim that they are safe because of their masks. The general public is not trained to keep surgical masks aseptic and to make sure the mask is well fitting, this way avoiding that air is passing through openings along the mask instead of through the mask. Contrary to statisticians who are usually considering thousands of data, a scientist needs only a few well thought-out experiments to prove or disprove a working hypothesis. It is surprising why, after 2 years of Corona crisis, the virologists have not yet set up a scientific experiment to study whether or not (in most cases contaminated) surgical masks can nullify the distance rules.

### **Usefulness of surgical masks**

So what is the value of those surgical masks? First of all, a sick surgeon will not operate. He disinfects his hands and arms very well and a sterile mask is used, which is preferably replaced regularly. The surgeon does not want to breathe directly on an open wound and therefore the masks are water-repellent. Saliva droplets do not pass through a mask and the surgeon can therefore ensure the safety of the patient. Of course, the surgeon also has to breathe, and that happens also through the openings along the mask because less air passes through the mask itself. In an operating room, the temperature is usually high and the aerosols evaporate immediately and the ventilation is good. So a mask used by professionals is very useful.

### **Surgical masks for the general public**

If the population is obliged to wear surgical masks, also a proper training should be given on how to keep those masks sterile, how to put them on and how to ensure that they fit properly. If one observes people in shops and streets, it appears that most masks are no longer sterile, do not fit closely, that they are regularly put on and off and, therefore, they rather offer a feeling of false security. A study by Delanghe et al. (2021) also shows how carelessly many people wear these masks. The politicians have also made them believe that, if they cannot keep social distance, masks are the solution (e.g., in public transport).

### **Surgical masks**

Self-made fabric masks are not considered as nothing is known about specifications.

One can pinch the nose and fix a surgical mask tightly against the mouth and breathe through the mouth, which works but cannot be sustained for long. It is clear that for most people the breath passes through the narrow openings along the mask (both by inhaling and exhaling; law of the slightest resistance). If coming too close to other people, even wearing a mask, one breathes in each other's aerosols and this gives a false safety feeling.

Bacteria are much larger than viruses and therefore are easier to stop by a mask than Corona, which is about 10,000 times smaller than 1 mm. In a small sphere of 1 mm diameter, there is

thus room for about 1000 billion of Corona viruses! As there is no scientific proof that surgical masks can nullify the distance rules, the advice is to always keep distance and by doing this, surgical masks seem without any additional value. In windy weather, it might even be recommended to cross the street to avoid running into other people. Are these masks becoming a global myth? It can easily be observed, e.g., in shops when people come too narrow and when one asks them to keep distance, their answer is invariably: "I'm safe as I'm wearing a mask". They are not aware that the people standing next to them are breathing in their exhaled aerosols!

Surgical masks do stop the biggest drops when speaking or coughing, but normally they fall to the ground within 1 meter. A small experiment can be done. One can easily put water in a mask and it will not pass through. This is because the mask is water-repellent and due to the surface tension, water does not pass through the small pores in the mask. Small animals like *Gerris lacustris* can glide over the water because of the surface tension. We cannot do this because we are too heavy and put too much pressure on the water. By applying a small pressure to the water in a mask, the water can pass through. This can easily be demonstrated by tying a mask to a tube and pouring a little water into it of 10 to 15 cm high, which corresponds to a (still small) pressure of 9.7 to 14.6 mbar. Due to the resulting pressure, water will now be pressed through the mask. When coughing or sneezing, we cause a pressure surge so that moist air is driven through the mask! Now it are not large droplets that fall quickly to the ground, but very small aerosols that may contain viruses and, depending on the temperature and relative humidity, can linger in the air for a long time period. In order to avoid putting pressure on a mask, the surface tension can be removed by adding a little detergent to a glass of water. When pouring such soap solution into a mask, it runs smoothly through it because the surface tension has disappeared!

In light of the above observations, some research results are also relevant. Kwon et al. (2012) reported the initial airspeed by healthy volunteers when speaking and coughing. This was on average 14.6 Km/h in men when speaking and on average 55 Km/h when coughing. In women this was 8.3 and 38.1 km/h, respectively. When coughing, there were outliers of up to 90 to 108 Km/h. Tang et al. (2013) also reported the dynamics of airflow by healthy volunteers when breathing and sneezing, both through the nose and through the mouth. When breathing through the nose, the maximum air velocity was 5 Km/h and the distance from the breath was 0.6 m, while when breathing through the mouth those values were 4.7 Km/h and 0.8 m distance. When sneezing, the airspeed was 16.5 Km/h. The authors note that the speeds that they reported are much lower than those previously reported by Wells (1955). The speed of sneezing (360 Km/h) reported by Wells (1955) could be an overestimation, which is why Xie et al. (2007) used estimated speeds when sneezing between 73 and 180 Km/h in their physical model to study how droplets behave and evaporate during various respiratory activities. Akhtar et al. (2020) published a quantitative study with 5 types of masks, including surgical masks. They repeatedly emphasize that in their model, the surgical masks closely matched their test set-up (taped with adhesive tape). The airflow was only 11.5 Km/h and the water droplets were of 1  $\mu\text{m}$  size. They considered a viral infection threshold of 1,000 virus particles inhaled at once or repeatedly. Even with this relatively slow airflow and with tightly fitting surgical masks, they came to the conclusion that surgical masks cannot replace the distance rules because the infection threshold of 1000 is exceeded from 5 million virus

particles in 1 coughing fit in surgical masks and from 100,000 in cloth masks. When coughing, the number of virus particles can reach up to 200 million and, moreover, the air velocity is many times higher, which is even higher when sneezing. In healthy subjects lying on a hard mattress, the pressure when coughing is  $\pm 89$  mbar (Kamikawa et al., 2016). In sitting healthy subjects, the oesophageal pressure was between 56 and 208 mbar (Laviates et al., 1998). These observed pressures are much greater than the pressure required to drive aerosols through a surgical mask (10 to 15 mbar, see above). When sneezing, the air velocities and the pressure obtained are much higher. Dbouk and Drikakis (2020) studied a three-dimensional model to study the effect of coughing on transmission of droplets to humans. In addition to the usual techniques, they also take into account the relative humidity (RH) as well as the wind speed. At 20 °C and 50 % RH, saliva droplets (on average  $\pm 70$   $\mu\text{m}$ ) can spread very far with a cough of 29.8 Km/h depending on the wind speed. Without wind, the droplets do not migrate far and drops smaller than 100  $\mu\text{m}$  completely dry out and 2 m social distancing is safe. At wind speeds of 4 and 15 Km/h, the droplets can be transported over large distances ( $> 6$  m at 4 Km/h and much more at 15 Km/h) and it also takes much longer before they fall to the ground. The test set-up was only 6 m long, which is why correct maximum distances are missing. Under these circumstances, keeping a distance of 2 m is certainly not enough. The authors argue for a holistic approach with close collaboration between different disciplines. In an experimental model Fontes et al. (2020) studied the fluid dynamics linked to physiological factors in the dispersion of droplets when sneezing. The study cites that the geometry of the mouth and nose are important as well as the stiffness of the mucus and saliva. The speed of the airflow when sneezing was set at 144 Km/h.

Observing how the population handles surgical masks and how poorly the masks usually fit on the face, it is clear that surgical masks only contribute to a sense of false security and that those masks cannot replace the distance rules. This condition seems more dangerous than keeping physical distance without masks.

### **HOW CAN AEROSOLS DISAPPEAR AND REDUCE THE RISK OF CONTAMINATION?**

On a sunny summer day, laundry can be dried outside, but that drying is not possible in cold and foggy weather. This is just to illustrate that the atmosphere has a very high suction power at higher temperatures and low humidity (read: the air has a much lower water potential than the wet laundry, which allows the atmosphere to easily take up water). In cold and foggy weather it does not work because the suction power at low temperature and high humidity is very small (read: the water potential of the air is then almost zero, so that the air can not absorb much more water). These principles of suction are also applicable to the aerosols we exhale. As a rule of thumb, one can say that if you do not see your own breath (in warm weather), the aerosols disappear very quickly, but if you can perceive your breath (cold and humid weather, or in a cold room of a warehouse) then the aerosols will last a long time and the risk of contamination is much greater.

### **INFORMATION ON THE PHYSICO-CHEMICAL PROPERTIES OF THE ATMOSPHERE**

Figure 1 shows the suction power of the air (in bar) in function of the temperature between -10 and 50 °C. It is clear that the suction power is an exponential function. The suction power increases very strongly from 33 (at -10 °C) to 1595 bar (50 °C). It is easier to work with

straight lines and therefore the  $\log_{10}$  of these values is also plotted in Figure 2 (and Table 1). On the basis of the formulas given in the figures, intermediate values can be calculated.

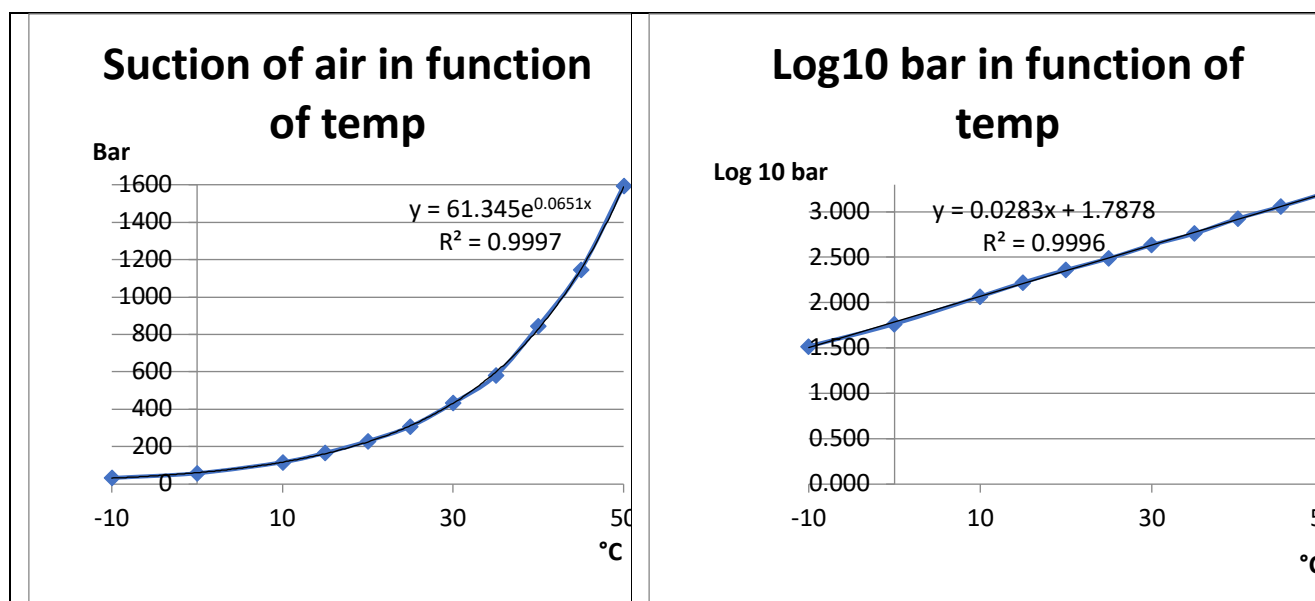


**Fig. 1: Suction power of the air (bar) in function of °C. Fig. 2:  $\log_{10}$  bar in function of the temperature**

Another parameter that determines the suction power of the atmosphere is the percentage relative humidity (% RH). The suction power of the atmosphere in function of the % RH is shown in Figure 3, and this for temperatures at -10, 0, 10, 20, 30, 40 and 50 °C.

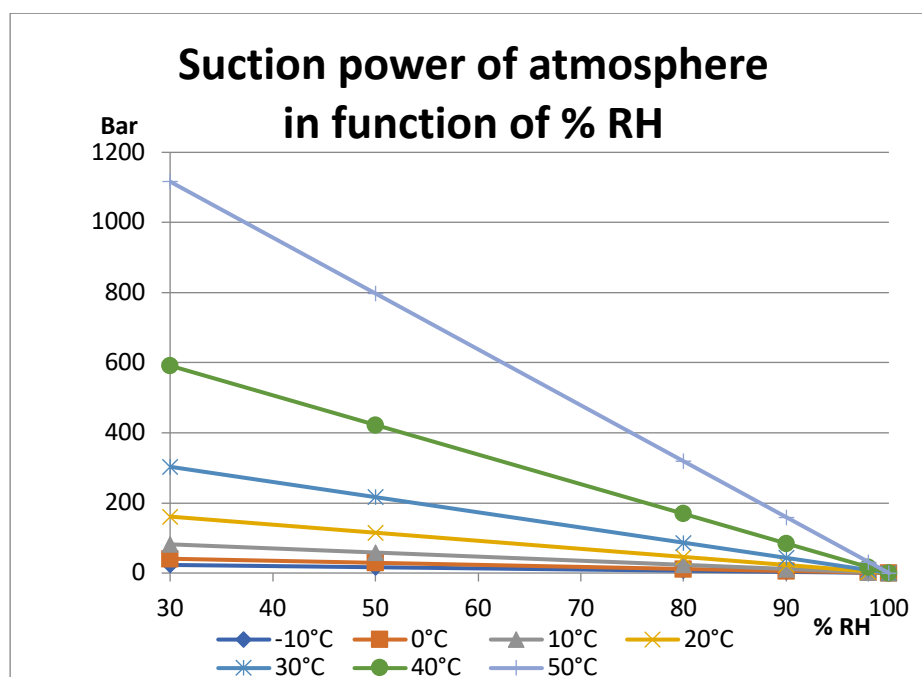


**Figure 3: Atmospheric suction power (in bar) plotted against % relative humidity (% RH). The values are given at -10, 0, 10, 20, 30, 40 and 50 °C at a % RH of 30, 40, 50, 60, 70, 80, 90, 98 and 100.**

**Table 1: Suction power of the air (in bar) in function of the temperature and  $\log_{10}$  of the values, as well as the maximum vapor pressure (in g/m<sup>3</sup>) and the  $\log_{10}$  of the values.**

| temp. °C | suction power in bar | $\log_{10}$ of suction | Vapour pressure in g/m <sup>3</sup> | $\log_{10}$ vapor pressure |
|----------|----------------------|------------------------|-------------------------------------|----------------------------|
| - 10     | 33                   | 1.477                  | 2                                   | 0.301                      |
| 0        | 58.3                 | 1.766                  | 4.1                                 | 0.623                      |
| 10       | 117                  | 2.067                  | 8.15                                | 0.911                      |
| 15       | 167                  | 2.222                  | 11.52                               | 1.061                      |
| 20       | 230                  | 2.362                  | 17.31                               | 1.238                      |
| 25       | 308                  | 2.489                  | 23.67                               | 1.374                      |
| 30       | 433                  | 2.636                  | 30.4                                | 1.483                      |
| 35       | 580                  | 2.763                  | 46.08                               | 1.664                      |
| 40       | 825                  | 2.917                  | 65.16                               | 1.814                      |
| 45       | 1147                 | 3.059                  | 92.15                               | 1.964                      |
| 50       | 1595                 | 3.203                  | 130.32                              | 2.115                      |

At 100 % At 100 % RH, the water potential of the air is equal to 0 and all lines therefore run together in this point (Figure 3), and the air has a maximum amount of water and therefore no suction power to absorb water. The humidity is usually much lower, and at 30 °C and 98 % RH the suction power of the atmosphere is still very large, namely 38.6 bar. At 30 °C and 90 and 50 % RH, the suction power is equal to 157 and 977 bar, respectively! More values about the suction power at different percentages of RH are given in Table 1. With these suction forces of the atmosphere, aerosols immediately completely evaporate and there is no longer any danger of the spread of the virus.

It is clear that the temperature and the percentage of relative humidity have a very large influence on the suction power of the atmosphere. Now the question arises: how much water vapor can the air eventually contain? This is indicated by the maximum vapour pressure (Table 1, right half).

The vapour pressure of the atmosphere or the maximum amount of water vapour that the air can contain (in g/m<sup>3</sup>) increases exponentially with an increase in temperature. So the warmer the air, the greater the suction power of the air becomes and the more water vapor the air can contain (see Figures 4 and 5, and Table 1). It is clear that the temperature has a very large influence on the suction power of the atmosphere and on the amount of water vapor that the air can contain.

At 30 °C, the air can hold up to 30.4 g/m<sup>3</sup> of water, which corresponds to a suction power of  $\pm 433$  bar. At 20 °C, it is 17.31 g/m<sup>3</sup> ( $\pm 230$  bar suction power); at 0°C, it is  $\pm 4.1$  g/m<sup>3</sup> (58.3 bar suction) and at -10 °C it is  $\pm 2$  g/m<sup>3</sup> ( $\pm 33$  bar suction). So the colder it gets, the less water vapor there can be in the air and in that way the dew point is reached much faster, i.e., the water vapor condenses. Cold temperatures and high % RH is a condition favorable for viruses. Hence, viruses spread more easily in the cold season.

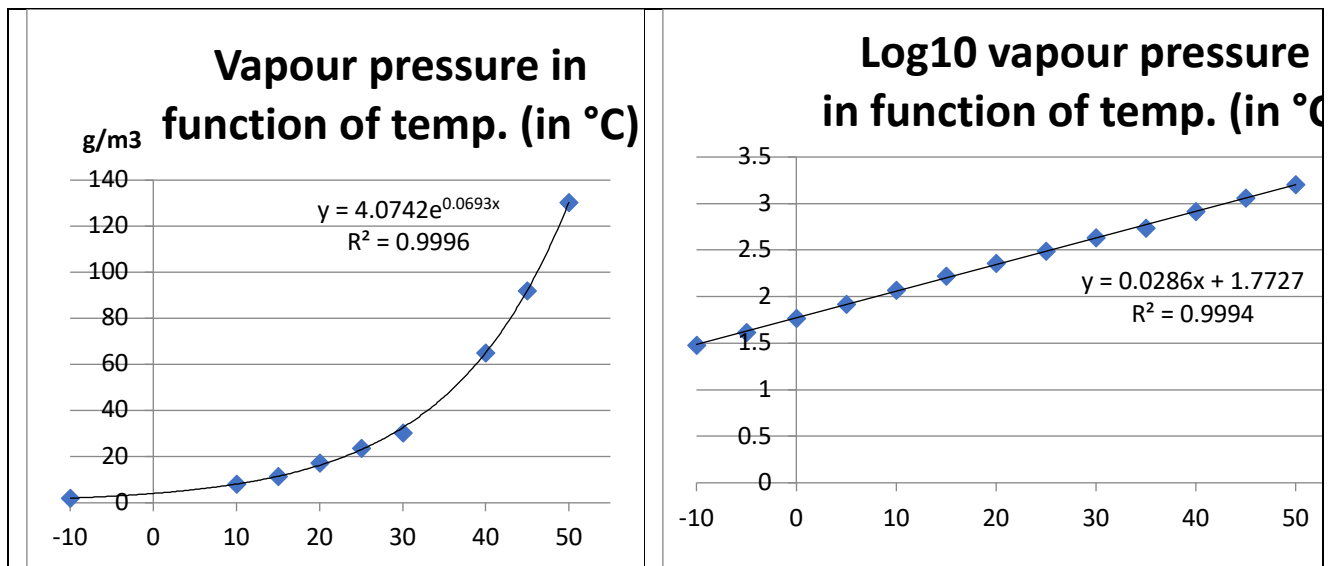


**Fig. 4: Vapour pressure (g/m<sup>3</sup>) in function of temp.**  
**Fig.5: Log10 of vapour pressure in function of temp.**

With the formula  $y = 0.0286x + 1.7727$  the water content can be intrapolated at other temperatures.

That the suction power of the air is very large is also evidenced when snow disappears even at persistent freezing temperatures. In this case, water molecules are pulled directly out of the snow. The same principle also applies to freeze drying of, e.g., vegetables through the use of strong vacuum pumps. In the above-mentioned processes, the temperature therefore plays an important role.

Now there is another important factor to take into account and that is the relative humidity (RH) of the air. In the above calculations, we only considered the maximum suction power or maximum vapour pressure. The % RH has a very large influence on the amount of water vapor that the air can additionally contain. If the % RH in a room is, e.g., 50 %, then the air can absorb twice as much water vapor before the air is saturated. The temperature also plays a role here. Table 2 gives an overview of the maximum amount of water vapour the air can contain, and how much can still be absorbed (surplus) at a certain temperature and % RH. These values are expressed in g/m<sup>3</sup> and thus allow to predict for a given room with a certain volume when the saturation point will be reached.

**Table 2:** Water content ( $\text{g/m}^3$ ) at certain temperatures and certain % RH. "Surplus" refers to how much water vapour per  $\text{m}^3$  can still be absorbed at a certain temperature and certain % RH.

| vapor per m <sup>3</sup> of air can be absorbed at a certain temperature and certain % RH. |       |        |         |        |         |        |         |        |         |       |         |        |         | RH 98% |      |
|--------------------------------------------------------------------------------------------|-------|--------|---------|--------|---------|--------|---------|--------|---------|-------|---------|--------|---------|--------|------|
| °C                                                                                         | g/m3  | RH50%  | surplus | RH 55% | surplus | RH60%  | surplus | RH70%  | surplus | RH80% | surplus | RH90%  | surplus |        |      |
| 0                                                                                          | 4.10  | 2.05   | 2.05    | 2.255  | 1.845   | 2.46   | 1.64    | 2.87   | 1.23    | 3.28  | 0.82    | 3.69   | 0.41    | 4.02   | 0.08 |
| 10                                                                                         | 8.15  | 4.075  | 4.075   | 4.482  | 3.6675  | 4.89   | 3.26    | 5.705  | 2.445   | 6.52  | 1.63    | 7.335  | 0.815   | 7.99   | 0.16 |
| 12                                                                                         | 9.36  | 4.68   | 4.68    | 5.149  | 4.212   | 5.616  | 3.744   | 6.552  | 2.808   | 7.488 | 1.872   | 8.424  | 0.94    | 9.55   | 0.19 |
| 15                                                                                         | 11.52 | 5.76   | 5.76    | 6.336  | 5.184   | 6.912  | 4.608   | 8.064  | 3.456   | 9.216 | 2.304   | 10.368 | 1.15    | 11.4   | 0.23 |
| 20                                                                                         | 17.3  | 8.65   | 8.65    | 9.515  | 7.785   | 10.38  | 6.92    | 12.11  | 5.19    | 13.84 | 3.46    | 15.57  | 1.73    | 16.9   | 0.35 |
| 25                                                                                         | 23.67 | 11.83  | 11.83   | 13.018 | 10.652  | 14.202 | 9.468   | 16.569 | 7.101   | 18.94 | 4.70    | 21.30  | 2.37    | 23.2   | 0.47 |
|                                                                                            |       |        |         |        |         |        |         |        |         |       |         |        |         |        |      |
| °C                                                                                         | g/m3  | RH10%  | surplus | RH20%  | surplus | RH30%  | surplus | RH40 % | surplus |       |         |        |         |        |      |
| 30                                                                                         | 30.41 | 3.04   | 27.37   | 6.08   | 24.33   | 9.123  | 21.29   | 12.164 | 18.24   |       |         |        |         |        |      |
| 35                                                                                         | 46.08 | 4.60   | 41.48   | 9.212  | 36.868  | 13.824 | 32.26   | 18.43  | 27.65   |       |         |        |         |        |      |
| 40                                                                                         | 65.16 | 6.516  | 58.644  | 13.032 | 52.128  | 19.548 | 45.61   | 26.06  | 39.1    |       |         |        |         |        |      |
| 45                                                                                         | 92.15 | 9.215  | 82.935  | 18.430 | 73.720  | 27.645 | 64.50   | 36.9   | 55.3    |       |         |        |         |        |      |
| 50                                                                                         | 130.3 | 13.032 | 117.288 | 26.064 | 104.256 | 39.096 | 91.22   | 52.12  | 78.2    |       |         |        |         |        |      |

It is clear that at colder temperatures the saturation vapor pressure will be reached much faster than at higher temperatures. If we compare 2 extremes, e.g., 0 °C and 25 °C and both at 60 % RH, it is clear that at 25 °C the air in a room can absorb much more vapour per  $\text{m}^3$  than at 10 °C (9.468 versus 1.64, or 5.77 x more). Experience also shows that at higher temperatures a high % RH does not occur often, and certainly not above 30 °C. Therefore, in the lower part of Table 2 at higher temperatures the % RH is given only between 10 and 40 %. It is therefore important that when ventilating a room, the temperature does not drop too much (see below). If you want to experience the effect of high RH and low temperature, you can visit marl quarries of, e.g., Kanne (Limburg, Belgium). There the temperature is constant  $\pm 12$  °C and the RH 98 %. In these circumstances, aerosols with virus can survive for a long period and only 0.19  $\text{g/m}^3$  of water vapour can be absorbed (Table 2). Under these circumstances, it is expected that the Corona virus can survive for a very long time period, because practically all exhaled air lingers and masks don't take anything away either.

### Sensible ventilation of rooms

Properly ventilating classrooms and other rooms is very important. In the summer, a window can be left widely open, because it is warm enough in the room. Leaving the window open continuously in the winter is a bad practice because a room then cools down so that the vapor pressure also drops and this way the fresh cool air becomes saturated with aerosols faster and that is exactly what the virus likes. In order to ventilate properly, it is usually enough to open windows and doors widely for a few minutes and create drafts so that all air is replaced or use a strong fan. Air has a small heat capacity and can therefore store little heat. So that air volume can quickly be reheated after closing the windows. However, if one leaves the windows open in the winter, the walls which have stored a lot of heat, also lose heat and then

the heating costs rise very high or the temperature in the room decreases too much, so that one actually creates favorable conditions for the virus, because the colder, the less suction power the air has. Here too, many people have a wrong idea about ventilation. They think that it is good if a lot of fresh air comes in, but too much cooling down entails dangers! That is why it is also questionable to see children sitting in a cold classroom with thick pulls on and with the windows open. This gives the virus more chances because at low temperature the maximum vapor pressure is much lower! So in winter, depending on the number of people and the volume of the room, one must regularly ventilate at regular intervals (e.g., every hour). In this way, the water potential in the air becomes very negative again, so that the suction power of the air is restored and aerosols immediately evaporate, especially if one heats sufficiently. Unfortunately, people have been led to believe that a CO<sub>2</sub> meter indicates when to ventilate to contain Corona, but a CO<sub>2</sub> meter alone is not blissful. It is of course easy to measure CO<sub>2</sub> because it has a very strong absorption in the infrared region (wave number 2300-2600 cm<sup>-1</sup>). But a high CO<sub>2</sub> concentration is scientifically no evidence for high aerosol concentration (with possibly virus particles). It is very easy to cause a CO<sub>2</sub> meter to rise above 5000 ppm simply by a few glasses of sparkling water. For example, think of a class in which the children have lunch and suppose that each child opens a bottle of sparkling water. This will probably cause the CO<sub>2</sub> to rise sharply, without there being a danger for aerosols (see experiments below). More critical is the relative humidity and temperature, which determine how quickly aerosols disappear.

In some rooms there is a higher CO<sub>2</sub> concentration even with a continuously opened window (550 to 600 ppm) and without people being present (e.g., by using laser printers). This is a situation that can also be found in the marl quarries of Kanne, where up to 660 ppm CO<sub>2</sub> could be measured without the presence of humans (possibly due to a small breakdown of Ca-carbonate from the marl in the humid environment). So we can conclude that the CO<sub>2</sub> concentration is not correlated at all with the risk of Corona infection. It is of course good for health to breathe in less CO<sub>2</sub>. This higher unhealthy CO<sub>2</sub> concentration can also be found in the larger air volume under mouth masks (Kisielinski et al., 2021). Since CO<sub>2</sub> meters actually have nothing to do with the survival of aerosols, the politicians have imposed something totally useless to combat Corona on the restaurants, pubs, schools and other institutions. Only the temperature and relative humidity of the air determine how quickly aerosols possibly with Corona viruses disappear or can persist for a very long time. Tables and figures were given above from which it can be calculated under which conditions aerosols last longer.

### **Critical view on CO<sub>2</sub> meters**

A first test takes place in a rehearsal room of 73 m<sup>3</sup> in which 3 clarinetists have practiced for 2 hours. After 65 minutes, a door to a second unheated room ( $\pm 15^{\circ}\text{C}$ ) of 21.6 m<sup>3</sup> was opened (no outside door was opened to save energy). The temperature, % RH as well as the CO<sub>2</sub> (in ppm) were recorded every 5 min by an ATAL MB450 WD CO<sub>2</sub> meter. After 2 hours, the rehearsal ended and the registration persisted to a final time of 200 min.

In order to be able to plot all data in 1 graph, the CO<sub>2</sub> conc. was converted to the total amount of CO<sub>2</sub> in the room (1 ppm = 1000 ppb = 1.53 mg/m<sup>3</sup>). Figure 6 shows the measurements.

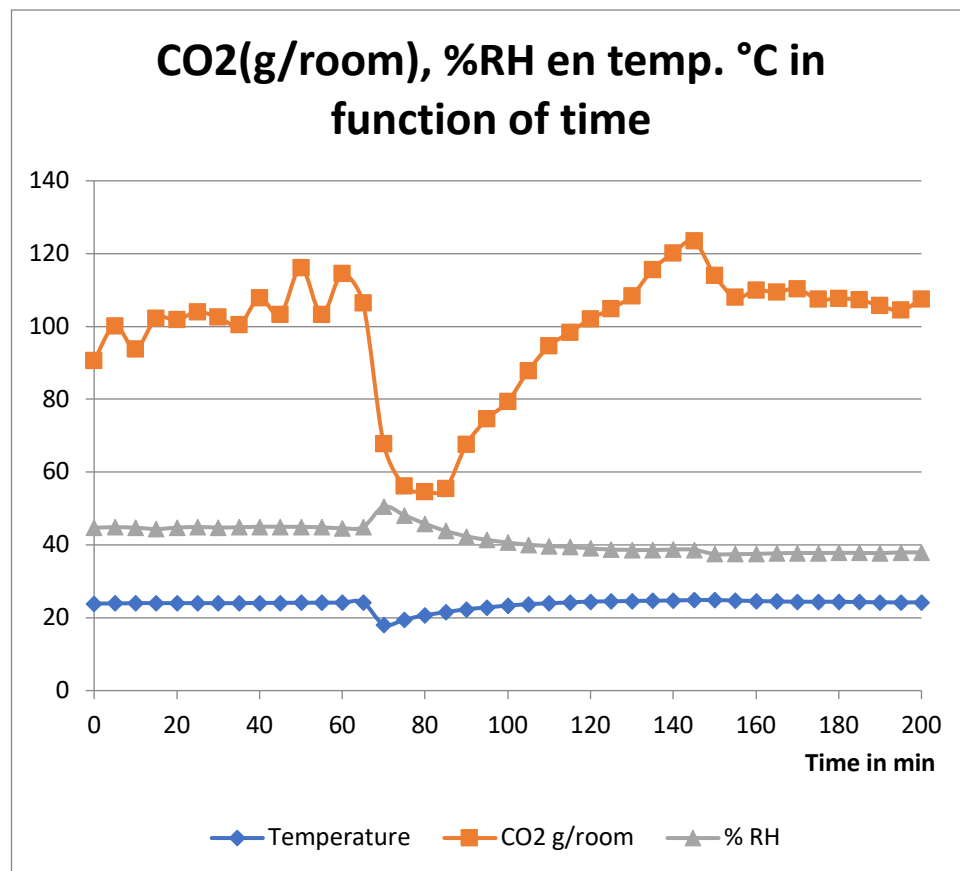


**Figure 6: Temperature in °C, % RH and total CO<sub>2</sub> (in g) in the rehearsal room.**

At the beginning of the rehearsal, the temperature fluctuated around 24 °C and the RH around 44.7 %. The total amount of CO<sub>2</sub> in the room gradually increased from 85 to 118 g. By opening the door, the temperature dropped to 18 °C to gradually climb back to 24 °C. Due to the temperature drop, the RH suddenly rose to 50.5% and then gradually decreased to 38% because the temperature was slightly higher than at the beginning of the experiment due to the extra-heating. Due to the volume increase of the room, the amount of CO<sub>2</sub> present also fell to 55 g to gradually increase again to ± 122 g. After 150 min, the rehearsal was stopped and the amount of CO<sub>2</sub> dropped slightly to ± 100 g. For each room it is important to know how much moisture can be absorbed at a certain temperature. This quantity is shown in Figure 7. At the time the door was opened, the % RH rose slightly because of the temperature drop (Figure 6). This is also immediately visible in the decrease of the capacity to absorb more moisture (decrease from 12 to 9). During the temperature drop, the concentration of moisture also decreases (due to the dilution in the larger room) and gradually the amount of moisture that can additionally be absorbed increased because the temperature increased again. What can be deduced from this is that it is very important to ventilate well so that the temperature does not drop too much, this way preserving the suction power of the atmosphere.

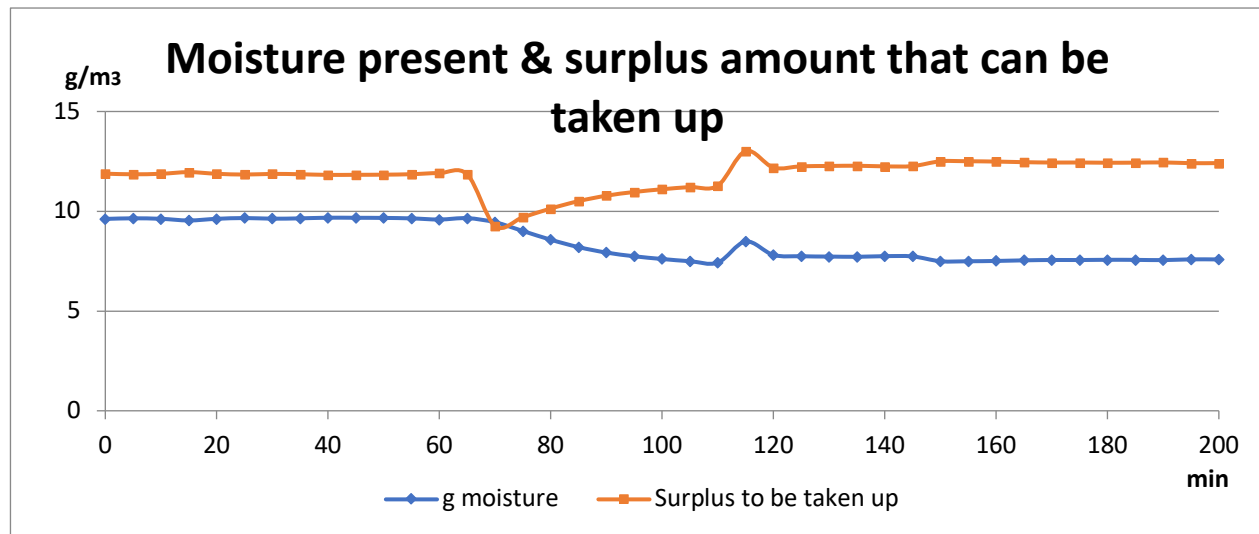


**Figure 7: Moisture present ( $\text{g}/\text{m}^3$ ) and surplus moisture that that can be included additionally ( $\text{g}/\text{m}^3$ ) during the experiment.**

### Suggestion of a useful parameter

Because  $\text{CO}_2$  is actually not correlated with the survival of aerosols with possibly viruses, we have to find a useful parameter. One proposal is to divide the relative humidity by the temperature in order to obtain a number that can serve as a guideline for ventilation. Figure 8 below shows that opening a door at 65 minutes has led to a sudden increase in that ratio from  $\pm 1.85$  to 2.8, that then gradually decreased to  $\pm 1.50$ .

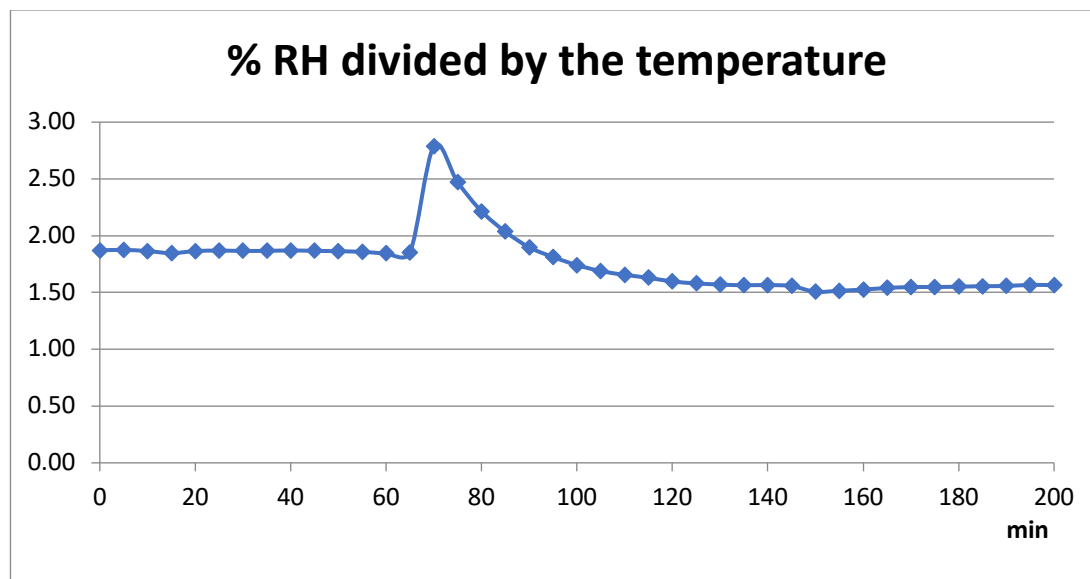


**Figure 8: % RH divided by the temperature ( $^{\circ}\text{C}$ ) in function of the duration of the rehearsal.**

From Figures 6 and 7 it can be deduced that there was never any fear for the lingering of exhaled aerosols because the suction power of the air was high enough. To further see which number can serve as a pivot to make decisions, one can also start from a theoretical point of view and look at the relative humidity at different temperatures and then divide it by the relevant temperatures in  $^{\circ}\text{C}$ . The percentages of RH used are 98, 90, 80, 70, 60 and 50 %, and

the temperatures considered are: 10, 20, 30, 40 and 50 °C. In this way, the graph can be used both indoors and outdoors. The data are plotted in Figure 9.

In Figure 9, only the values above 10 °C are plotted and it can be seen that at 80 % RH the suction power of the atmosphere is still very high to cause aerosols to evaporate (Table 2). For the sake of absolute certainty, it could then be decided here that the ratio between % RH and the temperature should not, for example, exceed an assumed value of 3.5. This implies that in a living room at 20 °C, 70 % RH could still be acceptable for the suction power of the atmosphere. However, earlier ventilation to keep the CO<sub>2</sub> concentration low is advisable. The chance that we find 70 % RH in living quarters is actually also small because 70 % RH does not feel pleasant.

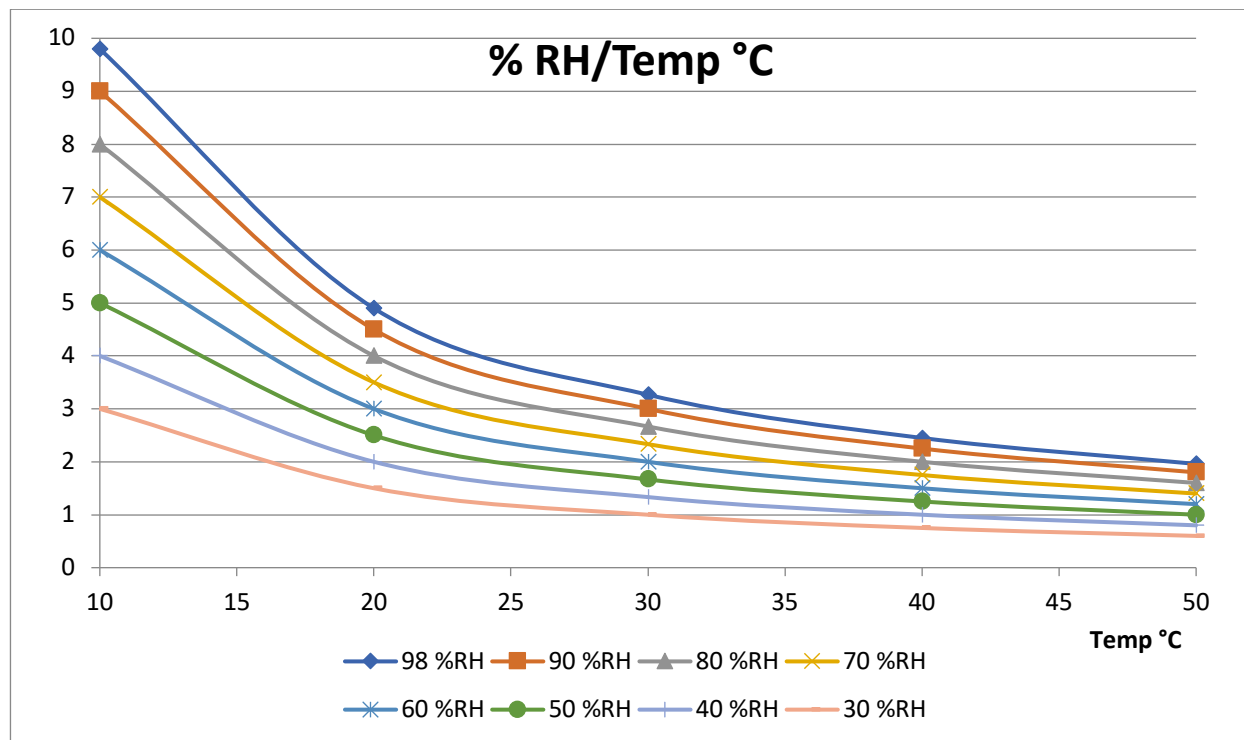


Figure 9: Ratio of % RH divided by the temperature in °C in function of the temperature.

### Additional test on the CO<sub>2</sub> measurements

During this short test, the values of ppm CO<sub>2</sub>, % RH and temperature are measured. Then 30 minutes after the start of the experiment, 2 glasses with sparkling water are placed at 10 cm in front and behind the CO<sub>2</sub> meter and removed again at 40 min. Thus, exposure period to sparkling water was only 10 min (Figure 10).

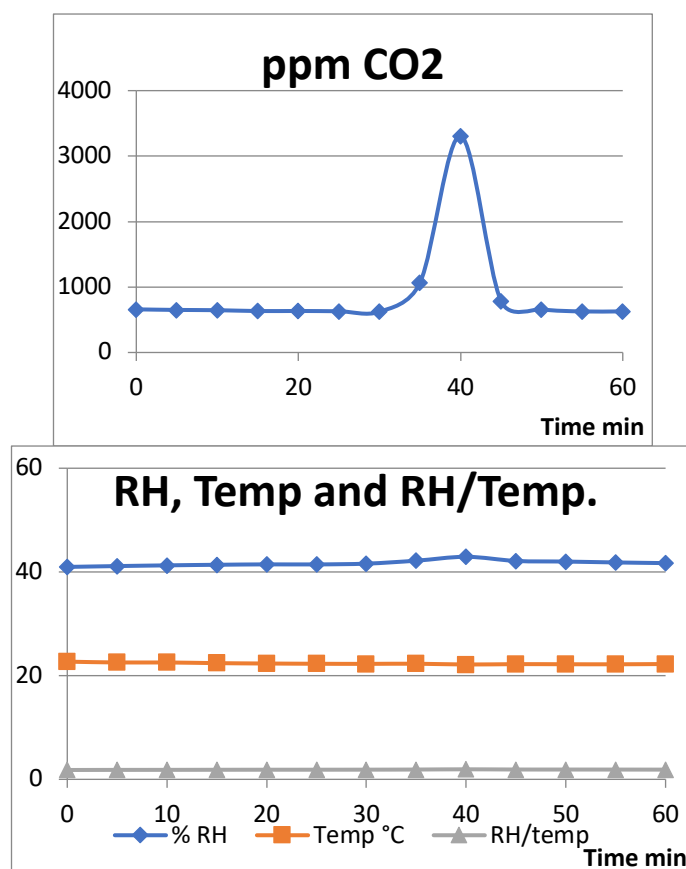


**Figure 10: ppm CO<sub>2</sub>**  
**Figure 11: % RH, Temp. °C, en % RH/temp**

The amount of CO<sub>2</sub> rises rapidly to above 3000 ppm (Figure 10). The temperature and the ratio of % RH/°C did not change much (Figure 12). The experiment clearly shows that CO<sub>2</sub> concentration is not correlated with these parameters.

The effect of high relative humidity and low temperature can be observed in a marl quarry of, e.g., Kanne (Limburg, Belgium). There the temperature is constant between 10 and 12 °C and the RH is 98 %. In these circumstances, aerosols with virus can survive for a long time and only a surplus of 0.19 g/m<sup>3</sup> of water vapour can be absorbed (Table 2). We wanted to check these values ourselves on 24/11/2021 with a portable Hama CO<sub>2</sub> meter that could also measure the temperature and % RH. The meter was attached to a string of 1 m length and the temperature indicated values of 10, 11 and sometimes 12 °C. The % RH was between 90 and 95, but this simple meter could not measure beyond 95 % (error 5 %). The CO<sub>2</sub> ranged from 420 ppm at the entrance (10 °C) to 660 ppm inside, which is significantly higher than the values outside. What can be learned from these simple observations is that the CO<sub>2</sub> content was not correlated with the number of people in the quarry, but probably due to an influence of high humidity on the calcium carbonate rock. More importantly, this is an easily accessible system in which aerosols practically do not disappear because of the very low suction power in the air with high relative humidity and low temperature. Moreover, in the quarry only 0.19 g of surplus water vapor per m<sup>3</sup> can be absorbed (Table 2). Under these circumstances, one can expect that the Corona virus can survive for a very long time period in the aerosols,

because practically all exhaled air lingers and surgical mouth masks probably will not reduce the spread of the virus. Figure 9 also shows that in the marl quarries of Kanne (10 – 12 °C and 98 % RH) with a CO<sub>2</sub> of 660 ppm measured, it is actually never safe because the aerosols can last for a long time, even though the CO<sub>2</sub> is only 660 ppm. This is further proof of the uselessness of CO<sub>2</sub> measurements to prevent Corona infections. The quarry might be a good place for some experiments with viruses.

### CONCLUSIONS RELATED TO CORONA

What does the above mean in concrete terms in relation to Corona? The air we exhale at warm or cold temperatures is  $\pm$  equal because our body temperature is kept constant. At warm temperatures (e.g., 30 °C), the suction power of the air is so great that the exhaled aerosols immediately evaporate and the exhaled air is not visible. On the other hand, air exhaled at -10 °C is clearly visible because the suction power of the air is much smaller at that temperature (33 versus 433 bar, Table 1). After a while, the suction power of the air will also cause the aerosols to evaporate at -10 °C. Walking around outside at -10 °C and keeping enough distance, there is also no problem with viruses in aerosols. However, sitting inside at low temperatures, the air will quickly become saturated with aerosols that may contain Corona and then there is a problem (read: if the ratio between the % RH/°C becomes large, e.g., greater than 3.5). Surgical masks can not actually solve the problem here and regularly ventilating in a good way is the message. Don't let the room cool down too much! Walking outside in freezing temperatures, the exhaled air with possibly aerosols is visible escaping through the openings along the mouth mask and possibly condensing on your lenses. Breathing in, even with a surgical mouth mask on, those aerosols will be sucked up through the openings along the mouth mask if coming too close to other people. So it seems obvious that mouth masks, which might be contaminated in almost 100 % of the cases, only offer a false safety feeling.

#### “Collateral damage”

Certain articles also indicate that there is no positive scientific evidence that surgical masks do anything to slow down Corona (Kisielinski et al., 2021). They also refer to literature that indicates that wearing surgical masks even contributes to the spread of Corona because more fine aerosols are created by breathing and/or coughing through the masks. Now the circle is complete: from purely physico-chemical considerations it was already possible to deduce that the wearing of masks, due to the false safety feeling, rather seemed to prolong the Corona pandemic, and this is now clearly supported by the additional fact that more aerosols are emitted so that the Corona virus can spread better.

As a result of wearing masks for a long time, various side effects also occur such as increased breathing resistance, with less oxygen saturation and higher CO<sub>2</sub> in the blood, shortness of breath, accelerated heart and breathing rhythm, headache, drowsiness and feelings of exhaustion, feelings of clamminess and overheating, itching, acne and skin lesions, which we will not go into further. Especially children and pregnant women (including fetuses) appear to be very sensitive to this. Think of the fact that diffusion of CO<sub>2</sub> also proceeds exponentially and if the mother has higher CO<sub>2</sub> concentrations in the blood, the diffusion gradient between fetus and mother is much smaller, making it more difficult for the fetus to release its CO<sub>2</sub>!

The recent study by Delanghe et al. (2021) also indicates that face masks give rise to a number of harmful bacteria and about 43% of the selected colonies were resistant to at least 1 of the 2 antibiotics tested, which in the long term can probably also result in more deaths. This, of course, also sheds a completely different light on non-sterile masks imposed on the well-behaved citizen.

Already in ancient times some myths were widespread such as that the earth was flat and the sun revolved around the earth. That myth was hammered in with a hard hand and has cost many scientists the head who showed that the earth revolved around the sun and not vice versa.

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