

# The Physics of 'Transmission' of Corona Virus

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**Abstract:** Beginning with "What the Virus is?" How it is spread and transmitted through a medium such as air and in conformance with the title, the 'Physics' of spread of the virus is extensively explained by means diagrams and illustrations exclusively prepared by author.

**Key Words:** Compression (Condensation), Corona Virus, Rarefaction, Longitudinal Waves, Transverse Waves, Waves, Velocity of Sound

## Philosophy:

*"To the Mathematician the problem of Wave Motion offer a field for his highest power of analysis; to the physicist they suggest experiments demanding all the skill at his disposal; to the engineer and to those who go down to the sea in ships these problems are matters of life and death, while to the poet and the artist they are the sea dancing to its own music" "*

----- Henry Crew, 1930

**Henry Crew (1859-1953) was an American physicist attended High School In Wilmington, Ohio, then matriculated to Princeton University in 1878**



**Henry Crew (1859-1953)**

(The above philosophy appeared as an Epilogue in "Physics, The Pioneer Science, Vol.I, By Lloyd William Taylor, DoverPublications, 1959, The Nature of Sound, Ch.24, p.327.)

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## **I. THE PREAMBLE**



Ladies and Gentlemen!

The Corona Virus and its transmission is not known to the members of general public. Common man with his many false assumptions puts it in different ways. The Virus, according to World Health Organization (WHO) originated from Wuhan, China and started spreading haphazardly to many parts of the world. The false belief is that the sinners are more affected than the God-fearing savants. Religious people including some Godmen took the Virus as something divine and heavenly having magical powers and strike the entire population. In some remote villages in India an idol imagined to be the virus is worshipped and prayed for the safety of mankind.

Any spread of news regarding this goes exponential and as on today the truth is unknown as the population is falsely equipped with many ‘Cock and Bull’ stories.

As a research physicist, I felt that the general public should be made to understand the Science (particularly the Physics) behind the transmission.

Hence, I present this paper for the readers.

## **II. INTRODUCTION**

### **2.1 What are coronaviruses?**

Coronaviruses are a large family of viruses that cause illness ranging from the common cold to more severe diseases such as Pneumonia, Middle East Respiratory Syndrome and Severe Acute Respiratory Syndrome. 2019-nCoV is a new strain that has not been previously identified in humans and causes COVID19/coronavirus disease. (News of **16-Jan-2020**)

### **2.2 What are the possible modes of transmission of COVID-19?**

Transmission of SARS-CoV-2 can occur through direct, indirect, or close contact with infected people through infected secretions such as saliva and respiratory secretions or their respiratory droplets, which are expelled when an infected person coughs, sneezes, talks or sings.

## **III. WAVES**

### **3.0 Corona Virus transmitted in the form of Waves**

**3.1 What is a ‘Wave?’** In simple language, ‘wave’ is a disturbance (created by whatever means) that travels through a medium. From the language of Physics, ‘wave’ is a ‘to’ and ‘fro’ motion of a body about its mean position of rest and we call such motion, Simple Harmonic Motion (SHM). Waves created on the surface of water just by putting a pebble anywhere on the surface, motion of pendulum of a clock are few examples.



**3.2 Types of Waves:** In the realm of Physics, there are many types of waves such as ‘electromagnetic waves’, ‘stationary waves’, ‘standing waves’, Progressive waves and so on. In our present treatment, we need to consider only two types of waves and finally stick on to one of them.

The two waves we have to just deal with are 1. Transverse Waves and 2, Longitudinal or Compressional Waves

**3.2.1 Transverse Waves:** From the point of view of Physics, a Transverse wave is one in which the direction of vibration of particle taking place at right angles to the direction wave In Fig.1 is shown an illustration of a Transverse Wave.

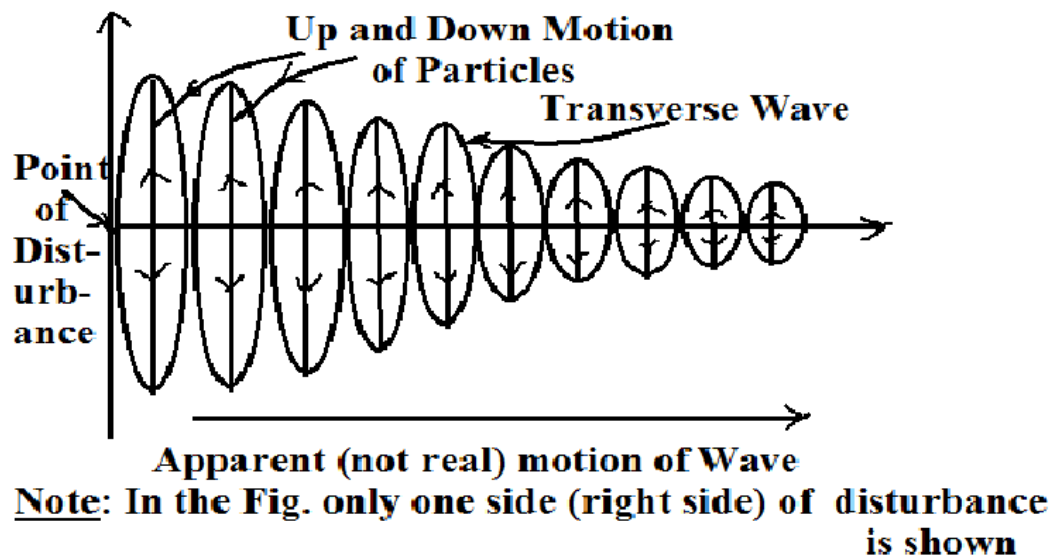


Fig1. Illustration of a Transverse Wave

In this wave we shall notice that each particle moves up and down and there is no bodily displacement of particles, even though there is an apparent motion. In the figure is shown the point of disturbance such as dropping a pebble in still water and the resulting motion of the wave. As a proof for each particle moving up and down, one may float a piece of cork in the water and it will be noticed that the cork moves up and down and there is no bodily displacement. To make matters simple, in the diagram, only one part (the right side) of the disturbance is shown.

**3.2.2 Transverse Waves are not useful for transmission:** This type of wave is not useful for transmission except that the cluster of virus move up and down in their own positions. But, there is some 10% chance that there can be some transmission localized in the neighborhood and hence we cannot ignore this type of waves.

**3.2.3 The cluster of Virus lingering around:** In Fig.2 is shown a large number of cluster of virus lingering around and waiting for transmission.

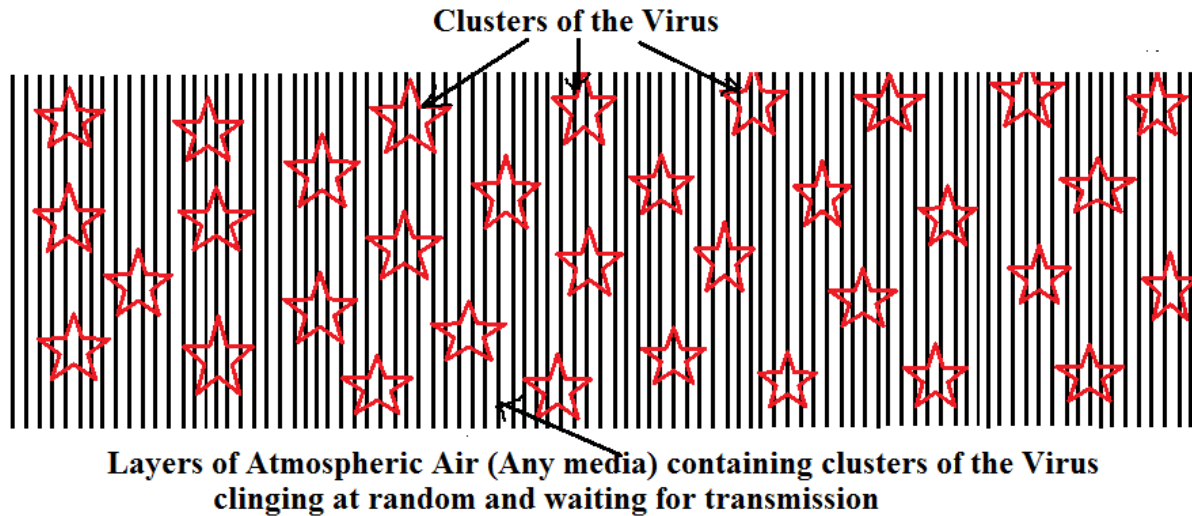


Fig.2 Layers of atmospheric air or any media containing clusters of the Virus clinging at random eagerly waiting for transmission

**3.3 Longitudinal or Compressional Waves:** In Fig.3 is shown layers of atmospheric air equally distributed (Of course with the cluster of virus clinging as shown in Fig.2)

Now, for a wave to get activated, there has to be ‘Motion’ as per Newton’s law. The motion can be created by blow of wind (Main cause). It can also be created by temperature variations in the medium. Let us assume that a disturbance is created on the left side of the layers of air in Fig.3. The situation after the disturbance is as shown in Fig.4. As the disturbance has happened on the left, the disturbance is carried towards the right. As is well known that a blow of wind on the left will keep the disturbance move towards the right.

Now, we come to the Physics part of the problem. The air layers near the disturbance come near and get compressed as shown in the Fig.4 as ‘Compression’, also called ‘Condensation’. This compression moves forward from left to right in the direction of wind. By the time this has happened, the disturbance (assumed to be periodic) sucks in air in the neighborhood creating a vacuum or Rarefaction. By the time this has happened, the previous compression has travelled some more distance on the right. The formations of compression and rarefaction are periodic and follows systematically one after the other as shown in Fi.4. Sound travels in the form of such a wave. An obvious definition from the point of Physics is that this wave is such that the direction of motion of the wave is in the same direction as the direction of motion of particles.

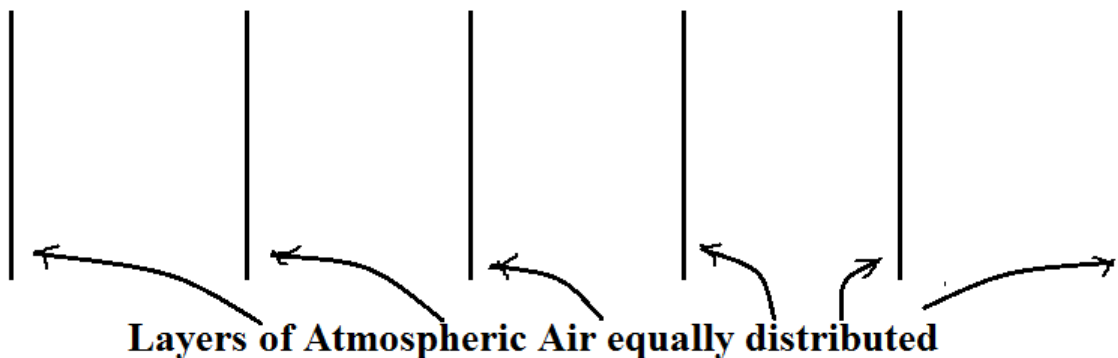


Fig.3 Few layers of atmospheric air distributed equally or at random

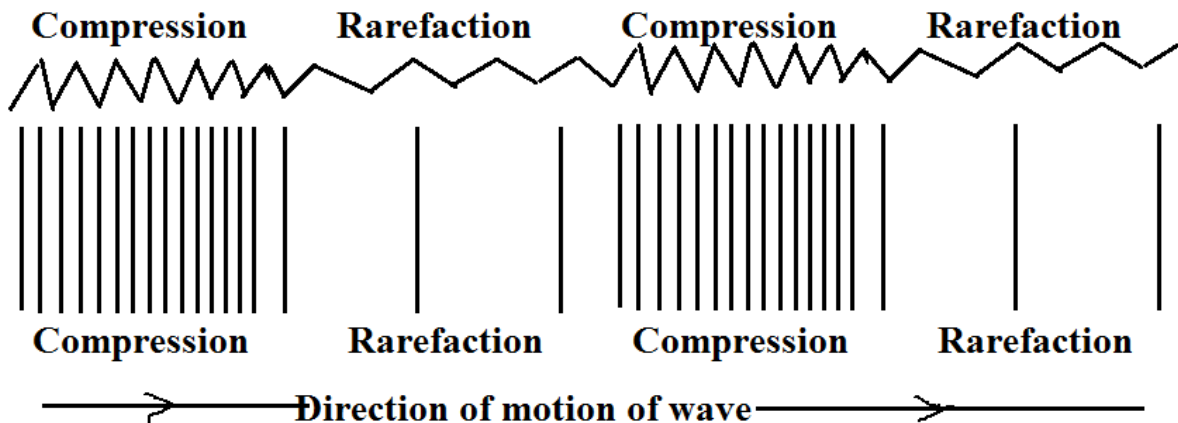


Fig.4 Formation of a Longitudinal Wave

**3.3.1 Most dangerous Wave:** From the point of view of the transmission of the virus, longitudinal wave is the most important and dangerous one. It is the compression most dangerous zone in a medium of corona virus as the virus clings and remain in the region of compression. My estimate for the virus in a region of Rarefaction is, say 10% then the estimate for the cluster of virus for a compression is more than 90%.

In the top of Fig.4 is shown the compression and rarefaction as compressed and stretched spring respectively. The wave travels with the speed of Sound (330 m/s). This means that during a time gap of 1 minute (60 seconds), the wave (either a compression or rarefaction) reaches 19800 meters or roughly 20 km. When the wave moves in the direction of wind, the distance covered may be little more.

In a local train or in a crowded bus, there will be more than 90% chance that one may encounter with a compression having concentration of the virus. Further, as the compression and rarefaction are equal in number in a region of space, there is more than 50% chance that any person can be imprisoned in a compression.

**3.3.2 Waves invisible:** These waves are not visible, but they are very much there. It is the laws of Physics which make them real. There are mathematical equations for each wave whether it is transverse or longitudinal. In fact, Mathematics is the language of Physics and I purposely avoided any Mathematics as the paper is meant for a common man's understanding.

3.3.3 In Fig.5 is shown a person getting scared of looking at the compression

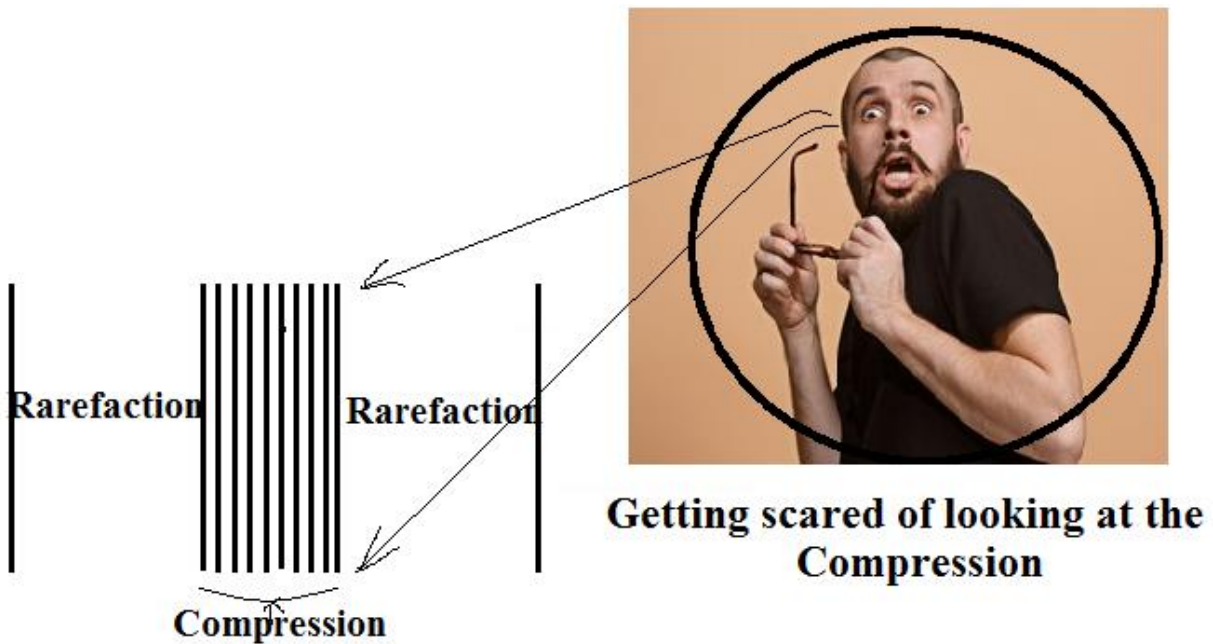


Fig.5 Getting scared of looking at the Compression

In Fig.6 is shown the population (general public) getting scared of the longitudinal wave specially the Compression

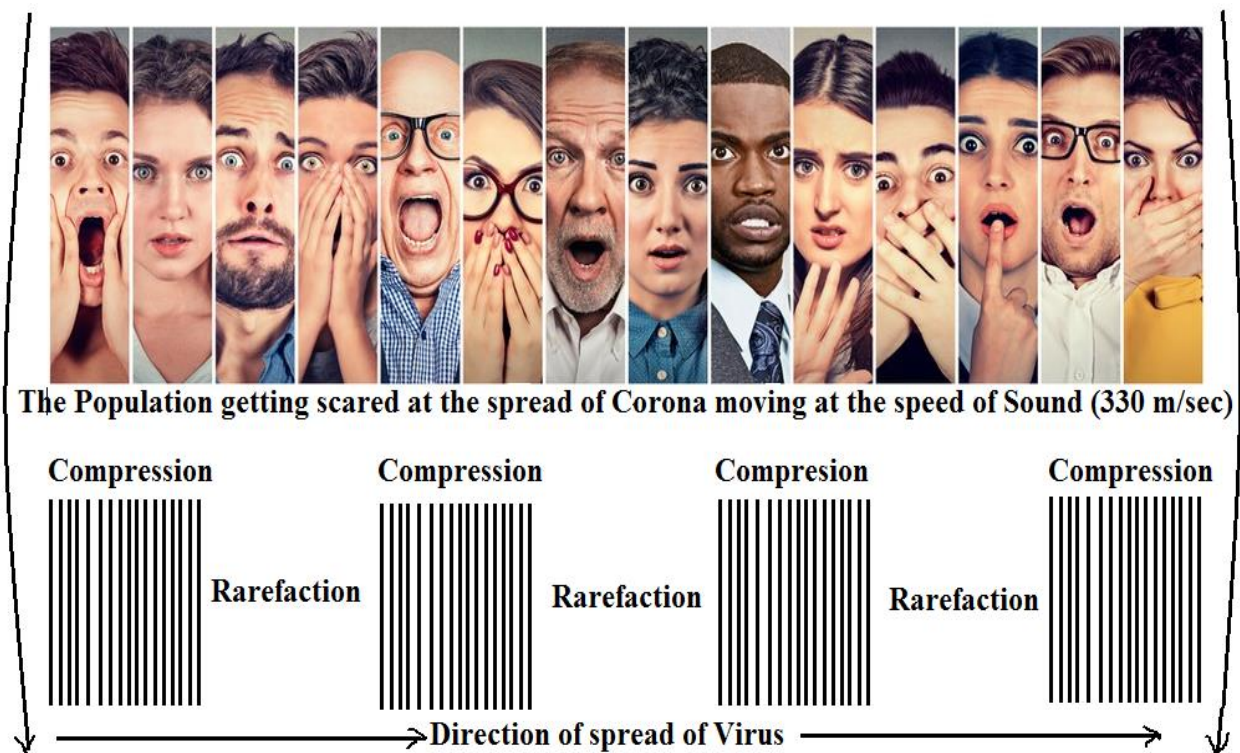


Fig.6 Illustration of members of public looking at and getting scared of the wave

#### IV. THE SECOND WAVE

**4. What is a Second Wave?** Second wave is similar to the first one, may be of the same intensity as the first one or may be of less intensity. It all depends on the blow of wind

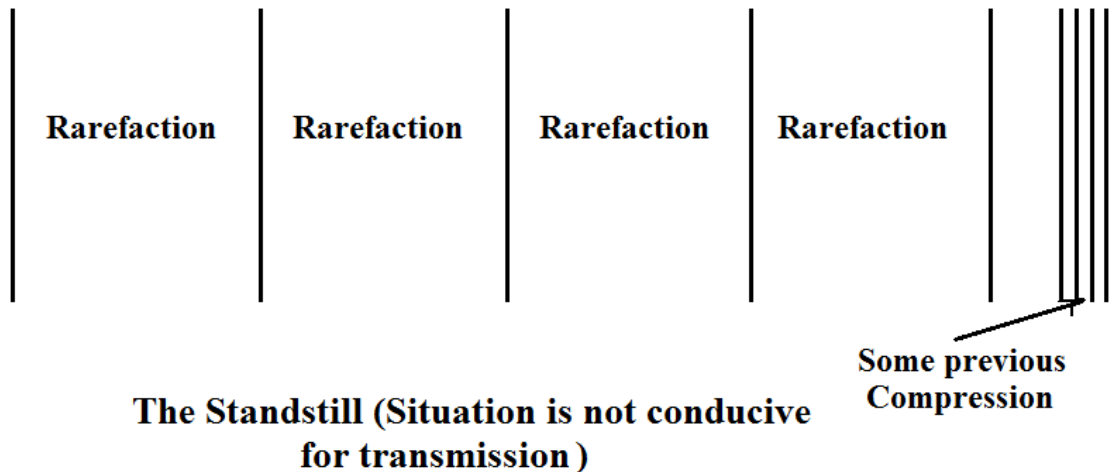


Fig.7 Illustration of a “Stand-Still” situation

accelerating the velocity of sound. After an unusual lull depending upon the atmospheric conditions and other climatic changes, it may so happen that the viruses are not active and the entire situation is almost standstill as shown in Fig.7. It is a favorable situation no doubt, but sudden atmospheric conditions favor a second wave. It is not that the second wave might come exactly after 1 year. It can come even earlier, say after a month or two of the first wave. There can be multiple second waves. What we are experiencing today after the arrival of Corona in February/March 2020 are multiple waves. Whether multiple or single, also depends on the place or locality in a state. For example, if the situation is mild in a city like Mumbai, Maharashtra, the situation is more precarious in the district of Pune also in Maharashtra.

#### V PROTECTION

**5. Precautions and Prevention:** Prevention can be attained only by taking certain precautions mentioned below:

**5.1 Wearing a Mask:** It is a precautionary method suggested by the World body, WHO and followed by the entire population of the world. I will not discuss anything about the material and quality of a mask except the right method of wearing it. In the Fig.8 is shown the right and wrong way of wearing a mask.

Wearing a mask is not fully safe. My rough assessment is that if 100 people wear mask properly, some 30 of them may be safe from the infection. This is because due to the size of bacteria. As bacteria is extremely small, we do not talk of its length and breadth. We shall use the word, ‘size’. The size of bacteria lies between 0.5 to 5 micron (Ref: Google search).



Fig.8 The wrong and right way of wearing a mask

1 micron means, 1 micro meter =  $10^{-6}$  meter. Now, coming to the size of pores in a standard mask is much larger. It can be even 2 micrometer or coming to a large size, it can be of 10 micrometer =  $10^{-5}$ m. This means some 10 bacteria can easily enter through the pores of a standard mask. Wearing a mask has some psychological feeling that there is some 'protection'. The people of the world wear it with that feeling.

### 5.2 Keeping safe distance: Keep safe distance as shown in Fig.9

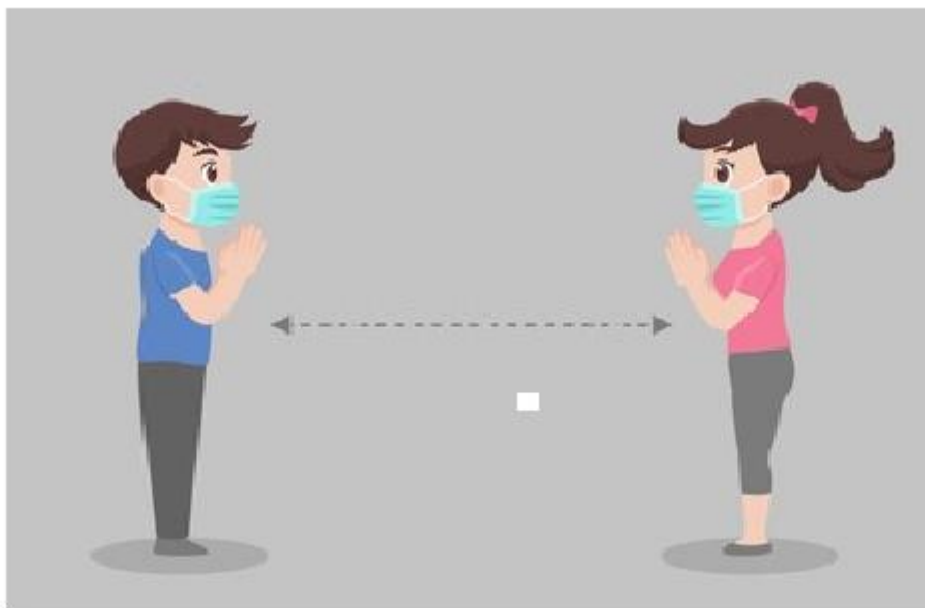


Fig.9 Keep safe distance of at least 1 meter (> 3 feet) between individuals



**5.3 Avoid items shown in Fig.10** Regarding the last item, ‘Crowd’ in Fig.10, I would like to give more information. Crowd is everywhere, especially in large cities such as Mumbai and Delhi in India. One should avoid crowded places. Do not enter any crowded place. As a picture speaks 1000 words, I have shown both real and caricature of a person trying to avoid crowded places. As shown in Figs. 11 and 12



Fig. 10 Things to be avoided

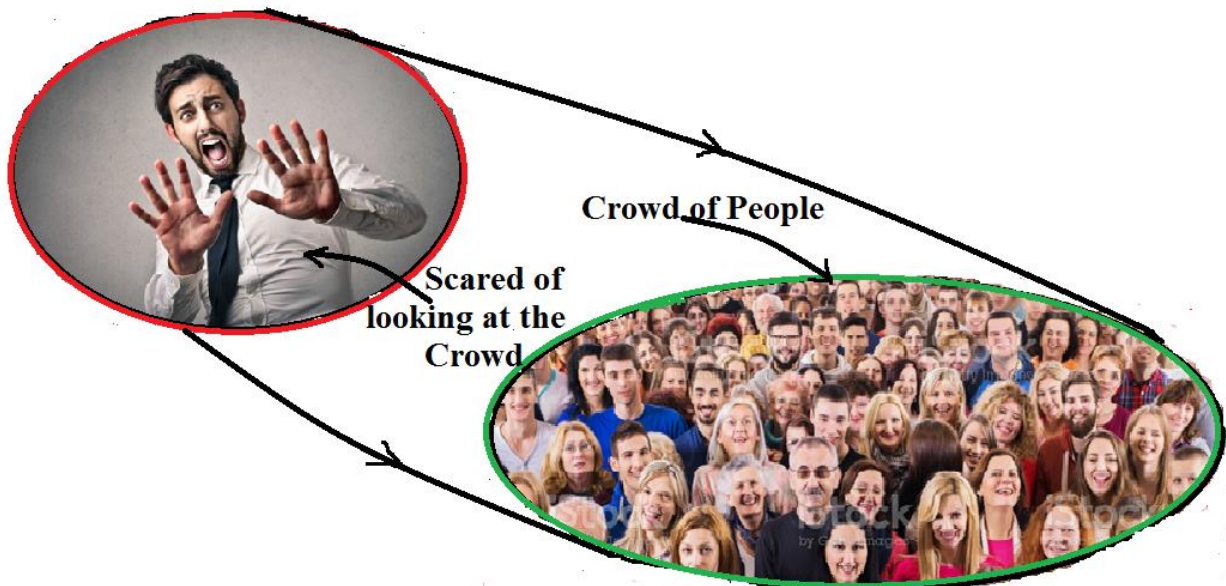


Fig.11

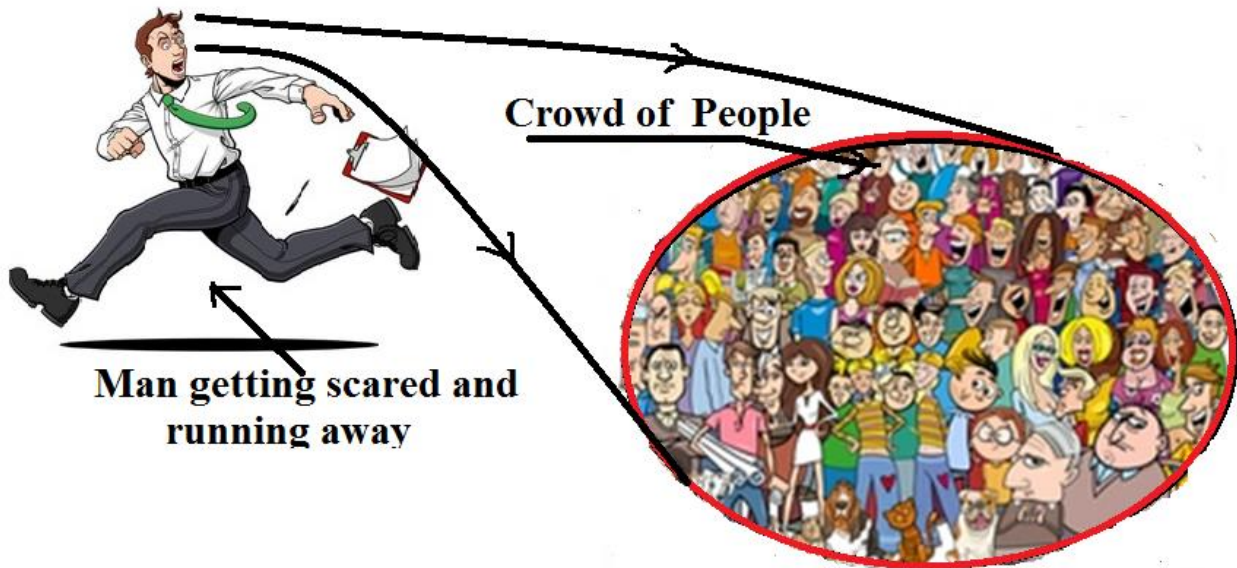


Fig. 12

**5.4 Staying indoors in closed Rooms:** In the picture on the left a man is seated in a closed room. There is no chance for any blow of wind to enter. Provide some ventilation for oxygen to enter. This is absolutely safe. No compression of the deadly wave can enter.

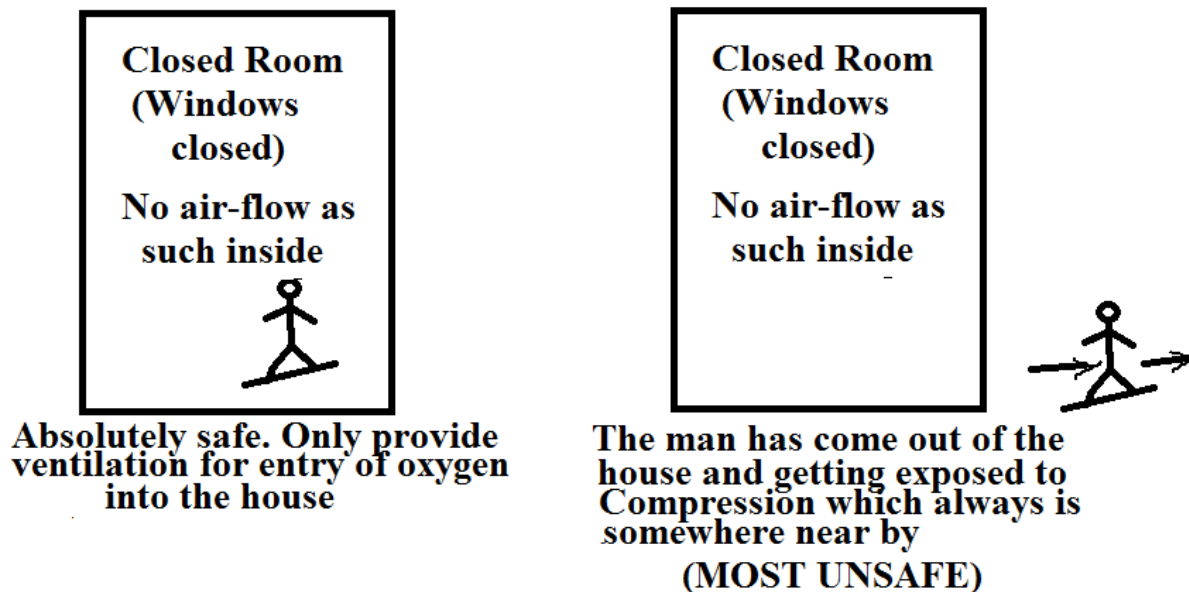


Fig.13 Stayng indoors in closed rooms with proper ventilation

In the picture on the right, the man has just come out of the closed room thereby getting himself exposed to atmospheric air and, of course, some compression with the clinging deadly virus. Now-a-days people insist on cross ventilation and ventilation in each room of the house. Corona spreading is more in ventilated rooms..

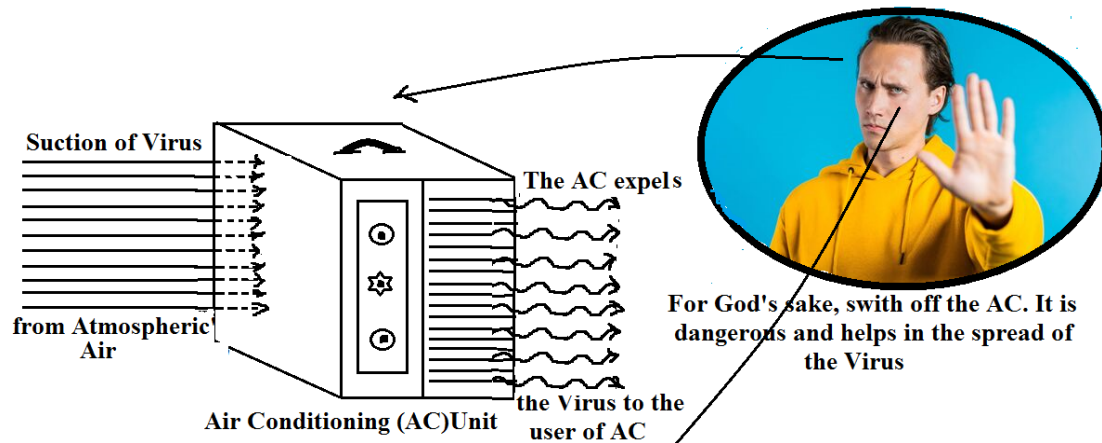


Fig.14 Use of Air Conditioners (AC)

**5.5 Use of Air Conditioners (AC):** In tropical countries, summer is very hot. I have now brought an idea of closed rooms with ventilation. Many people come forward with the use of Air Conditioners (AC). It is not safe as explained in Fig.14. As there is a suction of the virus through AC, local governments in some countries have instructed to avoid use of AC's in their offices and establishments.

## VI A POEM ON CORONA VIRUS

6. I had prepared a Poem on the deadly virus and the same has been published in some of my earlier papers. I reproduce the same here. The Poem is not in proper rhyme and rhythm. But, they are some meaningful statements pertaining to the present political situation.

### 6.1 The Poem:

**Coronavirus, the terrible unwanted incarnation on Earth**

**Following is a Poem on Coronavirus written by an Indian Physicist**



- I am Coronavirus
- I shall not come to you if you don't get afraid of me
- But, if you get afraid of me, I shall search for you
- This is what the people do
- People get afraid of me at alarming levels
- That is why I am after them
- Do not allow me to search for you
- Allow me to stay where I am supposed to
- Try to be a Physicist following Newton's Laws
- Your Reaction was not equal and opposite
- It surpassed my Action with some of your Reaction lingering around
- This lingering Reaction created by you affects your health and normal life
- To contain me, you have to find a Black Body and follow Quantum Theory



- **Call either Planck, Heisenberg or Schrodinger or all of them to contain me in the Black Body**
- **Well ! If you succeed, I shall remain a part of radiation from the Black Body with Einstein looking at his famous equation,  $E = mc^2$**
- **Your excess Reaction still lingers near me and created all the problem**
- **I still have not entered the Black Body because you are wrong at the very base of Newton's Laws exceeding your Reaction more than my Action**
- **I travel faster with the rotation of Earth which is some 1000 miles per hour**
- **I shall give a solution to your problem**
- **Maintain "Status quo" and try to reduce your Reaction and bring the same at level with my Action**
- **I shall then enter the Black Body and be a part of Radiation as before**

**Prepared by****\*Dr.(Prof.) V.C.A. NAIR, Ph.D****Date: 22 March 2020 coinciding  
with the Birth date, 22  
March 1868 of  
Prof. R.A. Millikan, the great**

**A Research Guide in Physics from Mumbai, American Physicist and 1923 Nobel  
Age: 81 and a native of Palakad, Kerala, India. Laureate in Physics**

**\*nairvca39@gmail.com****REFERENCES**

This paper is written freehand without referring and reviewing any published articles or literature. The memory of the author during his undergraduate studies (year 1961-1962) in the University of Mumbai, India helped in shaping the paper. However, to keep in line with Research Methodology, I would like to give two classical books for reference. They are:

1. John William Strutt, 3<sup>rd</sup> Baron Rayleigh, "Theory of Sound" originally published in 1877.  
---"An outstanding treatise", Review of Scientific Instruments astonishing how this treatise still retains a place of prominence in modern acoustical literature" – Google Books

2. E.G. Richardson, "Sound" a Physical Text Book, first published 1935, Edward Arnold (285 p)

**BIOGRAPHY**

**\*Dr.(Prof.) V.C.A. Nair** (b.15th Aug. 1939) is an Educational Physicist, Counselor, Research Guide and Consultant. He did his Masters in Physics from Mumbai University, India and Ph.D. from JJT University, Rajasthan also in India He is a Research Guide and distinguished alumni of JJT University. He is also a Chancellor designated Resource Person in the area of Physics in the University. He has to his credit over 4 decades of teaching Applied Physics in eminent Polytechnics under the Department of Technical Education, Government of Maharashtra, Mumbai, India.. He has the credit of having taught Applied Physics to nearly 16,000 students since 1965. He has published nearly 30 research papers in Physics, Geophysics Philosophy of Physics in International and UGC recognized Journals some of which can be seen in the net 'Google Search' when the name of the author or his e-mail is typed in that style. He is a Life Member of Indian Society for Technical Education which is an all India body. He had been to USA a number of times and visited eminent Universities such as Stanford, Harvard, MIT, 3 Universities of California at Berkeley, Los Angeles and also at Davis ,University of Princeton at New Jersey, University of Chicago , Roosevelt University at Chicago and University of San Francisco. At present Dr. Nair is a Research Guide for Physics at Shri JJT University, Rajasthan-333001, India and having successfully guided 3 Research Scholars leading to their Ph.D Degrees He is member of the Editorial Board of this Journal. His Ph.D. Thesis is in Geophysics and he is working on topics such as Tides, Clouds, Global Warming and Climate Change. –  
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