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Classification of Countries by SARS-CoV-2 Infectivity and Virulence: Environmental Associations with Temperature, Humidity, and Radiation

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Abstract. SARS-COV-2 Infection and Virulence are now planetary occurrences that cause severe debilitating diseases in millions and death in the hundreds of thousands (still counting). Approaches to control SARS-COV-2 Infection and Virulence include the development of prophylactics and vaccines. However, it is clear that there will be no cure for the diseases that are caused by SARS-COV-2 in the near future and a vaccine for the control of SARS-COV-2 Infection and Virulence will also not be available in the near future. In the meantime, deaths of individuals infected with SARS-COV-2 must be prevented by any means and at all cost. Currently, the only effective means of control for SARS-COV-2 is through restriction of population movement and contact which are accompanied by devastating economic losses amounting to several trillions of dollars (still counting). It was recently shown that SARS-COV-2 Infection and Virulence have reverse correlations with Temperature, Humidity and Far Infrared Irradiation. Here, it is shown that IP 10000 for SARS-COV-2, a measure of Infection and DP 10000, a measure of Virulence are not uniform in different populations and locations and that countries can be classified into 7 Groups by their IP 10000 and DP 10000 Numbers, and associated Temperature, Humidity and Far Infrared Irradiation. Group A countries, all located in Asia Pacific regions are associated with high Temperature, high Humidity and high Far Infrared Irradiation, and low IP 10000 and DP 10000. Group B countries, which are located within the perimeter of the Baltic sea are associated with low Temperature and low Far Infrared Irradiation but high Humidity, and intermediate IP 10000 and DP 10000. Group C countries, all located in middle and southern Europe are associated with low Temperature, low Humidity and low Far Infrared Irradiation, and high IP 10000 and DP 10000. Group D countries all located in the Middle East are associated with high Temperature and high

Far Infrared Irradiation but low Humidity, and intermediate IP 10000 and DP 10000. Group E countries, all local in the African continent and surrounding areas are associated with high Temperature, high Far Infrared Irradiation and relatively high humidity, and intermediate IP 10000 and DP 1000. Group F countries, all located in the North American continent are associated with low Temperature, low Humidity and relatively low Far Infrared Irradiation, and relatively high IP 10000 and relatively high DP 10000. Group G countries, all South American countries have moderately high Temperature, relatively low Humidity and high Far Infrared Radiation are associated with relatively high IP 10000 and relatively high DP 10000. It is submitted that high Temperature, high Humidity and high Far Infrared Irradiation will lower the Viability, Infectivity and Virulence of SARS-COV-2. It is further submitted that treatment of patients infected with SARS-COV-2 in an environment of high Temperature, Humidity and Far Infrared Irradiation will enhance recovery and prevent death of patients infected with SARS-COV-2. A Treatment Protocol that can save countless lives and trillions of dollars exists already and can be implemented in a relative short time.

Introduction.

SARS-COV-2 is the etiologic agent of COVID-19, the disease(s) [1-4] that is/are causing havoc around the world and sufferings, and claiming hundreds of thousands of lives, and costing trillions of dollars in economic damage. There is currently no cure for diseases that are caused by SARS-COV-2 nor is there a vaccine to combat SARS-COV-2 infection and virulence. There is no correlation between Infectivity and Virulence of SARS-COV-2 [5]. This can be explained partly by the biochemistry (or molecular biology) of SARS-COV-2. There is some evidence that SARS-COV-2 strains have different mutations that affect the biochemistry (or molecular biology) of SARS-COV-2 [6-8]. Many viruses that infect humans and cause diseases and deaths in humans are latent viruses that can be induced by environmental factors, including Temperature, Humidity and Radiation. The Viability, Infectivity and Virulence of viruses that infect humans and cause diseases and deaths in humans are also highly dependent upon Temperature, Humidity and Radiation [9-23].

The Infectivity and Virulence of SARS-COV-2 are not uniform in different population and locations [5,24]. It was recently shown that there are reverse correlations between IP 10000, a measure of Infectivity and DP 10000, a measure of Virulence of SARS-COV-2, and Temperature, Humidity and Far Infrared Irradiation [24]. It was also shown that (i) Group A countries, all located in Asia-Pacific region, including Singapore, Malaysia, Thailand, Hong Kong, Taiwan, Australia, New Zealand, Bangladesh, India, Philippines, Indonesia and Sri Lanka are associated with high Humidity, high Far Infrared Irradiation during the months of December 2019, January 2020, February 2020, March 2020 and April 2020, and low IP 10000 (Infectivity) and low DP 10000 (Virulence), (ii) Group B countries, all located within the perimeter of the Baltic sea, including Finland, Russia, Norway, Denmark, Estonia, Latvia, Lithuania, Germany and Poland are associated with low temperature and low Far Infrared Irradiation but high Humidity, and relatively low IP 10000 (Infectivity) and relatively low DP 10000 (Virulence), and (iii) Group C countries all located in upper and lower Europe, including Netherlands, Belgium, France, Italy, Spain, Sweden and United Kingdom, are associated with low Temperature, relatively low Humidity and low Far Infrared Irradiation, and high IP 10000 (Infectivity) and very high DP 10000 (Virulence) [24,25]. It was argued that Germany, a Group B country had relatively low IP 10000 (Infectivity) and relatively low DP 10000 (Virulence) of SARS-COV-2 in part because of the high Humidity that negated the effects of low Temperature and low Far Infrared Radiation and partly because of its response strategy consisting of testing, isolating and treating individuals infected with SARS-COV-2 at an early stage, and control of population movement and contact, also at an early stage whereas United Kingdom a Group C countries had high IP (10000) Infectivity) and very high DP 10000 (Virulence) for SARS-COV-2 partly because of the low Temperature, low Humidity and low Far Infrared Irradiation that it experienced during the months of December 2019, January 2020, February 2020, March 2020 and April 2020, and partly because of its faulty response strategy that consisted of relying on the concept of "Herd Immunity" which involves not interfering with SARS-COV-2 infection among its population

with the mistaken assumption that those who are infected with SARS-COV-2 and became immune to it would protect those who are not immune to SARS-COV-2. That was a mistaken assumption because "Herd Immunity" can only work if there is a vaccine in the first place. Without a vaccine, "Herd Immunity" can only be achieved after a large proportion of the population has been infected with SARS-COV-2 with the accompanying sufferings and deaths [25,26].

In this study, we asked whether countries other than Group A countries, Gorup B countries and Group C countries can also be classified within Groups based on their associated Temperature, Humidity and Far Infrared Irradiation, and IP 10000 (Infectivity) and DP 10000 (Virulence). The results of this study show that these countries can be grouped under (i) Group D if they are associated with very high Temperature, very high Humidity and very high Far Infrared Irradiation (ii) Group E if they are associated with moderately high Temperature, relatively low Humidity but high Far Infrared Irradiation, (iii) Group F if they are associated with low Temperature, relatively low Humidity and moderately high Far Infrared Irradiation, and (iv) Group G if they are associately with relatively low Temperature, relatively low Humidity but high Far Infrared Radiation. The results of this study also show that (i) Group D countries have low IP 10000 and DP 10000, (ii) Group E countries have relatively high IP 10000 and relatively low DP 10000, (iii) Group F countries have relatively high IP 10000 and relatively high DP 10000, and (iv) Group G countries have moderately high IP 10000 and relatively DP 10000.

Methods.

Data for the total number of individuals infected with SARS-COV-2 and total number of deaths due to SARS-COV-2 infections for each country was curated from the World Health Organization, Department of Health of each countries. IP 10000, a measure of Infectivity is defined as the Number of Individuals Infected with SARS-COV-2 Per 10000 Population. DP 10000, a measure of Virulence is defined as the Number of Deaths Per 10000 Individuals Infected with SARS-COV-2. IP 10000 and DP 10000 were calculated based on the total number of individuals infected with

SARS-COV-2 and total number of deaths due to SARS-COV-2 infections.

Temperature, Humidity and Far Infrared Irradiation values were curated from the Meteorological Readings and Forecasts of each country.

Data was analyzed for correlations by the Pearson method [28,29]. Differences between groups were determined by the student t-test [30,31] or one way Anova test [32,33] with $p < 0.05$ accepted as statistically significant.

Results.

It was previously shown that IP 10000, a measure of Infectivity and DP 10000, a measure of Virulence of SARS-COV-2 in Group A countries, Group B countries and Group C countries correlated with Temperature, Humidity and Far Infrared Irradiation profiles associated with these countries [24,25]. This paper asked whether the same mode of classification can apply to other countries and whether these other countries form different groups. Preliminary analysis showed that the countries of the Middle East, African continent and surroundings and the Americas can be grouped separately by virtue of the fact that they are associated with distinct Temperature, Humidity and Far Infrared Irradiation profiles. Figure 1 shows the Temperature, Humidity and Far Infrared Irradiation profiles for each Group of countries. There were significant differences between the groups. Group A countries, all located in Asia-Pacific region, including Singapore, Malaysia, Thailand, Hong Kong, Taiwan, Australia, New Zealand, Bangladesh, India, Philippines, Indonesia and Sri Lanka are associated with high Humidity, high Far Infrared Irradiation during the months of December 2019, January 2020, February 2020, March 2020 and April 2020. Group B countries, all located with the perimeter of the Baltic Sea including Finland, Russia, Norway, Denmark, Estonia, Latvia, Lithuania, Germany and Poland were associated with low temperature and low Far Infrared Irradiation, but high Humidity. Group C countries all located in upper and lower Europe, including Netherlands, Belgium, France, Italy, Spain, Sweden and United Kingdom, are associated with low Temperature, relatively low Humidity and low Far Infrared Irradiation. Group D countries, all located in the African Continent and surrounding areas were associated with

high Temperature, high Humidity and high Far Infrared Irradiation. Group E countries, all Middle Eastern countries were associated with relatively low Temperature, low Humidity by high Far Infrared Irradiation. Group F countries and North American countries, including Canada and United States were associated with low Temperature, low Humidity and moderately high Far Infrared Irradiation. Finally, Group G countries, all South American countries were associated with high Temperature, relatively low Humidity and high Far Infrared Irradiation.

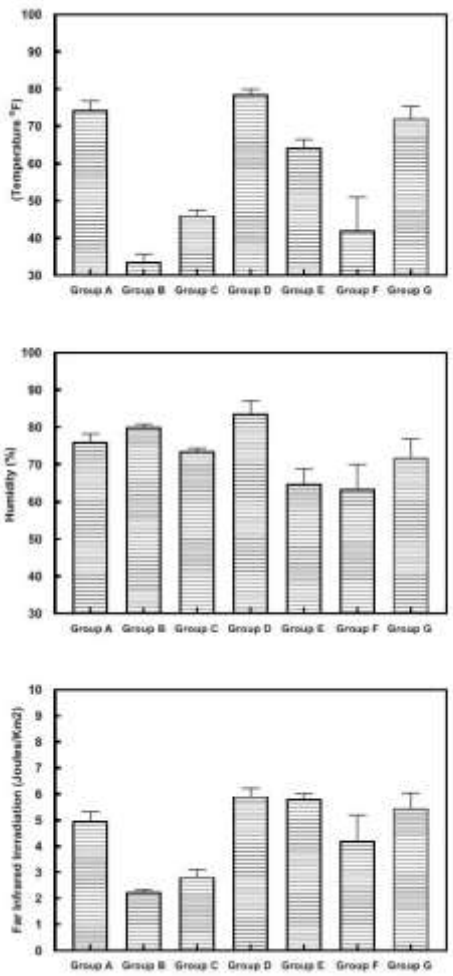

Figure 1. Comparison of the Temperature (Panel A), Humidity (Panel B) and Far Infrared Irradiation (Panel C) Experienced by Each Group of Countries for the Months of December 2019, January 2020, February 2020, March 2020 and April 2020. There Were Significant Differences in the means between Groups as Determined by One Way Anova Test with $p < 0.0001$ for Temperature (Panel A), $p < 0.0001$ for HumidityB, and $p < 0.0001$ for Far Infrared Radiation (Panel C).

The IP 10000 (Infectivity) and DP 10000 (Virulence) for each new group were

determined and compared with previously described groups.

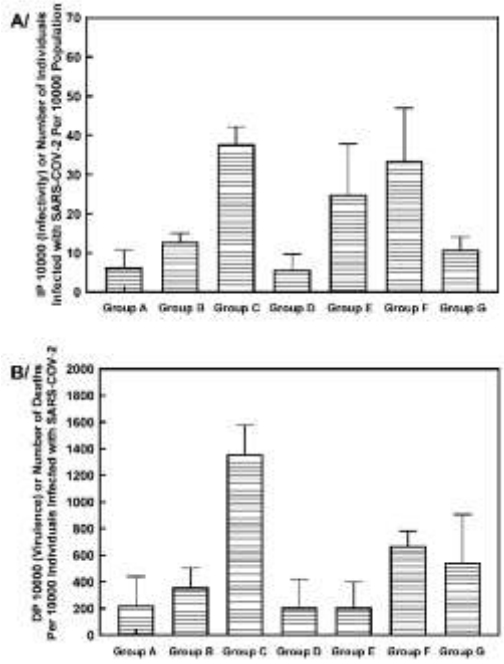

Figure 2. Comparison of the IP 10000 (Infectivity) or Number of Individuals Infected with SARS-COV-2 Per 10000 Population (Panel A) and DP 10000 (Virulence) or Number of Deaths Per 10000 Individuals Infected with SARS-COV-2. The Values were calculated for May 18, 2020. There Were Significant Differences in the means between Groups as Determined by One Way Anova Test with $p < 0.0001$ for IP 10000 (Panel A), and $p < 0.0001$ for DP 10000 (Panel B).

Figure 2 shows the IP 10000 (Infectivity) and DP 10000 (Virulence) associated with each groups. The differences between the different groups are quite striking. Group A countries, including Singapore, Malaysia, Thailand, Hong Kong, Taiwan, Australia, New Zealand, Bangladesh, India, Philippines, Indonesia and Sri Lanka which experienced high Temperature, high Humidity and high Far Infrared Irradiation during the months of December 2019, January 2020, February 2020, March 2020 and April 2020 had the lowest IP 10000 (Infectivity) and DP 10000 (Virulence) for SARS-COV-2. Group B countries, including Finland, Russia, Norway, Denmark, Estonia, Latvia, Lithuania, Germany which experienced had intermediate IP 10000 (Infectivity) and low DP 10000 (Virulence) for SARS-COV-2. Group C countries, Netherlands, Belgium, France, Italy, Spain, Sweden and United Kingdom had the highest IP 10000 and the highest DP 10000. Group D and Group E countries have relatively low IP 10000 and low DP 10000. Group F countries had relatively high IP 10000 and relatively high DP 10000. Group G countries had relatively high IP 10000 and relatively high DP 10000.

Figure 3 shows that is no correlation between Infectivity and Virulence of SARS-COV-2. However, Infectivity and Virulence of SARS-COV-2 as determined by IP 10000 and DP 10000 had reverse correlations with Temperature, Humidity

and Far Infrared Irradiation (Figures 4, 5 and 6).

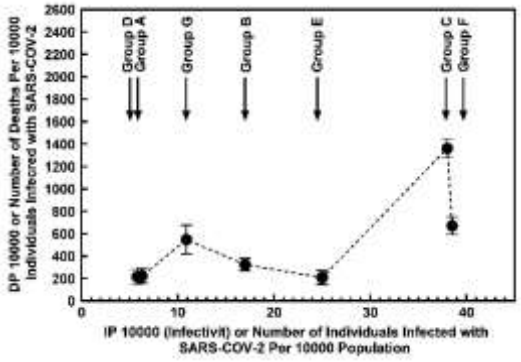

Figure 3. No Correlation Between IP 10000 (Infectivity) or Number of Individuals Infected with SARS-COV-2 Per 10000 Population and DP 10000 (Virulence) and Number of Deaths Per 10000 Individuals Infected with SARS-COV-2. The Values were calculated for May 18, 2020. The slope was not significantly non-zero (F= 5.3, p = 0.0693).

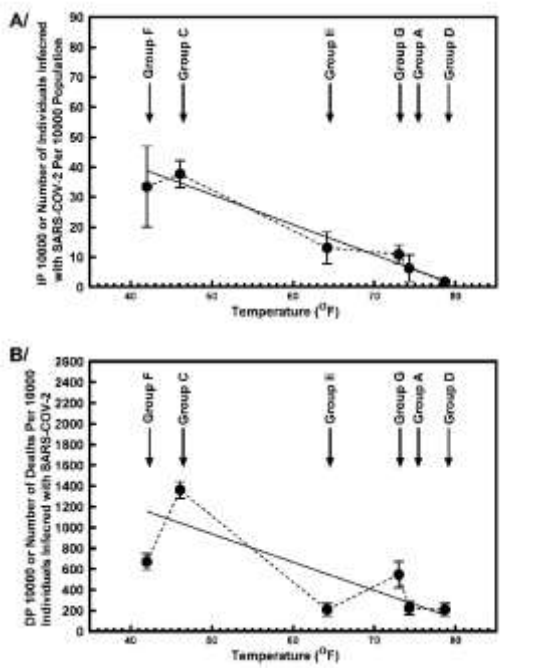

Figure 4 Reverse Correlation Between IP 10000 (Infectivity) or Number of Individuals Infected with SARS-COV-2 Per 10000 Population (Panel A) and DP 10000 (Virulence) or Number of Deaths Per 10000 Individuals Infected with SARS-COV-2 (Panel B) and Temperature. The Values were calculated for May 18, 2020. Group B countries were excluded in the analysis because the effects of Low Temperature Experienced by Group B countries during the Months of December 2019, January 2020, February 2020, March 2020 and April 2020 on IP 10000 (Infectivity) and DP 10000 (Virulence) Were Presumed to be Counterbalanced by the High Humidity during the same period. Panel A: r = -.98, p < 0.0001. Panel B: r = -74, p = 0.047.

Discussion.

There is currently no cure for SARS-COV-2 infection, a disease that has resulted in millions of hospitalizations and hundreds of thousands of deaths (still counting) worldwide. The origin of SARS-COV-2 is unknown. It has been argued that SARS-COV-2 originated from bats [3,6]. It has also been proposed that SARS-COV-2 most probably became activated from its latency through low Temperature, low Humidity and low Radiation [24,25]. It was previously shown that there was no correlation between Infectivity and Virulence of SARS-COV-2 [5,24,25], indicating that SARS-COV-2 is a rapidly mutating virus and that strains with different mutations and biochemistry (or molecular biology) exist in different populations and locations [7,8,34-38].

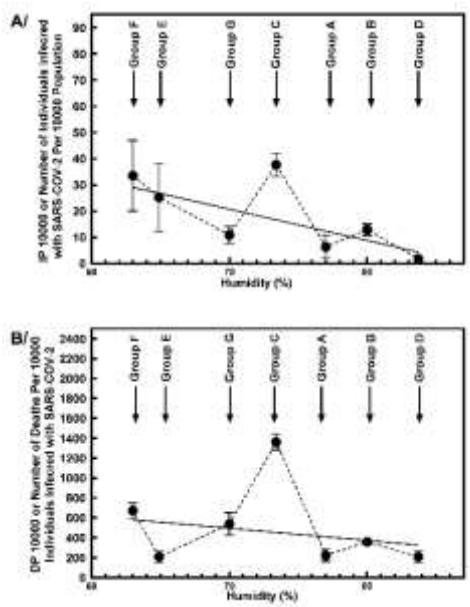

Figure 5. Reverse Correlation Between IP 10000 (Infectivity) or Number of Individuals Infected with SARS-COV-2 Per 10000 Population (Panel A) and DP 10000 (Virulence) or Number of Deaths Per Individuals Infected with SARS-COV-2 (Panel B) and Humidity. The Values were calculated for May 18, 2020. Panel A: r = -.69, p = 0.04 Panel B: r = -23, p = 0.31, however the slope was significantly non-zero, p = 0.0004.

In this paper, we show that with respect to SARS-COV-2 Infectivity and Virulence, countries can be grouped in 7 Groups based on their associated average Temperature, Humidity and Far Infrared Irradiation during the months of December 2019, January 2020, February 2020, March 2020 and April 2020, and the IP 10000 and DP 10000 of SARS-COV-2 in each country. Group A and Group E have the lowest IP 10000 and DP 10000. Group B and Group D have intermediate IP 10000 and intermediate DP 10000. Group C and Group F countries have the highest IP 10000 and highest DP 100000. Group G countries have intermediate IP 10000 but high DP 10000.

That Temperature, Humidity and Radiation affects the viability, infectivity and virulence of viruses were documented many years ago [9-20]. In this work, it is shown that SARS-COV-2 Infectivity and Virulence have reverse correlations with Temperature, Humidity and Far Infrared Irradiation. It is submitted that high Temperature, high Humidity and high Far Infrared Irradiation will significantly lower the Viability and Infectivity of SARS-COV-2 [24,25]. We have hypothesized that treatment of patients infected with SARS-COV-2 in an environment of elevated Temperature, High humidity and constant Far Infrared Irradiation will not only significantly enhance their recovery but will also prevent unnecessary deaths [24,25]. The protocol to test such hypothesis exists already, can be implemented in a relatively short time and will not be prohibitively expensive when compared to the trillions of dollars (still counting)

that has been lost already and the billions of dollars that are being spent already to find an elusive cure or vaccine.

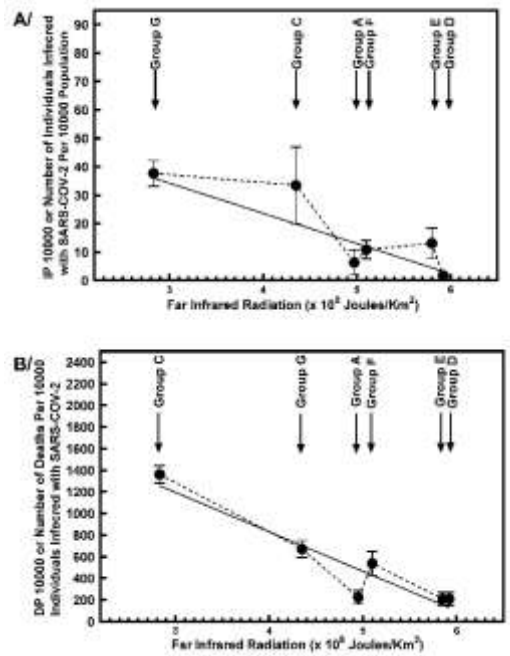

Figure 6. Reverse Correlation Between IP 10000 (Infectivity) or Number of Individuals Infected with SARS-COV-2 Per 10000 Population (Panel A) and DP 10000 (Virulence) or Number of Deaths Per Individuals Infected with SARS-COV-2 (Panel B) and Far Infrared Irradiation. The Values were calculated for May 18, 2020. Individuals Infected with SARS-COV-2 Per 10000 Population (Panel A) and DP 10000 (Virulence) or Number of Deaths Per 10000 Individuals Infected with SARS-COV-2 (Panel B) and Temperature. The Values were calculated for May 18, 2020. Group B countries were excluded in the analysis because the effects of Low Temperature Experienced by Group B countries during the Months of December 2019, January 2020, February 2020, March 2020 and April 2020 on IP 10000 (Infectivity) and DP 10000 (Virulence) Were Presumed to be Counterbalanced by the High Humidity during the same period. Panel A: r = -.87, *p* = 0.01 Panel B: r = -94, *p* = 0.0001.

It is difficult to understand why the so-called scientific experts and pundits are not spending some time studying some basic principles of virology. Many years ago, Lwoff [9-12] lamented that "The temperature problem did not succeed in capturing the attention of scientists, as exemplified by the fact that the subject is hardly mentioned or not mentioned at all in textbooks or treatises of animal virology. Why this work did not develop is a mystery. A scientist must not only have the right idea, do the right experiments, and give birth to a paper. He also must build a coherent doctrinal corpus and must force it into reviews and textbooks (And must force it also into the brains of his colleagues.)". The studies of Armstrong [14], Lwoff and Lwoff [15] and Lwoff et al [16] have all shown that viruses that infect humans, including Herpes Simplex Virus and Polio Virus cannot survive in an environment of moderately elevated temperature that can be tolerated by all humans. Lwoff [9,12,15,16] had also proposed that "hyperpyrexia may save an animal infected intra-cerebrally by a high dose of a virulent strain of poliovirus, or transform a hyper-acute disease into a latent infection".

Allen et al [18] observed that an outbreak of common colds occurred in an isolated station in Antarctica after a sudden change in weather that brought the temperature down from a high of 1-2^0 C to a low of -24^0 C and reduced the relative outside humidity from 93 % to 79 % and postulated that the sharp decrease of temperature may explain "the persistence of large number of rhinovirus serotypes". Muchmore et al. [19] stated that Parainfluenza Virus types 1 and 3 could be recovered from both asymptomatic and symptomatic subjects throughout winter in an isolated station in the South Pole and concluded that the viruses could not have been introduced and were most probably due to "persistence in man". Shaw-Stewart [20] suggested that the "natural temperature sensitivity of respiratory viruses" allows virions to become dormant and viral activation could take place as a result of chilling. Morikawa et al. [17] reported that they could identify several viruses that cause Respiratory Tract Diseases in asymptomatic individuals, including human parechovirus, adenovirus, enterovirus, rhinovirus, coronavirus 229E and HKU1, suggesting Virus Dormancy or Latency. Yamaya et al. [23] showed that H1N1 which was responsible for the 2009 Pandemic emerged during winter and were not viable at temperatures approaching 40^0 C. Yamaya et al. [23] showed that six different strains of H1N1 exhibited lower titers (i.e infectivity) in cells cultured at 40^0 C than in cells cultured at 37^0 C. Yamaya et al. [29] also described that levels of inflammatory cytokines (the agents that negatively affect individuals infected with various viruses) in cells infected with H1N1 were lower at 40^0 C than at 37^0 C. Yamaya et al. [29] concluded that exposure to temperature above 39^0 C may reduce the replication of pandemic and seasonal Influenza Virus. Chan et al. [28] showed that at a temperature of ~38^0 C and relative humidity greater than 95%, there was a significant loss of SARS-COV viability and infectivity than at ~33^0 C and relative humidity greater than 95% indicating that SARS-COV preferred a low temperature and low humidity for its viability and infectivity.

Despite the above studies, it is difficult to fathom why they are being ignored by the so-called pundits and scientific experts. There is still time for the so-called pundits and scientific experts to act so that a

world- wide catastrophe can be avoided in the coming Fall and Winter which are just around the corner. Now is not the time to celebrate and dance. The French people know about "Le Fable de la Fontaine: La cigale, ayant chanté tout l'été, Se trouva fort dépourvue, Quand la bise fut venue, Pas un seul petit morceau, De mouche ou de vermisseau, Elle alla crier famine, Chez la fourmi sa voisine, La priant de lui prêter, Quelque grain pour subsister, Jusqu'à la saison nouvelle. «Je vous paierai, lui dit-elle, Avant l'août, foi d'animal, Intérêt et principal.», La fourmi n'est pas prêteuse, C'est là son moindre défaut, «Que faisiez-vous au temps chaud?, Dit-elle à cette emprunteuse,— Nuit et jour à tout venant, Je chantais, ne vous déplaise, —Vous chantiez? j'en suis fort aise., Eh bien! dansez maintenant.". The so-called pundits, scientific experts, and Governmental and Scientific leaderships are urged to reconsider their strategies (They should also read the Theory of Chaos [39] and the Art of War [39]).

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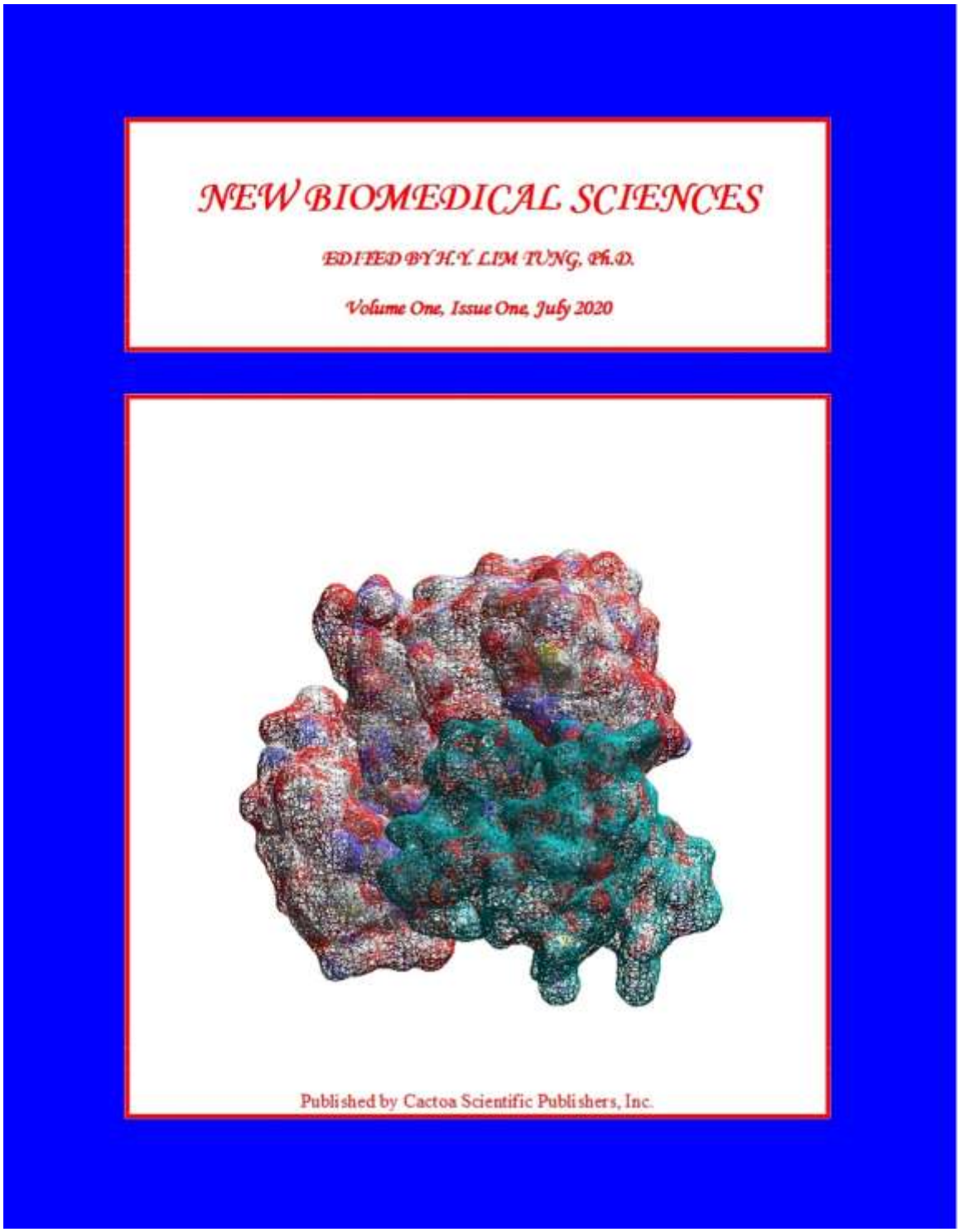
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