LETTERS

Edited by **Jennifer Sills**

Investigate the origins of COVID-19

On 30 December 2019, the Program for Monitoring Emerging Diseases notified the world about a pneumonia of unknown cause in Wuhan, China (*1*). Since then, scientists have made remarkable progress in understanding the causative agent, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), its transmission, pathogenesis, and mitigation by vaccines, therapeutics, and non-pharmaceutical interventions. Yet more investigation is still needed to determine the origin of the pandemic. Theories of accidental release from a lab and zoonotic spillover both remain viable. Knowing how COVID-19 emerged is critical for informing global strategies to mitigate the risk of future outbreaks.

In May 2020, the World Health Assembly requested that the World Health Organization (WHO) director-general work closely with partners to determine the origins of SARS-CoV-2 (*2*). In November, the Terms of Reference for a China–WHO joint study were released (*3*). The information, data, and samples for the study's first phase were collected and summarized by the Chinese half of the team; the rest of the team built on this analysis. Although there were no findings in clear support of either a natural spillover or a lab accident, the team assessed a zoonotic spillover from an intermediate host as "likely to very likely," and a laboratory incident as "extremely unlikely" [(*4*), p. 9]. Furthermore, the two theories were not given balanced consideration. Only 4 of the 313 pages of the report and its annexes addressed the possibility of a laboratory accident (*4*). Notably, WHO Director-General Tedros Ghebreyesus commented that the report's consideration of evidence supporting a laboratory accident was insufficient and offered to provide additional resources to fully evaluate the possibility (*5*).

As scientists with relevant expertise, we agree with the WHO director-general (*5*), the United States and 13 other countries (*6*), and the European Union (*7*) that greater clarity about the origins of this pandemic is necessary and feasible to achieve. We must take hypotheses about both natural and laboratory spillovers seriously until we have sufficient data. A proper investigation should be transparent, objective, data-driven, inclusive of broad expertise, subject to independent oversight, and responsibly managed to minimize the impact of conflicts of interest. Public health agencies and research laboratories alike need to open their records to the public. Investigators should document the veracity and provenance of data from which analyses are conducted and conclusions drawn, so that analyses are reproducible by independent experts.

Finally, in this time of unfortunate anti-Asian sentiment in some countries, we note that at the beginning of the pandemic, it was Chinese doctors, scientists, journalists, and citizens who shared with the world crucial information about the spread of the virus—often at great personal cost (*8*, *9*). We should show the same determination in promoting a dispassionate science-based discourse on this difficult but important issue.

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Ban veterinary use of diclofenac in Europe

In Europe, vulture recovery has been an important conservation success story (*1*). This success may now be jeopardized by the use of diclofenac in Europe's pastoral landscapes. Although diclofenac had already caused a rapid and catastrophic 95% decline in Asian vulture populations (*2*), the non-steroidal anti-inflammatory drug was approved for veterinary use in Spain in 2013 (*3*). Although measures for the safe disposal of carcasses of livestock treated with diclofenac are supposed to prevent avian scavengers from feeding on contaminated carrion (*4*), a Spanish cinereous vulture (*Aegypius monachus*) was found dead,

A Spanish cinereous vulture (*Aegypius monachus*) was found poisoned by diclofenac in September 2020.

poisoned with diclofenac (*5*), in September 2020. European regulatory authorities should permanently ban diclofenac use in livestock before the tragedy met by Asian vultures repeats itself in Europe.

Vulture breeding populations in Spain represent more than 90% of the total European vulture population (*6*). Diclofenac use in livestock could contribute an additional annual mortality rate of 0.9% to 7.7% in Spanish griffon vultures (*7*). The vulture discovered in September was tracked by GPS tag. Given that untagged birds are harder to find, it is likely that more vultures have been poisoned by diclofenac but have not been found. The genus of the recently discovered bird is also ominous; previous diclofenac deaths have only affected species of the genus *Gyps* (*2*, *8*).

If bold measures are not immediately taken throughout Europe, the consequences for European vultures could be severe. In addition to posing an indirect threat, the legal availability of diclofenac may provide a highly efficient weapon to lawbreakers who wish vultures harm. European and national decision-makers should embrace a precautionary approach that promotes treating livestock with cost-effective, vulture-safe alternatives to diclofenac, such as meloxicam (*9*). These decisions would protect European avian scavengers and align with the new European Green Deal action plan for restoring biodiversity (*10*).

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Salmon aquaculture threatens Patagonia

In March, a massive die-off of farmed salmon sent more than 2.2 million kilos of rotting fish biomass into the fjords and channels of the Pacific Patagonian wilderness (*1*), critical areas for biodiversity conservation. The mass mortality event is part of a pattern in which industrial salmon farming increases eutrophication and boosts harmful micro-algae blooms (*2*), which enter gills and suffocate fish (*3*). In turn, decomposition of salmon carcasses leads to increased dissolved organic matter, which, in combination with human-induced ocean warming, facilitates the occurrence of more algal blooms (*4*). With a new constitutional act under discussion, Chile should seize this opportunity to add regulations that will stop the cycle and protect the valuable Patagonian region.

Pacific Patagonia remained mostly pristine until the 1980s (*5*). The region served as one of the last territories of thriving blue whales (*5*) and provided non-breeding habitat for long-distance migratory shorebirds breeding as far away as Alaska (*6*). Salmon aquaculture markedly changed this vast coastal landscape from Chiloé Archipelago to Tierra del Fuego, affecting even remote channels without any previous signs of human activity other than from Indigenous cultures (*7*). Despite repeated warnings regarding socio-environmental impacts (*8*), salmon aquaculture surpassed 1,000,000 tons in 2020 and is now one of the largest economic activities in Chile, the second-largest salmon producer in the world (*9*). In addition to pollution generated by the industry, the regular escape of farmed salmon from broken cages adds non-native mesopredators to food-webs and affects wildlife by transferring aquaculture-associated diseases (*10*) and antibiotic resistant bacteria and genes, which can take hold in wild animals (*11*).

The international community, which serves as the market for Chile's salmon, can leverage its economic power to convince Chile to take action to protect this unique biodiversity hotspot from the environmental effects of salmon aquaculture. Existing government regulations and industry standards must be strengthened. For example, current sustainable aquaculture labelling schemes label some salmon operations as "sustainable" without fully evaluating impacts to wildlife and the surrounding environment (*6*, *11*). The United Nations should push the Chilean government to halt the current expansion of salmon industry toward southern latitudes, especially in the Magallanes region, one of the last bastions of the Patagonian wilderness. Furthermore, a comprehensive monitoring program should be put in place to conduct annual reviews, give

warnings to the industry where necessary, and dismantle aquaculture operations that violate the regulations.

The United Nations should take advantage of the socio-political momentum in Chile. In October 2020, 79% of voters approved the creation of a new constitutional act for Chile, with the potential to address a variety of issues, including a wide range of environmental regulations (*12*). The proposed legislation presents an opportunity to place much-needed limits on aquaculture development. The act will take shape with the input of independent candidates rather than the current parliamentarians and senators who have contributed to the precarious aquaculture cycle. After three decades of salmon industry development, this process could finally lead to policies that protect the Pacific Patagonian wilderness.

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ERRATA

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