To be a scientist is to be a hero. Or so it seems in popular lore. Many philosophers, too, tout science as "special," something to emulate, fostering a kind of unqualified reverence toward scientists (e.g., McIntyre, 2019, pp. 1–8, 201–205). The grandeur of their discoveries seems to elevate them into the realm of the *extra*-ordinary. Great scientists would seem to make good role models.

At the same time, scientists are human. They might lie, cheat, or steal, just as other people do (as exemplified in cases of scientific fraud), exhibiting behavior or personalities that we can neither admire nor endorse. Here, I address whether scientists are inherently more virtuous than ordinary persons (this month's Sacred Bovine). Is it possible (alternatively) to view scientists as imperfect individuals, while still celebrating their scientific achievements?

○ A Rare Disease & a Nobel Prize

Consider the case of Carleton Gajdusek (Figure 1). He shared a Nobel Prize in 1976 for discovering the cause of an exotic fatal disease, kuru, and for characterizing its new form of disease transmission: what he called a "slow virus" (now identified as prions).

Reports of kuru emerged in the early 1940s. It occurred among the Fore, a remote, uncivilized tribe in the New Guinea highlands. The disease was characterized by uncontrollable movements, sometimes outbursts of laughter and, later, stillness – *kuru* means "trembling." The Fore considered it a form of sorcery. Body parts (such as hair or feces) could be wrapped with a stone in leaves and their decay, they believed, would affect the owner. Westerners soon regarded kuru as a form of encephalitis or neurodegenerative disease. But antibiotics proved ineffective (discounting bacteria as a cause). There was no inflammatory or immunological response, typical of viral infections. Investigations ruled out diet and genetics as factors. A local government patrol officer – noting ritual eating of parts of the dead body (notably, the brain) – suggested, implausibly, that the disease was transmitted by cannibalism.

Gajdusek's work in unraveling the cause was remarkable (for an excellent narrative-based inquiry lesson, see Gros, 2012). First, the Fore inhabited rugged and densely forested terrain, accessible only by foot. Gajdusek had grown up with wilderness experiences, however, and was able to trek long distances, sleep in primitive conditions, and invest the sheer physical effort that was required. There were also cultural challenges. Yet, having felt like an outsider growing up in the United States, Gajdusek gravitated to other cultures and had earlier worked in Iran, Afghanistan, and Australia. To establish trust, he developed rapport with children first, a strategy to demonstrate that he was not a threat. All these traits helped Gajdusek document the symptoms and geographical incidence of kuru, and gather statistics showing that women and children were more frequently affected. Gajdusek's skills extended to collecting valuable biological samples (blood, organs) for analysis and securing permission to conduct autopsies to search for parasites, scarring, or traces of toxins (see more below). Finally, he worked with the National Institutes of Health to decipher the puzzling form of transmission. With standard vectors eliminated, he tried to transmit the disease directly with injections of blood or suspended cells – one critical use of his collected samples. The initial trials failed. But a veterinary pathologist in England observed exceptionally long incubation periods for a similar disease in sheep. Gajdusek thus set up the long-term tests, and 18 to 21 months later three chimps developed the telltale signs of kuru. That was the critical evidence for a cryptic "slow" virus. Later, others linked particular instances of cannibalism with specific victims of kuru, establishing those events (as unlikely as it may seem) as the occasions of disease transmission. Overall, a heroic effort indeed. Perhaps it is no wonder that the Nobel Foundation honored Gajdusek's work.

○ Ethical Questions

Mixed with the heroic story, however, are some less admirable details. First are questions of research ethics. The final transmission studies were done on macaques, grivets, and chimpanzees. Indeed, they proved pivotal to the conclusions. But such use of research animals is now deemed unacceptable, as the disease did not threaten these species and the research could not possibly benefit them. Of course, ethics change. At the time, such use of animals was widely viewed as acceptable. Still, objections to animal experimentation had already been voiced for decades. Should Gajdusek have taken more responsibility in pursuing alternatives? Historical context matters. So the case is not easy to resolve.

Gajdusek's methods for collecting specimens were also ethically problematic. At first Fore natives volunteered samples, based on the promise of a cure. But no such remedy followed. Also, the Fore began to suspect that the samples might be used for further sorcery. Ideally, researchers seek informed consent from patients. But how could the Fore be fully informed without understanding Western medicine or research? Thus, to obtain specimens, Gajdusek adapted a practice used by government officials and other anthropologists, who had bartered Western technology for food and help. Gajdusek offered salt, matches, knives, and axes in exchange for the valuable research samples and, especially, for brains and permission to

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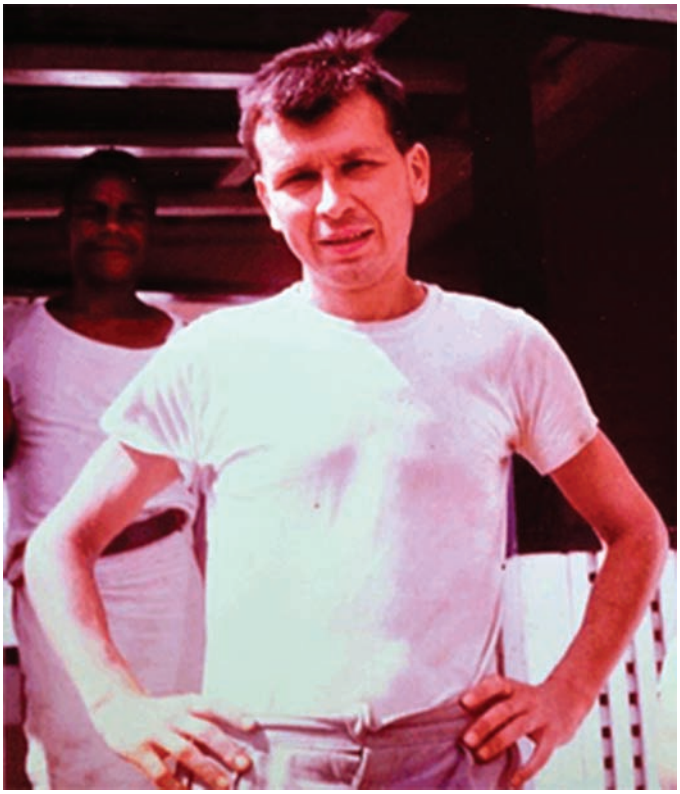

Figure 1. Carleton Gajdusek in 1957, during his investigations of kuru in New Guinea.

autopsy disease victims, which violated local customs. In retrospect one can see how the "trade" relied on an asymmetry of power. The samples contributed significantly to the success of the research, but was the method for obtaining them ethically warranted?

One might imagine that Gajdusek was emotionally callous, reflecting a stereotype of scientists as cold and inhuman. But this other extreme judgment would also seem inappropriate. Gajdusek cared deeply about the Fore. As a child, he had felt like an outsider, and his empathy for people in marginalized cultures fostered his pursuit of medicine in far-off places. While in New Guinea, he looked after many orphans and boys (who often wandered away from their villages) and enlisted some of them as assistants. When one of them succumbed to kuru, he grieved and chastised himself for his "feeble efforts." When *Time* magazine published an article that caricatured kuru unfavorably, he defended the Fore against media sensationalism. Gajdusek also cared deeply for the chimps – Georgette, Daisey, Joanna, and others – who ultimately sacrificed their lives in the research. An ethical assessment is certainly not easy.

Far more disturbing for an idyllic view of scientists, however, is Gajdusek's relationship with the Fore boys. He adopted many Fore orphans and migrant boys and brought them to the United States for education and opportunities. In the mid-1990s, however, allegations of improper sexual conduct emerged. Gajdusek was unapologetic, citing the Fore culture's sexual norms as different than those in the United States. The opinions of his adoptees (56 in total over the decades) varied: neither universal support, nor uniform condemnation. Eventually, Gajdusek pled guilty to charges and spent 12 months in prison before emigrating. How should one regard a Nobel Prize winner who is also convicted of pedophilia?

○ From Role Models to Real Models

Historian of science Stephen Brush (1974) once famously asked, "Should the history of science be rated 'X'?" (alluding to the then recently instituted film rating system). Brush was concerned that many renowned scientists did not embody admirable personalities and would not be good role models. Brush described three well-known physicists, but Gajdusek seems another case. But consider James Watson – another Nobel Prize winner – who promoted unsubstantiated scientific-racist claims, leading to his dismissal from a major research institute (Harmon, 2019). Or Hermann Muller (yet another Nobelist) and his views on eugenics. And so on. To protect the prestige of science, we may wish to bury their names and deeds. But should we?

Of course, there is an equal and opposing danger: that we might overly idealize and romanticize scientists. For example, some educators fail to acknowledge the prickly and abrasive behavior of Ignaz Semmelweis promoted handwashing as a way to prevent puerperal fever, but heaped scorn on those who (justifiably!) criticized his reasoning (Allchin, 2003, pp. 337–339). Others seek to champion their favorite scientists by hiding, discounting, or outright denying their scientific errors (Allchin, 2013, pp. 48–51, 59–64). Through misleading histories, one might easily lead students into a genre that we may call (in contrast to science fiction) *fictional science*.

When scientists do not meet our expectations, the fault is not necessarily theirs. The error may be our unrealistic expectations. Thus, an open and honest portrayal of scientists, with all their character flaws and misdeeds, may be a healthy antidote to scientific "myth-conceptions." As Brush noted, we might profoundly humanize science by acknowledging scientists as, well, human. Ironically, students tend to see science as more approachable when they see its practitioners as recognizably *human*. That is, we may wish to replace idealized "role models" with *real models*.

Real models, rather than utopian role models, invite us to grapple with human complexity. A good *scientist* may not always be a good *person*. Yet we can disentangle the epistemic values of science (creating knowledge) from other, more familiar, cultural or moral values. We can focus on the attributes separately and judge each on its own. Just as ordinary humans may combine good traits and bad traits, scientists, too, may exhibit complexity. But that mixture of values need not diminish our celebration of their scientific achievements. Scientists are, for better or worse, real people.

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