

The polarity assignment should be more consistent within one laboratory, and the results of Hirose *et al.*⁵ indicate that the orientation is similar for different nucleotide states of kinesin and for *ncd*. This implies that the tilt differences reported by the three laboratories result from differences in the assignment of the polarity of the microtubule, and that both motors have similar orientations that do not change drastically with changes in bound

nucleotide. Hirose *et al.*⁵ do observe nucleotide-dependent changes in the angle of a possible attachment region that could represent the power stroke. These changes, however, are probably too small to produce 8-nm steps¹⁵ without amplification in a dimer of heads.

Further work with dimeric head constructs is needed to determine if the tethered head⁸ is preferentially directed to its next binding site and how the orien-

tation changes during the ATPase cycle. In this regard, rapid freezing and analysis of unstained samples as employed by Kikkawa and colleagues⁴ should be particularly useful for trapping of transient intermediates. □

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OBITUARY

Jonas Salk (1914–95)

JONAS Salk, who died on 23 June, was a medical hero throughout the world, and especially in the United States. He achieved that status on 12 April 1955, when it was announced that his vaccine was safe and effective in preventing poliomyelitis. In a country that had for many years been battered by polio epidemics almost every summer, affecting mainly children, the announcement meant that a great battle had been won. Salk became a kind of god.

The path that led to this achievement began in 1942, when Salk joined the department of epidemiology at the University of Michigan, where a vaccine against influenza, made from virus inactivated with formaldehyde, was being developed. At the end of the war Salk moved to Pittsburgh, and continued to work on the influenza vaccine. In 1949 he was approached by the head of the March of Dimes Foundation, which ran a highly successful fund-raising campaign to fight polio. Salk received a contract for identifying the various types of poliovirus, a necessary step for producing a vaccine. There were widely different opinions about how a vaccine should be made; the majority of scientists opted for one based on attenuated virus, believing that only persistent infection can lead to long immunity.

After Enders and colleagues showed that poliovirus can be successfully grown in cultures of monkey cells, a means became available for obtaining virus much more easily. Salk then took advantage of this technology, combining it with the knowledge he had gained about poliovirus and his experience with the influenza vaccine. He disregarded current scientific opinion, and prepared a formalin-inactivated polio vaccine.

The new stature gained by Salk in 1955 gave him the opportunity to realize a dream — to build an institute for basic biological research, separate from universities, and intended for the study of human nature in all its complexity. With the help of the March of Dimes (now aimed at research into birth defects), he built the new institute at La Jolla, California, near the developing campus of the

University of California. He was preoccupied as much with the external appearance of the institute as with its organization, and convinced Louis Kahn to design it; Salk contributed greatly.

In this intellectual venture, Salk found approval and support from outstanding figures of the time, such as Jacques Monod, Leo Szilard and Warren Weaver. They attracted several promising young people in various fields, and together formulated a plan for the institute that



included biologists, artists and philosophers in the first group of 'fellows'. The dream of the interaction between science and the humanities, however, did not quite work out in practice, and the institute rapidly became focused on biological research — becoming remarkably successful, especially in the fields of molecular biology and neuroscience.

The arrival of the AIDS epidemic gave Salk a new reason to pursue his vaccine work, again going against prevailing scientific wisdom. His fundamental and original idea was to use the vaccine to improve the conditions of people already infected, what he called a 'therapeutic vaccine', a concept that most specialists did not accept. He conducted this research until the last days of his life. Before he died he could see a slight

change in the scientific thinking and some acceptance of the vaccine he was proposing, and the initiation of limited clinical trials. But whether this line of approach will prove fruitful remains to be seen.

Salk was a very kind person of profound convictions, who would not be easily led by other opinions, although he listened to them. He persisted in doing what he thought was right, even in the face of strong opposition. He worked hard in pursuing both his research and his dreams. He had an optimistic, philosophical mind, which he revealed especially in books dedicated to the fate of mankind in which he indicated ways for a continuing evolution. He was a physician concerned about the health of the people of the world, especially in Third World countries; for instance, he convinced the Indian government to ensure that the 22 million children born in India every year receive the polio vaccine, possibly as a fourth vaccine added to the usual DTP (diphtheria–tetanus–pertussis). He provided help to get this accomplished.

For his work on polio vaccine, Salk received every major recognition available in the world from the public and governments. But he received no recognition from the scientific world — he was not awarded the Nobel prize, nor did he become a member of the US National Academy of Sciences. The reason is that he did not make any innovative scientific discovery. The fact that a fundamental advance in human health could not be recognized as a scientific contribution raises the question of the role of science in our society. Salk's research met many of the characteristics of good science, such as independence, originality in the pursuit of an unpopular goal, and ability to conclude successfully a project in which no one else believed. His dedication was complete and totally unselfish. It is true that he did not contribute any technological advance; but is science only technology? Renato Dulbecco

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