The (Real) Secret of NIMH

"You must go to the rats.... The rats on Mr. Fitzgibbon's farm have — things — ways — you know nothing about. They are not like the rest of us. They are not, I think, even like most other rats. They work at night in secret."
—Mrs. Frisby and the Rats of NIMH

By WRAY HERBERT

The Secret of NIMH, an animated feature film showing in theaters this summer, takes as its premise the existence of a colony of intellectually and socially advanced rats. As a consequence of experiments by scientists at the National Institute of Mental Health, the rats have become virtually human in their ability to communicate, cooperate and innovate; and they use their acquired cleverness to escape the NIMH laboratory and create a civilization of their own. So culturally advanced are these rats that they are capable of altruism and heroism, which they demonstrate in coming to the aid of Mrs. Brisby, a field mouse in a predicament. Pure fantasy, the stuff of summer movies.

Or is it? The movie is based on the award-winning 1971 children's novel *Mrs. Frisby and the Rats of NIMH* (Atheneum) by Robert C. O'Brien (Mrs. Brisby is based on Mrs. Frisby). Robert C. O'Brien was a pseudonym used by the late Robert Conly, a Washington, D.C., writer, and although the origins of the original story have been obscured by time, several clues indicate that it was based closely on the work of NIMH psychologist John B. Calhoun, who is 1971 was conducting one of the most elaborate studies of rat behavior ever undertaken.

Calhoun, who conducted his research at the NIMH laboratory in Poolesville, Md. (a rural setting not unlike the settings for the book and movie), has recently completed his protracted study of rats, and the (real) secret of NIMH is that he did indeed create a colony of cultivated rats — rats, Calhoun says, with "values" as high as any human values. As Calhoun describes his yet unpublished findings, the parallels between the experimental and fictional rats of NIMH become difficult to resist.

Calhoun points out a number of details in the 1971 book that, he thinks, must have had their origin at the Poolesville laboratory. NIMH used a peculiar kind of "gathering cage," for example, to collect wild rats — a cage that is described accurately in the book. Certain features of the experimental rat "universes" are also detailed in the book — the unusual spiral staircases and the "dominance stand" (for the most dominant rat), which in the book becomes the dias of the conference room. In the book, an NIMH scientist experimentally increases the lifespan of the rats; Calhoun tried, unsuccessfully, to do the same. Even the rat colony's leader, Nicodemus, bears a resemblance to the dominant rat in Calhoun's early research: both were blinded in one eye.

But the most telling resemblance between the actual and fictional rats of NIMH is their culture. Calhoun had written about the idea of creating cultured rats as early as 1967, and his research on the evolution of rat behavior dates back to the mid-1950s. He had found through his earlier research that if rats (or mice) were put in closed environments, free from predation and pestilence, they would gradually increase in population to the point where overcrowding became pathological; when severely overcrowded, the rats became "autistic," incapable of social interaction or reproduction; ultimately the "societies" died out.

This early research led Calhoun to speculate about how a society might adapt to a world that is more than optimally populated. Every species has an optimal group size, Calhoun says, and when a group gets to be twice its optimal size it must split. If a society cannot split, he adds, it must learn to develop "culture" — or it is doomed to extinction. Culture, as Calhoun defines it, is a matter of developing newer and newer social roles, so that the optimal number of social contacts can be maintained despite the increasing population density. It is in this sense that Calhoun has experimentally given culture to the rats of NIMH.

Every new social role in a society requires cooperation and collaboration, and what Calhoun has done in his most recent research is to provide experimental rats with the opportunity to learn cooperative social roles. He designed two elaborate "universes," in which the movement and behavior of every rat was monitored and recorded by computer. Each universe — experimental and control — was populated by 40 rats, or two and one-half times the optimal population.

In the first experiment, Calhoun set up a situation where the experimental rats were required to cooperate in order to gain access to drinking water; only when two rats were present at the fountain was water made available, so that the rats had to learn to seek out help. On the other hand, they had to learn to offer assistance selflessly. The rats learned this kind of cooperation quite easily, Calhoun says, and as they did, their behavior became more and more "symbolic"; the normal aggressiveness that typifies interactions gave way to innovative body movements clearly intended to attract attention — and help — without being aggressive. Even dominant and submissive rats learned to seek each other out and to respond to each other's needs.

The second experiment provided the

rats with a much more difficult cooperative task, Calhoun says. Each universe was designed with one dark side and one light side, and because rats are nocturnal animals, the dominant rats tend to take over the dark side, leaving the submissive rats to the less desirable light side. In effect, two "clans" were formed. In order to operate the mechanized door of the food hopper in the second experiment, two animals of the same clan had to be present. The rats were being required in essence to recognize their clan membership and to cooperate with each other and with members of the other clan in order to survive. Although this proved very difficult and produced some stress among the experimental rats at first, Calhoun says, they did ultimately learn what was required and restored the society to peace. In order to accomplish this, each rat had to learn its social relationship with every other rat — a remarkable intellectual accomplishment.

Two generations of both experimental and control groups — controls were not given the opportunity to learn cooperation — were observed (by movie camera) every one and one-half minutes for 1,500 hours. Although the data analysis is far from complete, Calhoun says, there are clear and significant differences between the cultured rats and the controls. Instead of adopting the new social roles necessary for survival in their densely populated universe, the controls on their own developed ways of manipulating the environment — blocking major passageways with paper, for example — in order to isolate themselves and reduce social interaction. Eventually the controls began to die off and had to be replaced.

In contrast, the experimental rats became quite creative in their behaviors. Fighting (as measured by the number of wounds) was significantly lower among the experimental rats, Calhoun says, because dominant and submissive rats had to learn to work together. Members of the two different clans, on the other hand, learned to stay out of each other's way under other circumstances and thus to moderate social contact in a complex and overpopulated universe.

The data on reproduction and child rearing are somewhat confusing, Calhoun says. Learning cooperation — through the feeding and drinking tasks — seems to reset the nervous system in ways that affect the initiation and duration of motor behaviors. One result of this reprogramming is that mothers, who normally go into a kind of postpartum trance that keeps them in their nest, wander off early and fail to bond with their pups; then, in a very mechanized fashion, they kill the newborn. The result is that they have only about one-fifth as many offspring as controls, but curiously this reverses itself with time. Because the experimental rats are "more relaxed, more altruistic, and more compassionate," Calhoun says, they are better child rearers. There is less cannibalism among the experimental rats, and the pups grow much faster, so that in the long run the mortality rate for the young is much higher in the control group.

The most dramatic evidence of the rats' newly acquired "culture," Calhoun says, emerged quite accidentally. When the rats were learning to collaborate in the initial drinking task, a rat operating the fountain alone would push the lever without results; the rat's effort would cause a bell to ring, however, and the animals gradually learned to respond to the bell by offering assistance. As they progressed, the time between the first bell ring and another rat's offer of assistance grew shorter and shorter until it became almost instantaneous. When the experimental universe was infiltrated by an uncultivated rat from another cage, the cooperative rats continued to respond to what they thought was his call for assistance — even though the outsider kept attacking and wounding the rats whenever they approached. Some of the experimental rats responded so often, and were wounded so often, that they died. "Normally a stranger would be attacked," Calhoun says. "I say that is extreme altruism. They were willing to help a stranger who kept wounding them until they died. That's as high a value as any that humans have developed."

Although Calhoun concedes that the rats' behavior in this experiment has been programmed, he argues that their accomplishments are no less dramatic because they are learned. "Human behavior is conditioned, too," he says. "Once programmed, we have certain values and we behave accordingly. I see no difference between their programming and ours."

If the rats have been conditioned to respond to a bell, that — Calhoun insists — is what conscience is. Human heroism and self-sacrifice, he says, are also responses to such a bell, and would probably appear quite inexplicable to someone observing humans from afar. "My definition of culture is a variation on the golden rule. You learn that if you don't help out, ultimately you're going to suffer. We've taught the rats things they would have difficulty learning without teachers. That's what culture is all about." □