Self-Awareness: Humans Are Not Alone

An apparent hole detected in the mental evolutionary chain places chimpanzees and orangutans closer to human thought levels and further away than believed from other primates, a State University of New York at Albany psychologist reports. "It has been argued that there is a [mental] continuity from one animal to another; that they differ by a matter of degree," says Gordon G. Gallup Jr. Now, however, Gallup has pinpointed a "sudden change, a void, between great apes and others."

The critical factor, as Gallup describes in the May AMERICAN PSYCHOLOGIST, is self-recognition, an ability that until recently was thought to be inherent only in human beings. But experiments by Gallup and others since around 1970 yield "striking evidence" that chimps and orangutans indeed possess a sense of self. (Gorillas, the third member of the great ape catagory, have not yet been tested for self-recognition.)

Gallup's most recent research, soon scheduled for publication, provides further evidence that other primates do not possess the great ape's ability to conceive of their "selves." In that study, a wild-born, preadolescent macaque monkey was exposed to a mirror for 2,400 hours for a period of more than five months, but it failed to show any convincing evidence of self-recognition.

In contrasting studies over the last several years, chimpanzees and orangutans began to show signs of self-recognition after only two to three days of mirror confrontation. Gallup has shown that once exposed to mirrors, chimps move rather quickly from treating the image as if it were another chimp to recognizing it as themselves. "They used the reflection," he says, "to gain visual access to and to experiment with otherwise inaccessible information about themselves, [such as] grooming parts of the body that could not be seen directly, picking bits of food from between their teeth, blowing bubbles and making faces at the mirror."

Still Gallup sensed that his colleagues "might not be terribly convinced or enamored" with his conclusion that such behavior meant the chimps had really identified the source of the reflection. So, following an initial round of mirror exposure, each animal was anesthetized and painted around the eyebrow and ear with a bright red, odorless, nonirritating dye. Convinced that the chimps could not realize they had been so marked, Gallup placed them back into cages, first without a mirror, then with one.

He found that the chimps' attempts to touch a marked area on themselves increased by a factor of more than 25 times in the presence of a mirror. Not only did the incidence of such behavior increase, but so did the viewing time. In addition—even though the dye had long since dried and was indelible—the chimpanzees attempted to visually examine and smell the fingers used to touch the marked areas.

Lab workers support head of anesthetized chimp after marking certain facial areas with red dye for self-recognition test (marks not visible in photograph).

The implications of such results, as Gallup suggests, are far reaching. "To the extent that self-recognition implies a rudimentary concept of self, these data show that, contrary to popular opinion, man may not have a monopoly on self-concept," he says. The psychologist is not sure of the cause of the apparent gap between great apes and other primates, such as monkeys and baboons (which have also been tested). He theorizes the discrepencies may be due to differences in the size of cortical mass among the animals or to an inherent "threshold phenomenon" that provides some animals, but not others, with the ability to self-conceptualize.

"Primate research poses one of the greatest contemporary threats to traditional notions about man," Gallup says. "Man may not be evolution's only experiment in self-awareness." □

Rat insulin gene spliced into bacteria

Manufacture of human insulin in bacteria has been perhaps the most obvious and the most tempting promise of the recombinant DNA techniques. As the number of diabetics increases worldwide, a shortage is developing of the beef and pig insulin that has allowed many diabetics to live nearly normal lives. Furthermore, a source of human insulin could help diabetics who become allergic to the animal hormones.

Now the first step toward insulin manufacture in bacteria has been accomplished. Researchers at the University of California at San Francisco announced this week that they have successfully placed a mammalian insulin gene into a bacterium. Although the insulin gene originated from a rat, rather than from a person, the researchers believe that the same techniques could be used for a human gene. However, putting the human insulin gene into bacteria would require, according to the National Institutes of Health guidelines, stricter safety measures in tightly sealed laboratories such as those being constructed at NIH and Ft. Detrick.

The insulin genes that Howard Goodman, William Rutter and co-workers inserted into the bacteria were not the actual genes dissected from a rat chromosome. Instead the researchers introduced a copy of a copy. The first copy is messenger RNA, the short-lived intermediate that carries genetic information from the cell nucleus to the protein-making apparatus in the cytoplasm. Because cells in the rat pancreas produce predominately one protein, insulin, most of the messenger RNA in those cells contains the information for producing that hormone. With a special enzyme called reverse transcriptase, the investigators made DNA copies identical to the functioning gene from the messenger RNA. This procedure has also been used for study of human genes (SN: 5/7/77, p. 294). The new DNA copies were then joined to rings of bacterial DNA, and those rings, or plasmids, inserted themselves into the bacteria *Escherichia coli*. The bacteria containing insulin genes were easily identified, because the plasmids also carried genes that make bacteria resistant to drugs.

Although the transferred insulin gene can be reproduced within the bacterium, it cannot actually produce insulin there. So far no mammalian gene has functioned to make protein after researchers relocated it into a bacterial cell. However, there is evidence that genes of yeast can function in bacteria (SN: 3/12/77, p. 165). Rutter and Goodman predict that, despite the complicated mechanisms of insulin production, within a year they will be able to persuade rat genes to function in bacteria and actually direct manufacture of rat insulin.

If bacteria cannot yet function as an insulin factory, they can already function as a gene factory. The UCSF researchers have discovered details about the insulin protein by carefully analyzing the abundant copies of the insulin gene produced in bacteria. Production of insulin in the