key's brain that receives sensory information from its hand also support the idea of "use-dependent" brain allocations. Randall J. Nelson and colleagues at the University of California at San Francisco discovered that the brain area devoted to images of the hand surface varies far more between individual monkeys than does the size of a monkey's hand. The parts of the hand that are used most receive the greatest share of the available brain space. The scientists suggest that the way an animal uses its hand determines how brain tissue will be allotted to represent the image.

The flexibility of brain space is further demonstrated when the scientists cut one of the three nerves that carry sensory information from the hand to the brain. Immediately, the processes of the other two nerves, while maintaining their original representations, expanded into the "silenced" space. One area of the hand ended up with more than 20 times its original brain area and another hand region gained a new representation far from its original map. The newly apportioned brain space is topographically organized according to the same principles as the original map. Michael M. Merzenich, Nelson and colleagues conclude that their monkey findings, along with studies of patients with nerve damage, indicate that perceptual maps on the surface of the brain are not fixed and that continual use dependent competition probably determines the boundaries. □

Diversification in neuron chemistry

A dogma of neuroscience has fallen by the wayside as new techniques reveal multifaceted chemical production in individual nerve cells. The old rule was that each cell manufactures only one transmitter chemical, which it releases to influence other cells. But now more than a dozen examples provide exceptions to the rule. Some neurons contain two, and in at least one case three, chemicals that may serve as intercellular messengers. "And we expect to find many more examples," Tomas Hokfelt of the Karolinska Institute in Sweden told the Cincinnati meeting of the Society for Neuroscience. The combined effects of a nerve cell's chemical transmitters determine the cell's physiological influence.

Brightly fluorescent silhouettes of nerve cells provided the impetus for scientists to revise conceptions of neuron chemistry. Researchers have developed specific antibodies to selectively label cells producing each neurotransmitter. To the antibody they attach a molecule that fluoresces red or green or yellow under ultraviolet light (SN: 10/28/78, p. 298). Thus with a set of fluorescently tagged antibodies they can visualize on a slice of tissue the cells with specific neurotransmitters. Some cells have been found to fluoresce with more than one antibody tag.

One peptide and one "classical" neurotransmitter are produced in many of the dual transmitter nerve cells. The synthetic routes of such compounds are completely separate. "This suggests that the dynamics of the transmitters might be very different in such cells," Hokfelt says.

Two transmitters in a single neuron may allow precise control of the cell's signal. Hokfelt, Benjamin S. Bunney and collaborators at Yale University have found, for instance, that a group of midbrain neurons, known to release the classical transmitter dopamine, also release a peptide similar or identical to cholecystokinin (CCK), a substance originally found in the intestine. The activity of these cells is affected by both transmitters—but in opposite directions. Dopamine inhibits the nerve cells, whereas CCK activates them. "Thus the interaction of these two compounds may be very important in regulating activity of these cells," Bunney says. "CCK may be intimately involved in the control of the activity of a subpopulation of dopamine neurons."

Another example of paired transmitters has been found in the cells that innervate sweat glands. The cells release both the classical neurotransmitter acetylcholine and the peptide called vasoactive intestinal polypeptide (VIP). The acetylcholine triggers sweat gland secretion; the VIP dilates vessels to increase local blood flow. Together, the neurotransmitters effectively stimulate sweat gland response. Hokfelt says, "The coexistence of these compounds makes physiological sense."

Hokfelt and colleagues are now looking for more systems of physiologically sensible neurotransmitter coexistence, with other interactions that enhance physiological response. □

Protein celebrities meet in the brain

First there was the disclosure that pituitary gland proteins could, in addition to their hormonal roles, influence the mind and behavior (SN: 9/25/76, p. 202). Then there was the discovery of brain proteins called endorphins and their effects on human thoughts, emotions and behaviors (SN: 11/25/78, p. 374). Third came the finding that the pituitary hormones and endorphins are related. And now it appears that another protein—interferon—may be related to the pituitary hormones and endorphins, according to a report in the October PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES by J. Edwin Blalock and Eric M. Smith of the University of Texas Medical Branch in Galveston. If this is the case, it opens the possibility that the antiviral protein, interferon, may sometimes pose as a hormone or even influence the mind and behavior.

A few months ago Blalock and Smith found that interferon has some protein hormone activity, notably that of the pituitary hormone adrenocorticotropic hormone (ACTH), and that, after interacting with cell membranes, interferon and protein hormones share common pathways of cell activation. These similarities suggested to Blalock and Smith that there might be structural similarities between the protein hormones and interferon. They tested this, using as their tools antisera (antibodies) against ACTH, gamma-endorphin and human leukocyte interferon (one of three major kinds of interferon) and the digestive enzyme pepsin, which would carve the amino acid sequence of ACTH out of interferon if such a sequence were present and show ACTH activity.

As they report, antiserum against ACTH blocked the activity of human leukocyte interferon but not that of fibroblast interferon (another major type of interferon). Conversely, antiserum against human leukocyte interferon blocked the activity of ACTH. And when human leukocyte interferon was digested with pepsin, it totally destroyed interferon's antiviral activity but generated ACTH activity instead. Antiserum against gamma-endorphin also blocked the activity of human leukocyte interferon. However, antisera against two other pituitary hormones — luteinizing hormone and follicle-stimulating hormone — did not block the activity of human leukocyte interferon.

Thus, it looks as if human leukocyte interferon is structurally related to at least one pituitary hormone—ACTH—and to at least one endorphin — gamma-endorphin —and that leukocyte interferon may be a precursor for these proteins or may share a common precursor with them. And in either case, leukocyte interferon might possess, in addition to its antiviral activity, hormonal or even psychological and behavioral activity.

Before such unorthodox insinuations can be said to be the case, though, lots more research into the relationships among the pituitary hormones, endorphins and interferons has to be carried out. For instance, since Blalock and Smith submitted their findings to the PNAS in July, part of the amino acid sequence for human leukocyte interferon has been published by other researchers, allowing them to compare that sequence with the sequence known for ACTH. There were no similarities between the sequences, Smith told SCIENCE NEWS. This finding, or nonfinding, detracts from the antigenic and enzymatic suggestions that leukocyte interferon is structurally related to ACTH. However, Smith and Blalock remain hopeful that when the final sequence of human leukocyte interferon becomes known, it will resemble that of ACTH. □