

Neurotransmitter lateralized in brain

For more than a century, the left and right halves of the human brain have been known to function differently. Only in recent years, however, have the singular abilities of each side come into sharper focus. The left hemisphere is now known to be involved in speech and in logical, analytical thinking. The right hemisphere is now known to be concerned with spatial relations and with artistic and holistic thought processes. Indeed, neuroscientists declared at a 1977 symposium that brain asymmetry "impinges upon the entire spectrum of brain behavior research from the synapse to the sentence."

Now, for the first time, a neurotransmitter — a chemical that passes electrical messages between nerves — has been found to have a natural, strongly lateralized distribution in the human brain. Arvin Oke and colleagues at the University of Kansas in Lawrence report in the June 23 *SCIENCE* that a specific region of the left human brain, but not of the right human brain, is rich in the neurotransmitter norepinephrine, whereas another specific region of the right brain, but not of the left brain, also contains a lot of this neurotransmitter. "Such naturally occurring left-right differences in concentration of a neurotransmitter represent a new aspect of hemispheric specialization," they say. They also believe that these concentration differences might "be correlated in the future with functional and behavioral aspects," for instance, with human speech, or with schizophrenia.

Recently Oke and his colleagues used some relatively new techniques — liquid chromatography combined with electrochemical detection — to map neurotransmitters in various areas of the human brain. In the process of this mapping they noted, to their surprise, that the left and right sides of the brain seemed to differ in their concentrations of these chemicals. So they probed further for evidence of this nature, concentrating on the thalamus. The thalamus is an area of the brain located smack between the left and right brain hemispheres and thus comprising a bit of each. And the neurotransmitter they looked for was norepinephrine.

They found that a particular area of the left brain side of the thalamus — the pulvinar region — is especially rich in norepinephrine, but that the pulvinar region of the right brain side of the thalamus is not. In contrast, the somatosensory input area of the right brain side of the thalamus, but not the somatosensory input area of the left brain side of the thalamus, has a high concentration of norepinephrine. "Thus we believe the results truly represent norepinephrine lateralization in the thalamus," they conclude.

What's more, this appears to be the first

time that a natural asymmetry of neurotransmitter in the human brain has been documented. The only other time that lateralized neurotransmitter levels were observed in the human brain was in a patient with Parkinson's disease. The patient had an asymmetry of the neurotransmitter dopamine. This lateralization was probably due to a causal link between dopamine and Parkinson's, however, rather than to any intrinsic chemical laterality, since a dopamine deficiency is known to underlie this disorder.

So why should the left and right sides of the thalamus differ in their norepinephrine distribution? Probably because each side uses the neurotransmitter for its own specific purposes. For instance, surgery of the left pulvinar region of the thalamus, which has much norepinephrine, produces postoperative speech difficulties, but surgery on the right pulvinar region of the thalamus, which has a paucity of norepinephrine, does not. And, as mentioned before, the left hemisphere of the brain is involved in speech. So it's quite possible that norepinephrine helps the left side of the thalamus, and perhaps some other areas of the left hemisphere of the brain as well, to produce human speech. Similarly, because the somatosensory region of the right side of the thalamus has been found to be rich in norepinephrine, and because the right hemisphere of the brain is thought to be involved in schizophrenia, norepinephrine in the right thalamus, and perhaps in other right brain regions as well, may be implicated in this condition. □

R&D: The future looks dim ahead

Optimism was not the tone pervading the colloquium on R&D policy in Washington last week. W. Bowman Cutter, the executive associate director of budget of the Office of Management and Budget, set the tone early when he told the conference, sponsored by the American Association for the Advancement of Science, that federal research money will get tighter, at least for near term, because the economy is in trouble.

The Carter administration will be asking everybody, including the research and development community, to accept a pause, "as yet undefined," in the expected rate of increase in the federal budget in order to make corrections in an economy that seems headed in "some very unfavorable and distasteful directions," Cutter said. "I see the [fiscal year] 1980 budget as the tightest in a decade," he predicted.

Markley Roberts, an economist for the AFL-CIO labor union, questioned whether the administration's planned budget restraint was consistent with the kinds of healthy, full-employment economic growth that provide incentives and re-

sources to support research and development. Cutter countered, saying, "We're not moving toward a restrained budget for the hell of it. We're doing it because ... productivity seems to have fallen off on a cyclical basis in the last year or so, inflation is up much above our guesses, and we are now in the fortieth month of a recovery with a deficit somewhere in excess of \$50 billion." He warned that if federal budget planners don't tighten their purse strings voluntarily, other agencies with clear power in this area, such as the Federal Reserve Board, will step in and take over with a much heavier hand and use "much more blunt instruments than we have. We see the choice we're making as being far and away the best among the real possibilities."

New York University President John C. Sawhill challenged that analysis, saying that the federal budget deficit was "somewhat counterbalanced" by the size of the states' budget surpluses together with the federal trade deficit. "If you look at the total impact of these three on the economy, the federal deficit really is not having that large an inflationary impact," he said.

Sawhill went on to say that "one of the ways you improve productivity, at least in the longer range, to bring inflation under control, is by maintaining increasing investment in research and development."

The AAAS meeting, the third in an annual series, was devoted to examining the relationship between innovation, the economy and investments in research and development. One of the few points on which all discussants agreed was that economic and regulatory uncertainties were discouraging private industry from investing in basic research or any long-term research ventures. At the same time, the government has been questioning its role in funding technological development (as opposed to basic research), particularly, Cutter pointed out, because the government hasn't the acumen industry has for analyzing the market potential of a development product.

Basic research, three-quarters of which is carried out by universities, may also be in trouble. Although the administration in its 1979 budget proposal called for a five percent growth in the proportion of money devoted to basic research, at least in the academic sector, this increase "will easily be absorbed in the acquisition of up-to-date equipment alone, leaving little or nothing for an increase in the man-hours devoted to basic research or for assuring that younger scientists receive a share of the funds," Sawhill said. Universities have been operating for several years on a "very stringent budget" and must now upgrade their laboratory equipment if they are to accomplish research that will keep the United States competitive in the world market, he said.

Together, these factors were seen as weakening the U.S. world technological superiority. According to Arthur Bueche,