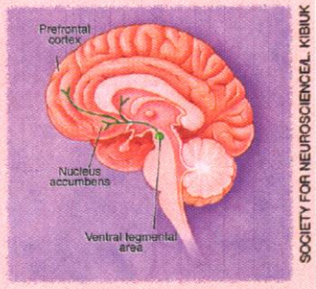
LETTERS

Heady matters

The prospect of "cloning headless humans as sources of organs for transplant" is declared to be "absurd on both scientific and moral grounds." Whether the neurotransmitter dopamine is a "pleasure juice" or an enhancer of "sensory awareness" (right, pathways of dopamine-releasing neurons in the brain) is explored. And what we know about how the olfactory and the vomeronasal systems function and how both are related to "unconscious odors" is clarified.



Using One's Head

A recent News & Comment item by Oliver Morton ("First Dolly, now headless tadpoles," 31 Oct., p. 798), arrives at the conclusion that the flurry of interest that surrounded news reports about the prospect of cloning headless humans as sources of organs for transplant was "ephemeral." We wish that were so. The article also points the finger of blame in the direction of the media in Europe and the United States eager for hype and sensationalism. Again, we wish that were the only source of blame for this latest chapter in the public misunderstanding of advances in genetics.

The intensity of the media coverage that followed in the wake of the announcement that cloning might be used to make headless bodies for mining organs and tissues is not well described as "ephemeral." The intense media coverage of the sort that greeted this article guarantees it will have a very long life in the public mind.

That scientists are partly to blame for this state of affairs is something that is hard to admit. But it ought to be acknowledged. Jonathan Slack of the University of Bath in southwestern England made tadpole embryos that have just bodies and others that apparently have just heads. This research led him to pronounce to a BBC television documentary crew preparing a film on cloning that perhaps the same could usefully be done in people. A torrent of silliness was unleashed as word of an impending world of decerebrate humanity leaked out to the general press in Europe and North America.

Lest anyone think that scientists stood horrified while these events unfolded, it should be noted that a former head of the National Institutes of Health got into the act, declaring on the CBS Evening News that the purposeful creation of human mutants for organ harvesting would be "ghoulish" and "chilling" because embryos without brains "would have zero potential to say no."

It is certainly true that headless humans would find it hard to "just say no." But the whole idea of a debate about the merits of headless clones is absurd on both scientific and moral grounds. People without heads are dead. To use them as organ sources, one would need to keep their bodies functioning. Getting a human being born and to adulthood without a head would be a virtually impossible task.

Morally, the idea is also ridiculous. Intentionally creating defective human bodies would not be an acceptable use of genetic science. The mass production of bodies without brains would cheapen respect for the human image and form beyond any reasonable limit. And intentionally disabling embryos so that they would grow without heads or brains would surely be an impermissible act of creating and sacrificing potential humans solely for the benefit of others.

The genetic revolution presents important scientific and moral issues for society. We need to be concerned about how genetic information will be used by government, industry, the military, and the medical profession. We should be concerned that genetic knowledge can threaten our privacy, imperil our right to health care or a job, leave us vulnerable to loss of insurance, or even force us to know things about our future that we might not want to know. We should wonder how a knowledge of our potential child's genetic legacy will shape reproductive choices. These issues require a lot of hard thinking. Scientists and those who are interested in the ethical consequences of advances in science must strive to point public debate toward what is practical and possible as well as what is plausibly moral. Since we are currently armed with heads and brains, it behooves us to use them to decide how best to cope with the real

benefits and risks of an increasing flood of genetic knowledge.

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Dopamine's Role

Ingrid Wickelgren's Special News Report "Getting the brain's attention" (3 Oct., p. 35) presents the views of those who question the current orthodoxy that dopamine acts in the nucleus accumbens as a key neurotransmitter underlying the behavioral effects of positive reinforcement or the feeling of pleasure, or both. However, the most important evidence against this hypothesis receives little attention.

"One line of research that could settle the debate," Wickelgren writes, "is directed at dopamine's role, if any, in unpleasant events." She goes on to say that evidence on this score is "controversial." We are not sure to what controversy she refers. The considerable evidence that dopamine release in the nucleus accumbens is reliably observed under conditions of stress has recently been summarized by Salamone *et al.* (*1*). This evidence shows that unpleasant events such as footshock increase extracellular levels of dopamine in the nucleus accumbens, as measured, for example, by in vivo intracerebral microdialysis. The only controversy relating to such reports, as far as we are aware, is whether they reflect the unpleasantness or the novelty of the footshock (*2*). Our own work, also applying microdialysis to the nucleus accumbens, circumvents this problem. We have shown that a simple sensory stimulus, such as a light or a tone, which before Pavlovian conditioning does not affect extracellular dopamine levels in the nucleus accumbens, elicits such dopamine release after conditioning with a footshock unconditioned stimulus (*3*). This effect, which controls for the novelty of the conditioned stimulus, has been essentially replicated in somewhat different paradigms (*4*).

We believe, in the light of findings such as these, that there is no special relationship between dopamine release in the nucleus accumbens and positive reinforcement. Indeed, our more recent findings go farther. In these experiments (*5*), we exposed groups of rats either to five Pavlovian pairings of light (as conditioned stimulus) and tone (as unconditioned stimulus), or to an equal number of presentations of light and tone over an equivalent period of time, but in an unpaired manner. For both groups the tone was then paired twice with footshock, followed by a test to determine the response to the light (not itself paired with footshock). In the light-tone conditioning group, but not in the random light-tone group, the light on the test trial elicited dopamine release in the nucleus accumbens. Thus, Pavlovian conditioning, even when it pairs stimuli that are not normally considered biological reinforcers and which before conditioning do not elicit accumbens dopamine release, is sufficient to confer upon such stimuli the capacity to do so.

Wickelgren considers the hypothesis that "the dopamine signal serves to draw attention to salient events of all sorts." We believe that this is probably along the right lines. Strong support comes from research showing that the phenomenon of latent inhibition (in which a stimulus loses salience, as measured by its ability subsequently to enter into a Pavlovian conditioned association, as a result of repeated unreinforced presentation) depends on changes in stimulus-elicited dopamine re-