

'Matador' With a Radio Stops Wired Bull

By JOHN A. OSMUNDSEN

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Modified Behavior in Animals Subject of Brain Study

By JOHN A. OSMUNDSEN

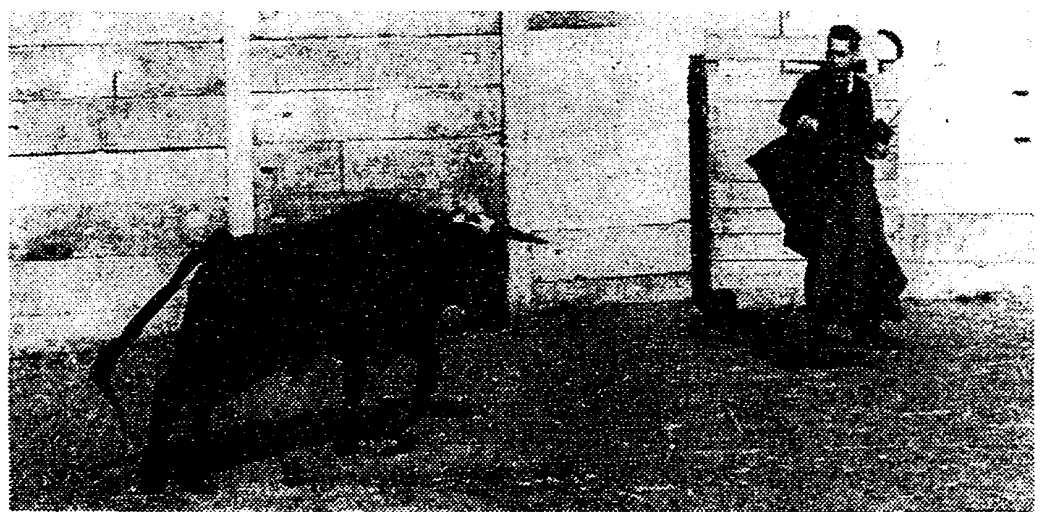
Afternoon sunlight poured over the high wooden barriers into the ring as the brave bull bore down on the unarmed "matador" — a scientist who had never faced a fighting bull. But the charging animal's horns never reached the man behind the heavy red cape. Moments before that could happen, Dr. José M. R. Delgado, the scientist, pressed a button on a small radio transmitter in his hand, and the bull braked to a halt.

Then, he pressed another button on the transmitter and the bull obediently turned to the right and trotted away.

The bull was obeying commands from his brain that had been called forth by electrical stimulation—by the radio signals—of certain regions in which fine wire electrodes had been painlessly implanted the day before.

The experiment, conducted last year in Cordova, Spain, by Dr. Delgado of Yale University's School of Medicine, was probably the most spectacular demonstration ever performed of the deliberate modification of animal behavior through external control of the brain.

Dr. Delgado was trying to find out what makes brave bulls brave — just as other of his experiments have aimed at finding the biological basis for emotions, personality and behavior in man and other animals through electrical stimulation of their brains.



Dr. José M. R. Delgado of Yale University's School of Medicine facing a charging bull



Bull, halted in mid-charge by command from Dr. Delgado's transmitter, raises dust cloud

He has been working in this field for more than 15 years. Techniques that he and other scientists have recently developed have been refined to the point where, he believes, "a turning point has been reached in the study of the mind."

"I do believe," he said in a

recent lecture, "that an understanding of the biological bases of social and antisocial behavior and of mental activities, which for the first time in history can now be explored in a conscious brain, may be of decisive importance in the search for intelligent solutions to some

of our present anxieties, frustrations and conflicts."

Dr. Delgado said in an interview recently that he was particularly concerned with what he called the "gap between our understanding of the atom and

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our understanding of the mind."
"We are in a precarious race," he said, "between the acquisition of many megatons of destructive power and the development of intelligent human beings who will make intelligent use of the formidable forces at our disposal."

Based on His Experiments

Dr. Delgado's contention that brain research has reached a stage of refinement where it can contribute to the solution of some of these problems is based he said, on many of his own experiments.

These have shown, he explained, that "functions traditionally related to the psyche, such as friendliness, pleasure or verbal expression, can be induced, modified and inhibited by direct electrical stimulation of the brain."

For example, he has been able to "play" monkeys and cats "like little electronic toys" that yawn, hide, fight, play, mate and go to sleep on command.

And with humans under treatment for epilepsy, he has increased word output sixfold in one person, has produced severe anxiety in another, and in several others has induced feelings of profound friendliness—all by electrical stimulation of various specific regions of their brains.

The evocation of bodily responses from electrically stimulated brains goes back to the middle of the 19th century, when scientists produced limb movements and other reactions by applying weak electrical currents to the exposed brains of anesthetized animals.

Emotions Were Inaccessible

One trouble with that sort of work, however, was that the animals were asleep, and thus many of the most important aspects of brain activity, such as emotions and intelligence, were inaccessible to study.

This limitation was overcome at the turn of the century by the development of techniques to insert wires into the animal's brain through an ivory plug screwed into the skull. This served as an anchor for the wires, which carried weak stimulating currents from dry cell batteries.

In 1932, Dr. F. R. Hess of



The New York Times
STUDYING BEHAVIOR:
Dr. José M. R. Delgado in his office at Yale University School of Medicine.

Switzerland used a similar set-up to stimulate various cerebral regions in conscious cats. He showed that electrical currents could influence the animal's posture, balance, movement and such basic psychic manifestations as fear and rage.

For some still unexplained reason, those techniques were not used much by biologists until the early nineteen-fifties. Then important developments in brain surgery, psychosomatic medicine, psychopharmacology and physiological psychology turned the attention of scientists to electrical exploration of the brain.

Makes Use of Telemetry

Of all the scientists who are working in this area, however, Dr. Delgado appears to be the only one using radio to stimulate animals' brains, with special attention to effects on social behavior. He also makes use of telemetry in studying physiological activity in brains and other organs.

"I do not know why more work of this sort isn't done," he remarked recently, "because it is so economical and easy."

Essentially, Dr. Delgado's system for studying social behavior consists of constant time-lapse photography of animal colonies, the analysis of

those films and recording of all the animals, details in the behavior patterns.

This permits not just qualitative assessment of the animals' social interactions but also the quantification of each one's behavioral profile, Dr. Delgado said. This is particularly important when analyzing the modifications in social behavior of the group produced by radio stimulation of a particular response in one or more of the animals.

For example, stimulation of several specific regions of the brain can induce aggressiveness in a monkey. Having quantitative data on that animal's behavior, as well as on that of others in the colony can reveal more precisely the magnitude of various, sometimes subtle, effects of electrical stimulation on individual and collective social behavior.

Some of the Results Listed

With such techniques, Dr. Delgado has shown:

¶ Monkeys will learn to press a button that sends a stimulus to the brain of an enraged member of the colony and calms it down, indicating that animals can be taught to control one another's behavior.

¶ A monkey, stimulated to extremely aggressive behavior, will make "intelligent" attacks only on competitive members of the colony, sparing other, friendlier, ones.

¶ Monkeys and cats can be triggered into sequential behavior in which one might open its mouth, turn around, walk to a corner, climb a wall, jump down and return to "start," repeating those movements in the same order every time they are stimulated but they will modify the pattern if other animals get in the way or if they are threatened.

The latter two experiments show that electrical brain stimulation does not simply evoke automatic responses but reactions that become integrated into social behavior according to the individual's own personality or temperament, Dr. Delgado said.

Experiments have been conducted on human beings by Dr.

Delgado and other scientists, primarily during the treatment of certain types of epilepsy. Stimulation of particular areas of the brain have produced anxiety, profound feelings of friendliness and, in one case, a six-fold increase in word output.

The Yale neurophysiologist believes that techniques such as the one he is using can lead to the discovery of the cerebral basis of anxiety, pleasure, aggression and other mental functions and that "we shall be in a much better position to influence their development and manifestation (in various ways) especially by means of more scientifically programmed education."