PHYSIOLOGY

"Brainstorm" Becomes Scientific

Brain Waves, Too, Desert the Realm of Slang to Join Physicians' Vocabulary as New Tool of Research

By JANE STAFFORD

NOTE: The recording and interpretation of the electric impulses from the brain have recently become a fertile field of research. This article, with that in SNL, June 22, p. 397, will give you a compact summary of the major programs now being conducted along this line.

BRAINSTORMS and brain waves have been taken out of the realm of slang and become scientific records. Scientists have found a way to tap the electrical impulses generated by brain activity and to study their messages which come off as wavy lines on strips of paper. They are translating these into terms of illness and health, thought, rest and unconsciousness.

This does not mean that the scientists, at Brown and Harvard Universities here and in England and Germany, can, strictly speaking, "read your mind" with their new electrical hook-up. They cannot tell from the brain messages what you are thinking. But they can tell whether you are "sitting and thinking" or "just sitting." They can tell, without having seen you while the messages were being transcribed, whether you were awake or asleep, in a faint, suffocating, under an anesthetic, or a sufferer from that mysterious malady, epilepsy.

In fact, the first fresh lead to a solution of the age-old problem of epilepsy which scientists have found in a long time is furnished by the electrical apparatus which has been popularly but mistakenly christened a mind-reading apparatus.

Neurological Storm

Discovery that epilepsy is probably a neurological storm—a brainstorm plus a storm in the rest of the nervous system—is but one of the achievements made in this new field of investigation. Important information about the effect of anesthetics on the brain is being gained and it is hoped that this information will enable the surgeon to be much more skilful and precise than he now can be in choosing the kind and amount of anesthetic he uses to put a patient to sleep before an operation. Other facts which scientists hope to learn from the brain messages received over the electrical hook-up relate to the differences in mental processes between men and apes and between men themselves.

Scientists call these brain messages obtained by electrical methods electroencephalograms. This long word is not hard to pronounce if you split it into its natural parts: electro-en-cephalo (referring to brain)-gram. They are akin to the now familiar electrocardiograms, the telegrams from the heart which modern physicians use to diagnose certain types of heart ailment.

Century Old Idea

Although the electroencephalograms are creating quite a furore in scientific and lay circles as something very new as well as promising, they have their beginnings in discoveries made nearly a century ago. Medical knowledge of the electrical properties of living tissues dates from the researches of Prof. Emil du Bois-Reymond, beginning in 1843. It is the electrical properties of living tissues that enable modern scientists, using the technical advances of modern electrical and radio engineers, to study the action of heart, muscle, nerves, and now the brain itself. The idea of measuring and figuring the variations of action currents from the living heart by leading them off through "electrodes" placed on the moist skin and connected with that important electrical instrument, the galvanometer, first occurred to Augustus D. Waller in 1889. His method was improved on, made accurate and the name "electrocardiogram" coined by Willem Einthoven of Leyden in 1902.

Using radio apparatus, Prof. E. D. Adrian of Cambridge University was able to detect the electric current passing along a single nerve fiber. For this achievement, he shared in the Nobel Prize for 1932 in medicine and physiology.

The German scientist, Dr. Hans Berger of Jena, found that the changes in electrical potential connected with human brain activity may be magnified by running them through a vacuum-tube amplifying system similar to that used in radios and then the enhanced current used to operate an oscillograph which writes in light on a photograph a wavy line corresponding to the fluctuations of the electricity in the brain.

Dr. Berger's work has been confirmed and amplified by Prof. Adrian in England, by Drs. H. H. Jasper and L. Carmichael of Brown University, and by Drs. A. J. Derbyshire, F. A. Gibbs, H. Davis and E. L. Garceau of Harvard University. It was Drs. Gibbs, Davis and Garceau who used the new technic to investigate epilepsy, while Dr. Derbyshire, with Drs. A. Forbes, B. Remple and E. Lambert, also of Harvard, has been investigating the effects of various anesthetics on the brain and central nervous system.

Having an electroencephalogram made of your mental processes is about as simple and painless as having your picture taken. At a recent demonstration to scientists in Detroit, a number of men volunteered to be "human guinea pigs" and, apart from some embarrassment at being part of the show, seemed to enjoy the experience. They sat in a comfortable chair with their eyes closed and did mental arithmetic problems given by Dr. Gibbs, or answered questions or "just sat" and did and thought nothing, while the interested scientists gathered around the machine where the brain waves were appearing on paper. One of the subjects, not sure that he had given the correct answer to the multiplication problem given him, did it over again in his mind, saying nothing to the doctors. Much to his astonishment, Dr. Gibbs afterward showed him on the transcription of his brain waves the place where he first did the multiplication, the place where he rested, the place where he did his own private checking of his multiplication, and where he again rested, satisfied that his answer had been correct.

Making It Painless

When Dr. Berger first started making electroencephalograms, he thought it was necessary to penetrate within the head to obtain the brain current records and so he inserted needle electrodes through the patient's skin. The Harvard scientists insert one tiny needle electrode in the lobe of the ear and the other in the scalp, using a local anesthetic first so that there is no pain when the needles

are inserted. The Brown scientists, however, fasten pieces of metal next to the skin on the patient's head and these pieces, acting as electrodes, pick up the brain currents without any sensation on the part of the patient.

Waves Magnified

The electrodes pick up the brain waves and send them through a vacuum tube amplifying set similar to those used in radios. This magnifies the brain waves so that the enhanced current can operate an oscillograph which writes in light on a photograph a wavy line corresponding to the fluctuations of the electricity in the brain. The fluctuations which appear on the photograph, or on a piece of paper something like ticker tape, represent the state of activity or changes in that state within the brain.

The size, shape and frequency of the waves all are thought to be significant. Scientists are not yet able to decode all the symbols in these messages from the brain and so they state that exact interpretations of the electroencephalograms cannot yet be made. They have already decoded enough of the symbols, however, to draw some interesting conclusions and to feel that the electroencephalograms will "prove significant in psychology and clinical neurology" as well as tell much about the brain's activity in mental and nervous diseases.

Two kinds of brain waves were detected by Dr. Berger. The biggest waves he called alpha waves, giving to the smaller ones the name of beta waves. The alpha waves, Dr. Berger found, became smaller when the patient was under certain types of anesthetic, during an epileptic seizure, and when the person being studied did a "mental" problem or had his senses stimulated. The waves are the largest when the person is relaxed.

Alpha and beta waves were also detected by Drs. Jasper and Carmichael. In addition they found another type of wave which appeared when the subject's senses were stimulated by light or sound. Further experiments may show that waves of this type are irritation or stimulation waves.

Slow in Illness

The frequency of the alpha waves does not vary much from day to day in the same person, the Brown University investigators reported. In one or two cases of illness, the frequency of these waves was very low.

Some normal persons and especially sick persons show different frequencies or lack of synchronism between the functioning of one side of the brain and that of the other. One girl, who was subject to "fits" or convulsions and who was quite ambidextrous, had an alpha-wave frequency of ten per second on the left side of her head and of but six to eight across the right side of her head.

Extremely interesting is the information Drs. Davis, Gibbs and associates of Harvard have gained from electroencephalograms of epileptic persons. Epilepsy, a malady characterized by sudden loss of consciousness and fits, today afflicts almost as many persons in the United States as tuberculosis. In spite of much research, physicians are still almost as baffled by it as were the old Roman doctors who tried to cure Julius Caesar of the seizures he suffered which are said to have been epilepsy.

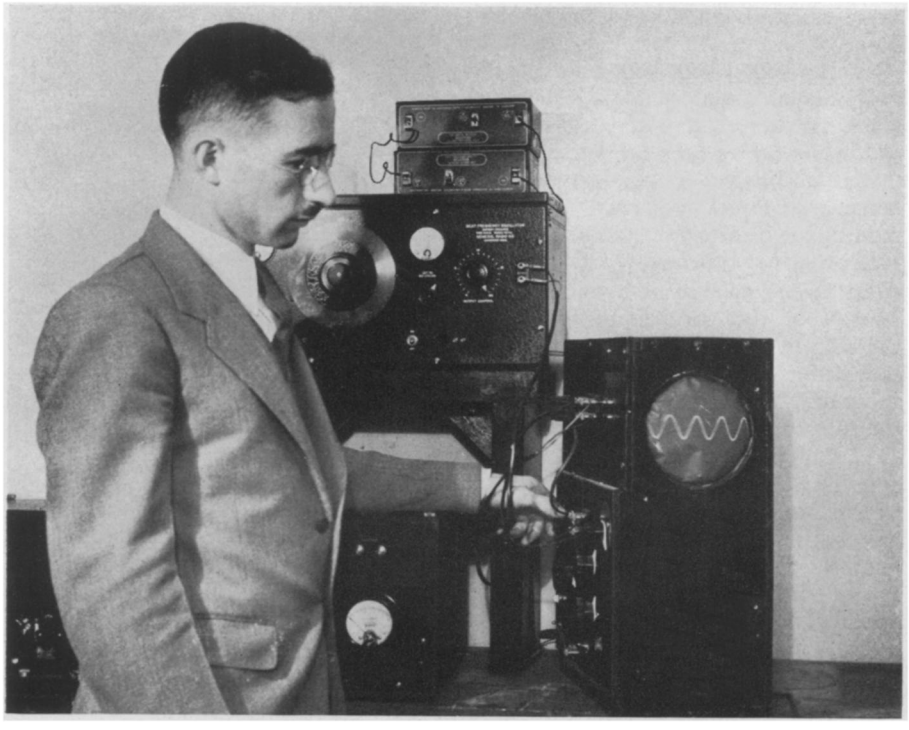
Epilepsy, the Harvard scientists find from study of electroencephalograms, is probably a nerve and brain storm—neurological storm, they call it—which results in great piling up of electrical discharges. Even between seizures, something is wrong with the brain and nervous system, the brain messages show. Normally the small waves come off from the brain at the rate of about ten per second. When a person is sleeping, in a faint, or loses consciousness temporarily in the strange sleep disease called narcolepsy, the brain waves are slowed down to about three to five per second and have about double the normal voltage.

In minor epilepsy, just before and during an attack, the brain waves come off at the rate of about three per second and in a strange pattern of large round waves with a spiky wave between the round ones. In major epilepsy both fast and slow waves of much greater than normal voltage are found.

Hopes For Future

These changes probably hold the clue to what is going on in the brain at the time of a seizure, and if they find just what the waves mean in terms of nervous activity, the Harvard scientists believe they may be able to find out what an epileptic seizure is and how it starts. If they find that in some cases it starts in a part of the brain which the surgeon can get at, there might be a chance that the part where the disorder starts could be removed. This prospect is far in the future, however, Dr. Gibbs emphasized.

Definite and characteristic changes appear in these patterns of brain activity when different kinds and different amounts of anesthetics are used, the Harvard scientists also found. The patterns are not the same when an animal is under ether, for example, as they are when he has been given avertin. Changes in the pattern of the brain waves also



NOT FOR MIND READING

But with this apparatus, being tested by Dr. H. H. Jasper of Brown University, the electric impulses from the brain can be observed or photographed.

occur when the animal's sensory nerves are stimulated, and from this observation the scientists hope to find how the brain activity is linked with the world outside, for example, what happens in the brain when you feel a touch on your arm. A difference between the electric messages picked up from the brain and those of nerves was found by the British scientist, Dr. Adrian.

The electrical disturbance which travels as an impulse along a nerve fiber spreads along the fiber as a momentary wave—a brief impulse followed by a brief interval of rest and recovery. In the cerebral cortex, the gray matter of the brain, on the other hand, instead of the abrupt spikes observed in a record from an active nerve fiber, there are more gradual large electric oscillations which form a series of waves of smooth contour. These are the brain waves.

The information being obtained about the brain and nerves by electrical means is expected to revolutionize our whole knowledge of the way the human mechanism works, in the opinion of some scientists. Commenting on these advances, Prof. C. Judson Herrick, of the University of Chicago, recently said: "I venture the prediction that the electrobiological era now beginning will yield as revolutionary changes in our conceptions of the physiology of the nervous system as the invention of the microscope inaugurated in anatomy."

Science News Letter, July 6, 1935

GEOLOGY

Earth Is Between 1850 And 3500 Million Years Old

HOW OLD is the earth? Write it down in the family album that its age is between 1850 and 3500 million years. This is the verdict of scientists speaking at the symposium in Los Angeles on "The Geologic and the Cosmic Age Scales."

The meeting, sponsored jointly by the American Physical Society and the Astronomical Society of the Pacific and held at the University of California at Los Angeles, disclosed the different ways science dates the approximate "birthday of the earth" over a thousand million years ago.

One technique is called the "hour glass" method since it is based on the amount and rate of sedimentation laid down by erosion over millions of years. It is comparable to measuring time by using the flow of sand through an hour glass. The difficulty is that no one can be sure that the rate of sedimentation was anywhere near constant through the long periods of time involved, said Dr. George D. Louderback of the University of California.

Much more accurate is the radioactive "time clock" method described by Dr. Robley Evans of Massachusetts Institute of Technology. Certain rocks of the earth contain the elements thorium and uranium, which continually disintegrate and finally form lead. The rate of doing this is unchanged by any natural phenomena yet found by science. Thus, the ratio of the lead to the thorium or uranium present shows how old the rock is.

Still more accurate is to measure the amount of the gas helium present in the sample. This gas is formed as the radioactive elements break down and shoot off alpha particles which are really the cores of helium atoms.

Finally, the impact of the alpha particles on the surrounding material forms, over long periods of time, very small haloes or rings. Some specimens of mica show these rings very well. The age of the sample can be determined by studying the size and fineness of these haloes.

All these methods, as well as others based on astronomical considerations, point to the earth's age—between 1,850,000,000 and 3,500,000,000 years.

Science News Letter, July 6, 1935

●RADIO

Tuesday, July 9, 3:30 p. m., E.S.T.

THE GEOLOGY OF THE DIAMOND, By Dr. F. L. Ransome, Professor of Economic Geology, California Institute of Technology.

Tuesday, July 16, 3:30 p. m., E.S.T.

WASTE BY WIND AND WATER, by H. H. Bennett, Director, Soil Erosion Service, U. S. Department of Agriculture.

In the Science Service series of radio addresses given by eminent scientists over the Columbia Broadcasting System.

ASTRONOMY

African Astronomer Discovers New Comet

A NEW object in the heavens has been reported to astronomers throughout the world by the International Astronomical Union bureau.

The object is a comet and was discovered by Dr. Cyril Jackson of the Union Observatory, Johannesburg, South Africa.

Of the thirteenth order ot astronomical brightness when found (June 19), the object was much too faint to be seen with the naked eye. It appeared low in the southeast sky just north of the bright star Antares, in the constellation of Scorpius. The astronomical coordinates were right ascension, sixteen hours, forty-four and three-tenths minutes; declination, minus nineteen degrees and forty-eight minutes.

The new comet was later sighted (June 24) by astronomers at Harvard College Observatory, Dr. Harlow Shapley reports.

Dr. Fred L. Whipple and Dr. L. E. Cunningham of the Observatory staff find that the brightness of the newest comet is diminishing. On June 24 it had dwindled to the fifteenth order.

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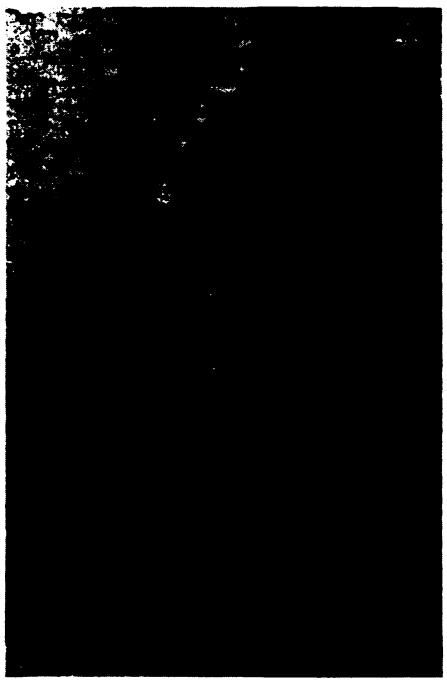

A CLOSE-UP

Showing the appearance of a section of the huge fulgurite shown on the facing page.