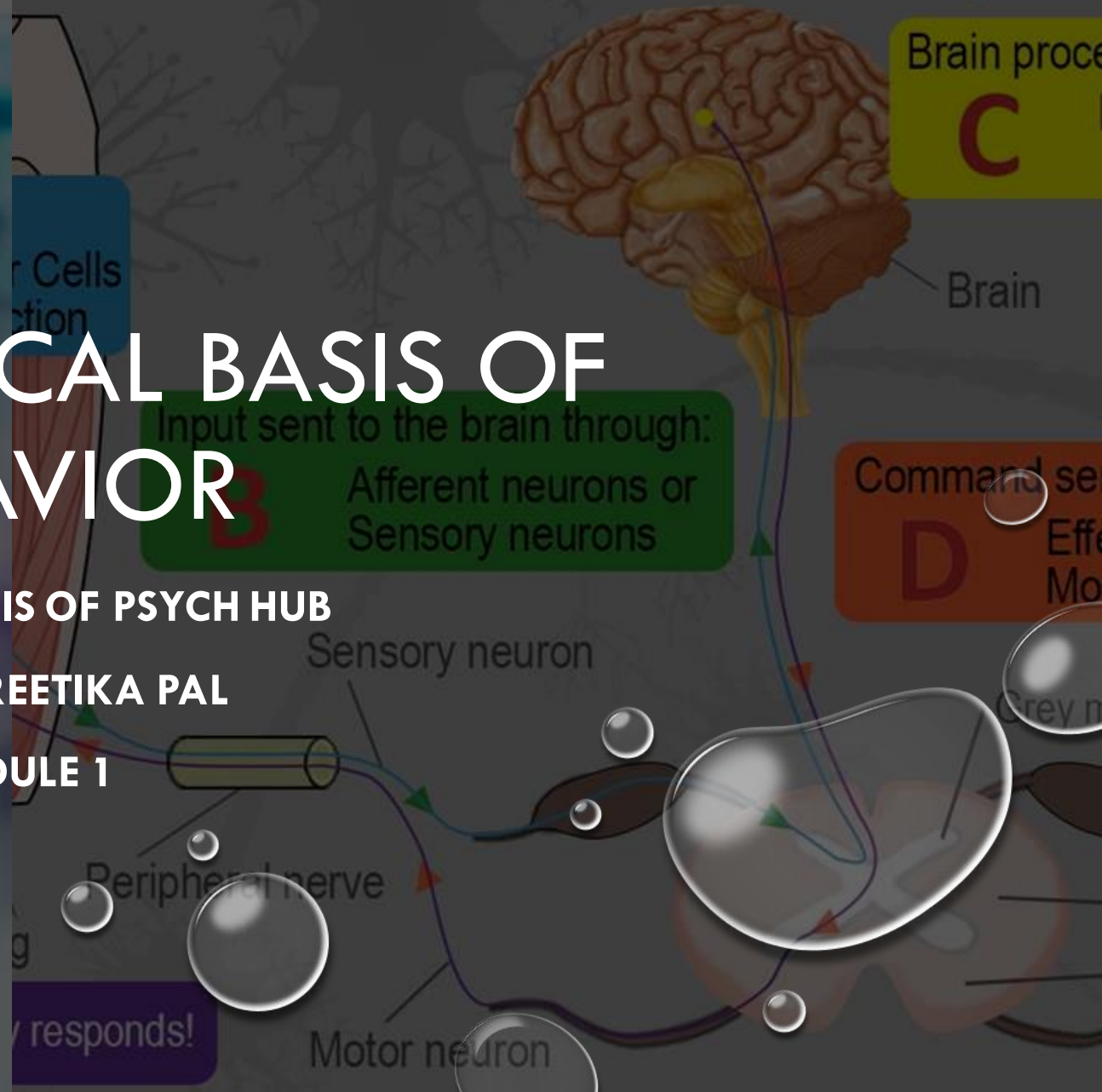


PHYSIOLOGICAL BASIS OF BEHAVIOR

UNDER THE AEGIS OF PSYCH HUB

BY PROF. REETIKA PAL

MODULE 1





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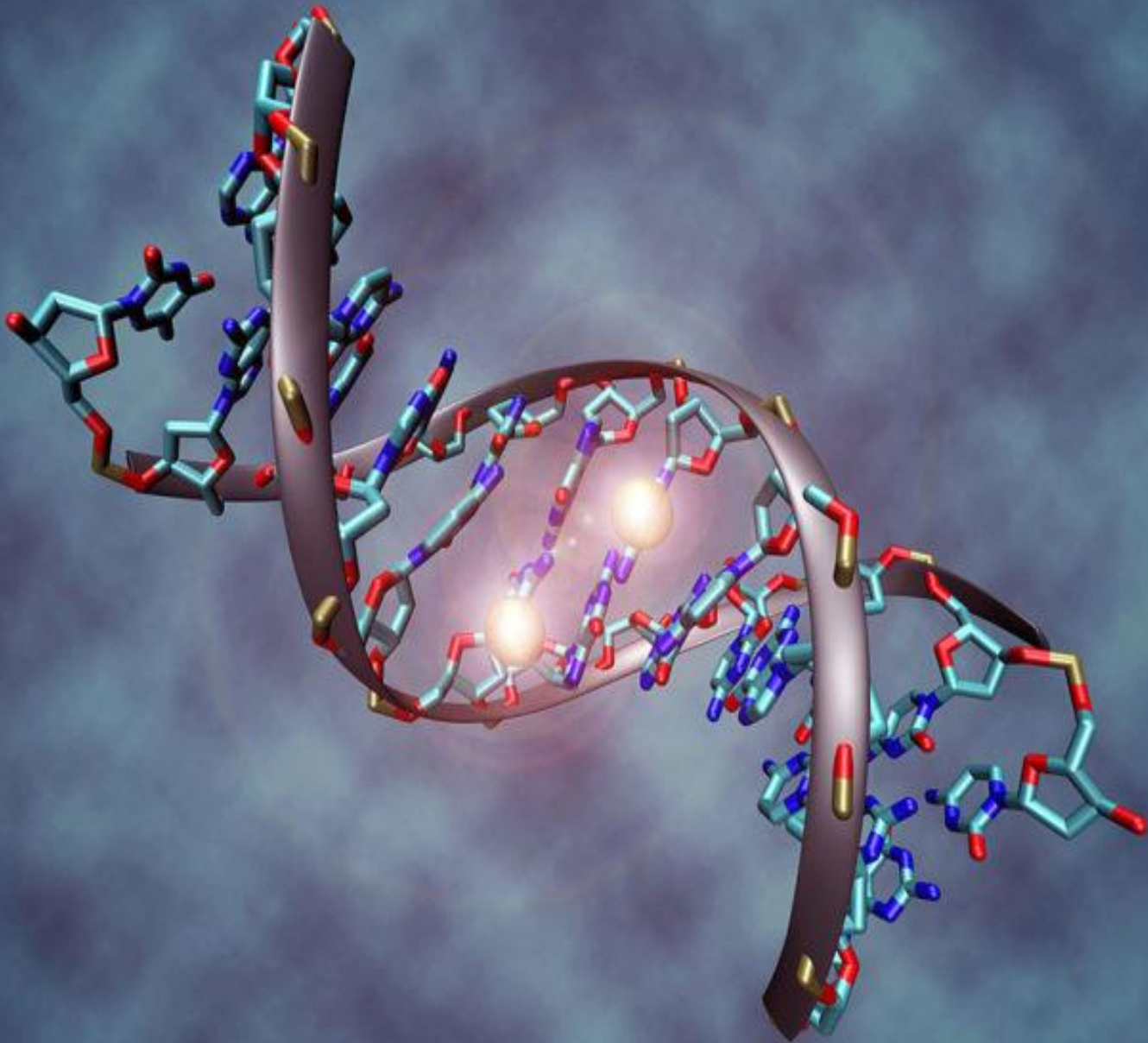
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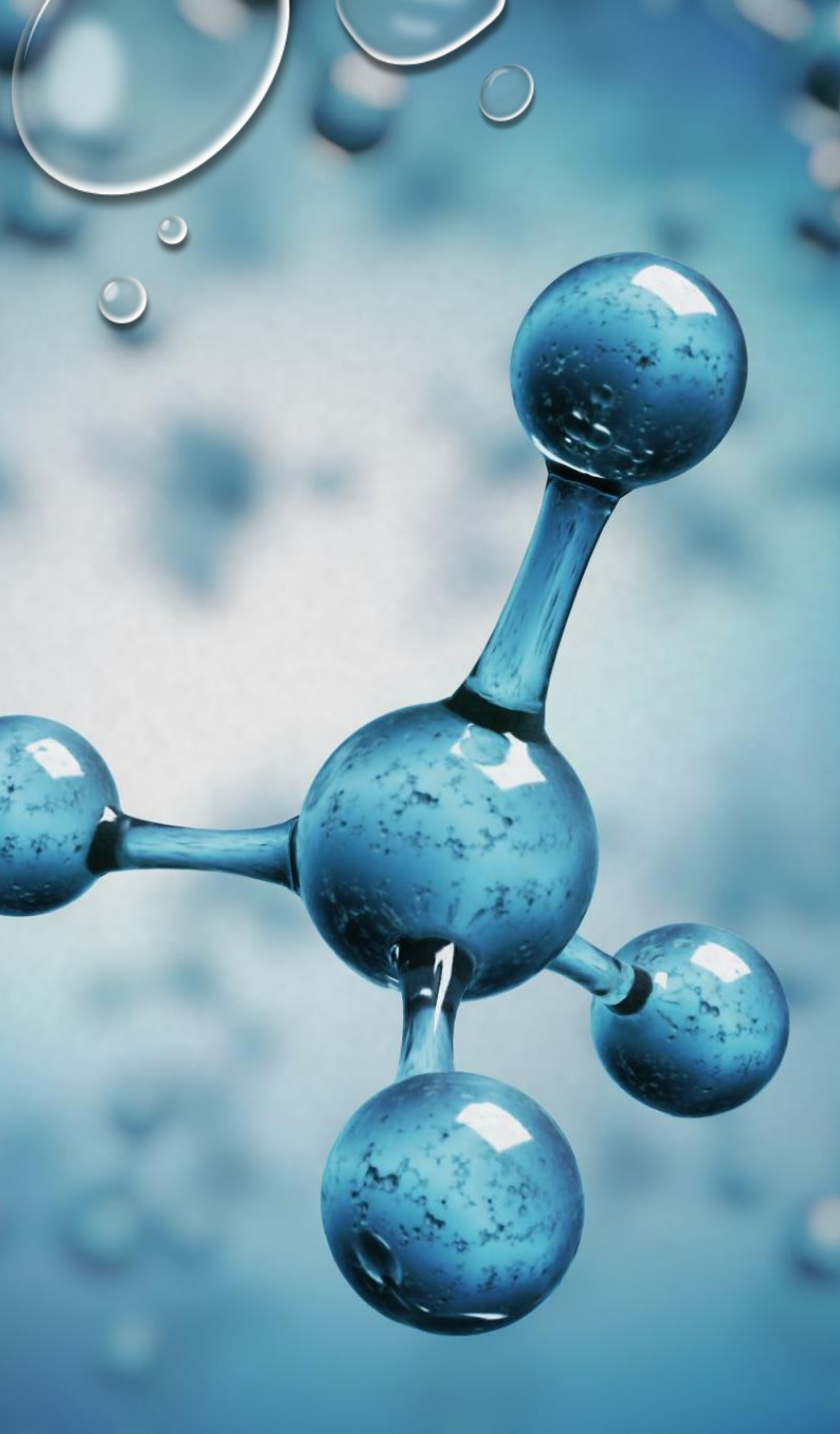


WHAT IS BIOPSYCHOLOGY

THE ORIGINS OF BEHAVIORAL NEUROSCIENCE

- THE TERM NEUROSCIENCE IDENTIFIES THE SUBJECT MATTER OF THE INVESTIGATION RATHER THAN THE SCIENTIST'S TRAINING.
- A NEUROSCIENTIST MAY BE A BIOLOGIST, A PHYSIOLOGIST, AN ANATOMIST, A NEUROLOGIST, A CHEMIST, A PSYCHOLOGIST, OR A PSYCHIATRIST—OR EVEN A COMPUTER SCIENTIST OR A PHILOSOPHER.
- PSYCHOLOGISTS WHO WORK IN THE AREA OF **NEUROSCIENCE SPECIALIZE IN BEHAVIORAL NEUROSCIENCE, THE BRANCH OF PSYCHOLOGY THAT STUDIES THE RELATIONSHIPS BETWEEN BEHAVIOR AND THE BODY, PARTICULARLY THE BRAIN.**

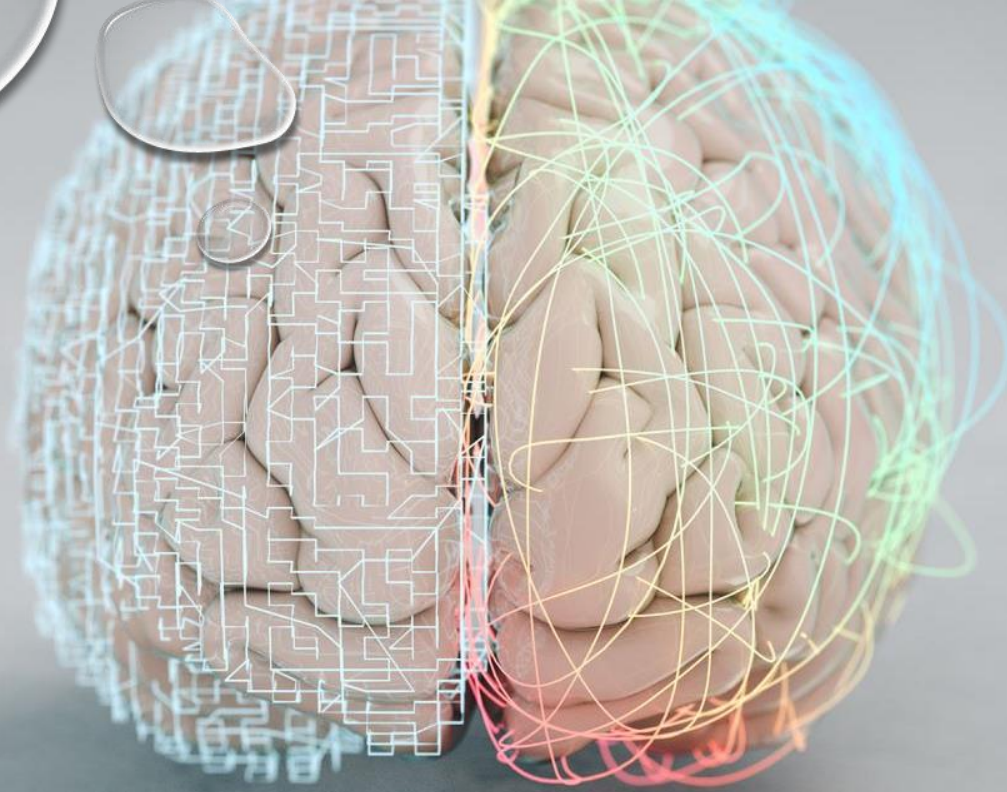




- **BEHAVIORAL NEUROSCIENCE IS THE MORE MODERN TERM FOR BIOLOGICAL PSYCHOLOGY; SOMETIMES THE TERM BIOPSYCHOLOGY, PSYCHOBIOLOGY, OR PHYSIOLOGICAL PSYCHOLOGY IS ALSO USED.**
- **FOR PSYCHOLOGISTS, BEHAVIOR HAS A VERY BROAD MEANING, WHICH INCLUDES NOT ONLY OVERT ACTS BUT ALSO INTERNAL EVENTS SUCH AS LEARNING, THINKING, AND EMOTION.**
- **BEHAVIORAL NEUROSCIENTISTS ATTEMPT TO ANSWER QUESTIONS LIKE “WHAT CHANGES IN THE BRAIN WHEN A PERSON LEARNS?” “WHY DOES ONE PERSON DEVELOP DEPRESSION AND ANOTHER, UNDER SIMILAR CIRCUMSTANCES, BECOMES ANXIOUS WHILE ANOTHER SEEMS UNAFFECTED?” “WHAT IS THE PHYSIOLOGICAL EXPLANATION FOR EMOTIONS?”**

HOW DOES IT RELATE TO PSYCHOLOGY?

- WRITERS HAVE POINTED OUT THAT PSYCHOLOGY HAS A BRIEF HISTORY BUT A LONG PAST. WHAT THEY MEAN IS THAT THINKERS HAVE STRUGGLED WITH THE QUESTIONS OF BEHAVIOR AND EXPERIENCE FOR MORE THAN TWO MILLENNIA, BUT PSYCHOLOGY AROSE AS A SEPARATE DISCIPLINE FAIRLY RECENTLY;
- THE DATE MOST PEOPLE ACCEPT IS 1879, WHEN WILHELM WUNDT ESTABLISHED THE FIRST PSYCHOLOGY LABORATORY IN LEIPZIG, GERMANY.
- **BUT BIOLOGICAL PSYCHOLOGY WOULD NOT EMERGE AS A SEPARATE SCIENCE UNTIL PSYCHOLOGISTS OFFERED CONVINCING EVIDENCE THAT THE BIOLOGICAL APPROACH COULD ANSWER SIGNIFICANT QUESTIONS ABOUT BEHAVIOR. TO DO SO, THEY WOULD HAVE TO COME TO TERMS WITH AN OLD PHILOSOPHICAL QUESTION ABOUT THE NATURE OF THE MIND. BECAUSE THE QUESTION FORMS A THREAD THAT HELPS US TRACE THE DEVELOPMENT OF BEHAVIORAL NEUROSCIENCE, WE WILL ORIENT OUR DISCUSSION AROUND THIS ISSUE.**



PRESCIENTIFIC PSYCHOLOGY AND THE MIND- BRAIN PROBLEM



- THIS ISSUE IS USUALLY CALLED “THE MIND-BODY PROBLEM,” BUT IT IS PHRASED DIFFERENTLY HERE TO PLACE THE EMPHASIS SQUARELY WHERE IT BELONGS—ON THE BRAIN. **THE MIND-BRAIN PROBLEM DEALS WITH WHAT THE MIND IS AND WHAT ITS RELATIONSHIP IS TO THE BRAIN.**

- THE POSITION IS KNOWN AS MONISM, FROM THE GREEK MONOS, MEANING “ALONE” OR “SINGLE.” MONISM IS THE IDEA **THAT THE MIND AND THE BODY CONSIST OF THE SAME SUBSTANCE.** IDEALISTIC MONISTS BELIEVE THAT EVERYTHING IS NONPHYSICAL MIND, BUT MOST MONISTS TAKE THE POSITION THAT THE BODY AND MIND AND EVERYTHING ELSE ARE PHYSICAL; THIS VIEW IS CALLED MATERIALISTIC MONISM. THE IDEA THAT THE MIND AND THE BRAIN ARE SEPARATE IS KNOWN AS DUALISM. FOR MOST DUALISTS, THE BODY IS MATERIAL AND THE MIND IS NONMATERIAL. MOST DUALISTS ALSO BELIEVE THAT THE MIND INFLUENCES BEHAVIOR BY INTERACTING WITH THE BRAIN.

The Greek philosophers were debating it in the fifth century BCE (G. Murphy, 1949), when Democritus proposed that everything in the world was made up of atoms (atomos, meaning “indivisible”), his term for the smallest particle possible. Even the soul, which included the mind, was made up of atoms, so it, too, was material..

Plato and Aristotle, considered the two greatest intellectuals among the ancient Greeks, continued the argument into the fourth century BCE. Plato was a dualist, whereas his student Aristotle joined the body and soul in his attempt to explain memory, emotions, and reasoning.



DESCARTES AND THE PHYSICAL MODEL OF BEHAVIOR

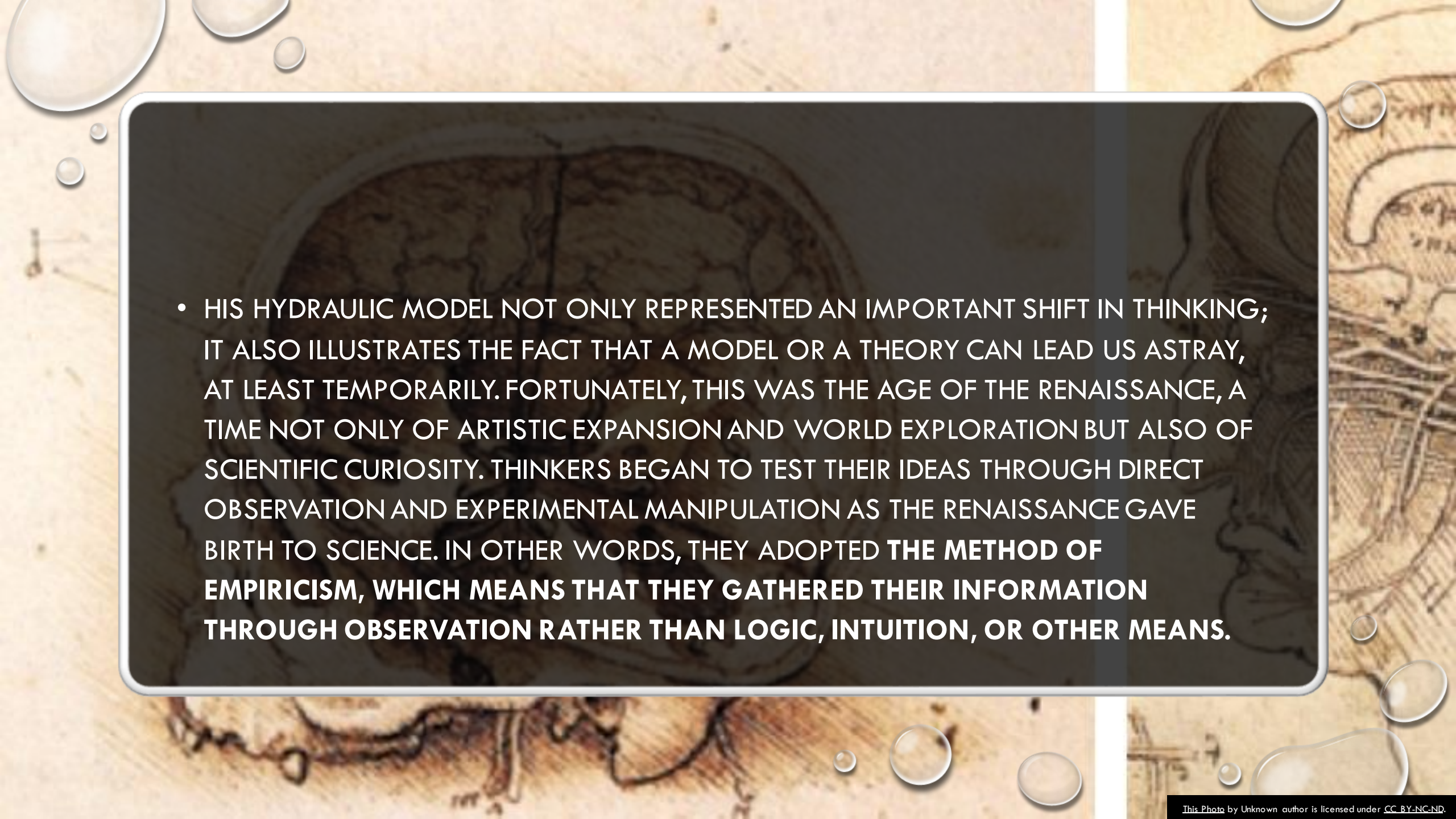
- SCIENTISTS OFTEN RESORT TO THE USE OF MODELS TO UNDERSTAND WHATEVER THEY ARE STUDYING. A MODEL IS A PROPOSED MECHANISM FOR HOW SOMETHING WORKS. SOMETIMES, A MODEL IS IN THE FORM OF A THEORY, SUCH AS CHARLES DARWIN'S EXPLANATION THAT A SPECIES DEVELOPED NEW CAPABILITIES BECAUSE THE CAPABILITY ENHANCED THE INDIVIDUAL'S SURVIVAL AND OPPORTUNITY TO REPRODUCE.

- OTHER TIMES, THE MODEL IS A SIMPLER ORGANISM OR SYSTEM THAT RESEARCHERS STUDY IN AN ATTEMPT TO UNDERSTAND A MORE COMPLEX ONE. FOR EXAMPLE, RESEARCHERS HAVE USED THE RAT TO MODEL EVERYTHING FROM LEARNING TO ALZHEIMER'S DISEASE IN HUMANS, AND THE COMPUTER HAS OFTEN SERVED AS A MODEL OF COGNITIVE PROCESSES.



- IN THE 17TH CENTURY, THE FRENCH PHILOSOPHER AND PHYSIOLOGIST RENÉ DESCARTES USED A HYDRAULIC MODEL TO EXPLAIN THE BRAIN'S ACTIVITY (DESCARTES, 1662/1984).
- DESCARTES'S CHOICE OF A HYDRAULIC MODEL WAS INFLUENCED BY HIS OBSERVATION OF THE STATUES IN THE ROYAL GARDENS AT ST. GERMAIN. WHEN A VISITOR STEPPED ON CERTAIN TILES, THE PRESSURE FORCED WATER THROUGH TUBES TO THE STATUES AND MADE THEM MOVE.
- USING THIS MODEL, DESCARTES THEN REASONED THAT THE NERVES WERE ALSO HOLLOW TUBES. THE FLUID THEY CARRIED WAS NOT WATER, BUT WHAT HE CALLED "ANIMAL SPIRITS"; THESE FLOWED FROM THE BRAIN AND INFLATED THE MUSCLES TO PRODUCE MOVEMENT. SENSATIONS, MEMORIES, AND OTHER MENTAL FUNCTIONS WERE PRODUCED AS ANIMAL SPIRITS FLOWED THROUGH "PORES" IN THE BRAIN.

- DESCARTES'S CHOICE OF THE PINEAL GLAND WAS BASED ON HIS CONCLUSION THAT IT WAS AT A PERFECT LOCATION TO SERVE THIS FUNCTION. ATTACHED JUST BELOW THE TWO CEREBRAL HEMISPHERES BY ITS FLEXIBLE STALK, IT APPEARED CAPABLE OF BENDING AT DIFFERENT ANGLES TO DIRECT THE FLOW OF ANIMAL SPIRITS INTO CRITICAL AREAS OF THE BRAIN. **THUS, FOR DESCARTES, THE PINEAL GLAND BECAME THE "SEAT OF THE SOUL," THE PLACE WHERE THE MIND INTERACTED WITH THE BODY. ALTHOUGH DESCARTES ASSIGNED CONTROL TO THE MIND, HIS UNUSUAL EMPHASIS ON THE PHYSICAL EXPLANATION OF BEHAVIOR FORESHADOWED THE PHYSIOLOGICAL APPROACH THAT WOULD SOON FOLLOW.**

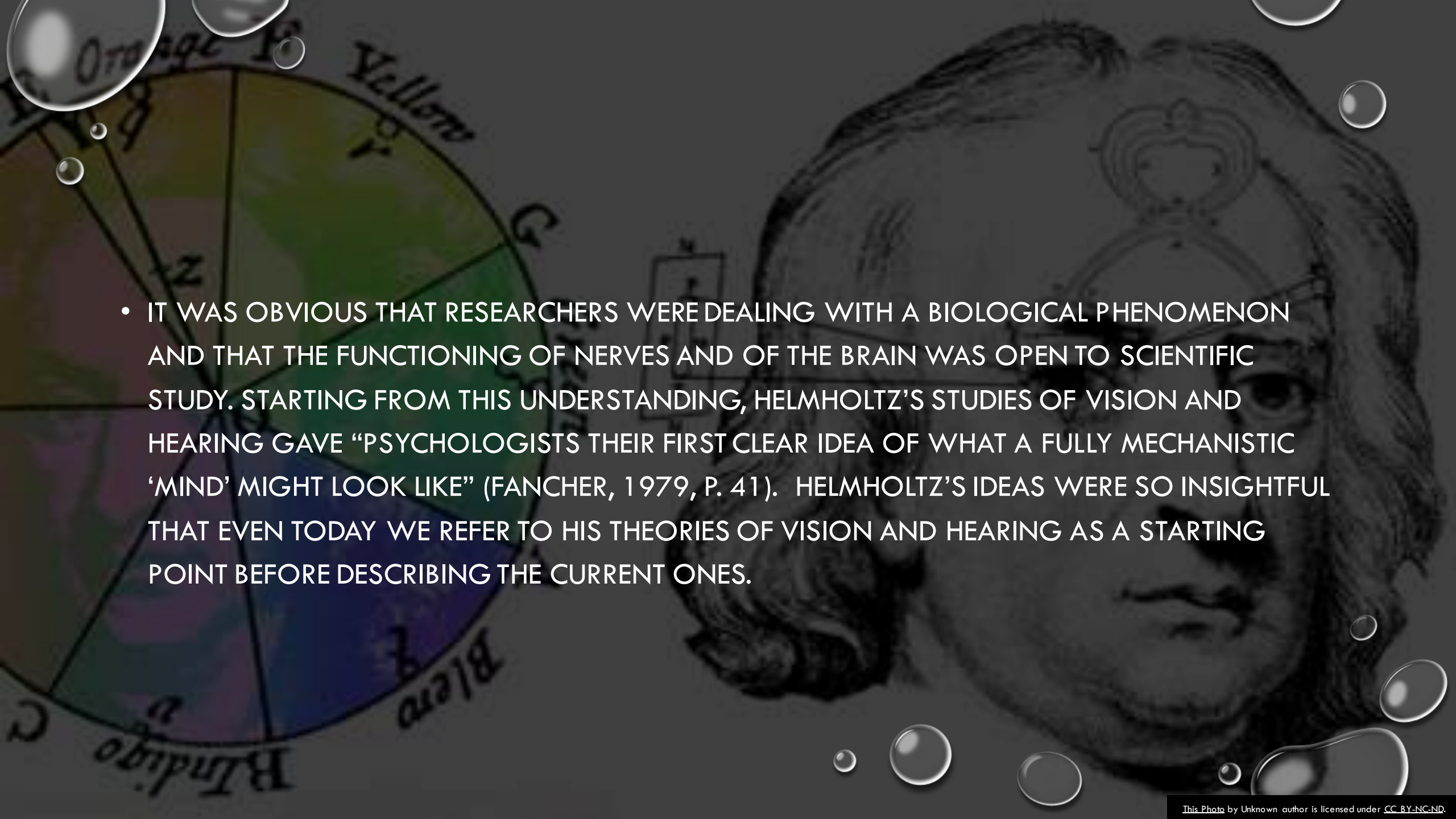
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- HIS HYDRAULIC MODEL NOT ONLY REPRESENTED AN IMPORTANT SHIFT IN THINKING; IT ALSO ILLUSTRATES THE FACT THAT A MODEL OR A THEORY CAN LEAD US ASTRAY, AT LEAST TEMPORARILY. FORTUNATELY, THIS WAS THE AGE OF THE RENAISSANCE, A TIME NOT ONLY OF ARTISTIC EXPANSION AND WORLD EXPLORATION BUT ALSO OF SCIENTIFIC CURIOSITY. THINKERS BEGAN TO TEST THEIR IDEAS THROUGH DIRECT OBSERVATION AND EXPERIMENTAL MANIPULATION AS THE RENAISSANCE GAVE BIRTH TO SCIENCE. IN OTHER WORDS, THEY ADOPTED **THE METHOD OF EMPIRICISM, WHICH MEANS THAT THEY GATHERED THEIR INFORMATION THROUGH OBSERVATION RATHER THAN LOGIC, INTUITION, OR OTHER MEANS.**



HELMHOLTZ AND THE ELECTRICAL BRAIN

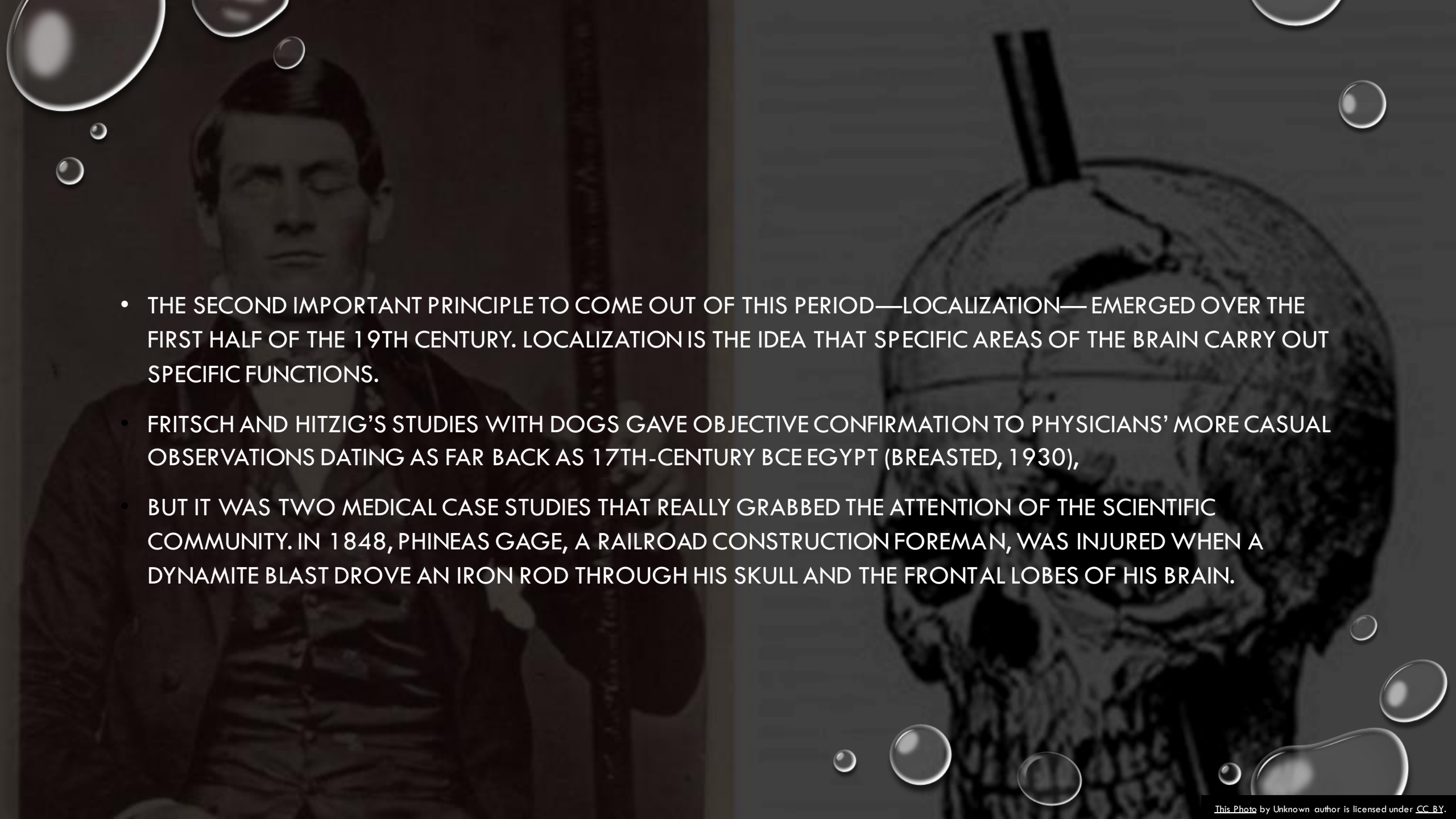
- IN THE LATE 1700S, THE ITALIAN PHYSIOLOGIST LUIGI GALVANI SHOWED THAT HE COULD MAKE A FROG'S LEG MUSCLE TWITCH BY STIMULATING THE ATTACHED NERVE WITH ELECTRICITY, EVEN AFTER THE NERVE AND MUSCLE HAD BEEN REMOVED FROM THE FROG'S BODY.
- A CENTURY LATER IN GERMANY, GUSTAV FRITSCH AND EDUARD HITZIG (1870) PRODUCED MOVEMENT IN DOGS BY ELECTRICALLY STIMULATING THEIR EXPOSED BRAINS. WHAT THESE SCIENTISTS SHOWED WAS THAT ANIMAL SPIRITS WERE NOT RESPONSIBLE FOR MOVEMENT; INSTEAD, THE CAUSE WAS NERVES OPERATED BY ELECTRICITY! BUT THE GERMAN PHYSICIST AND PHYSIOLOGIST **HERMANN VON HELMHOLTZ**.
- DEMONSTRATED THAT NERVES DO NOT BEHAVE LIKE WIRES CONDUCTING ELECTRICITY. HE WAS ABLE TO MEASURE THE SPEED OF CONDUCTION IN NERVES, AND HIS CALCULATION OF ABOUT 90 FEET/SECOND (27.4 METERS/SECOND) FELL FAR SHORT OF THE SPEED OF ELECTRICITY, WHICH TRAVELS THROUGH WIRES AT THE SPEED OF LIGHT (186,000 MILES/SECOND OR 299,000 KILOMETERS/SECOND).



- 
- IT WAS OBVIOUS THAT RESEARCHERS WERE DEALING WITH A BIOLOGICAL PHENOMENON AND THAT THE FUNCTIONING OF NERVES AND OF THE BRAIN WAS OPEN TO SCIENTIFIC STUDY. STARTING FROM THIS UNDERSTANDING, HELMHOLTZ'S STUDIES OF VISION AND HEARING GAVE "PSYCHOLOGISTS THEIR FIRST CLEAR IDEA OF WHAT A FULLY MECHANISTIC 'MIND' MIGHT LOOK LIKE" (FANCHER, 1979, P. 41). HELMHOLTZ'S IDEAS WERE SO INSIGHTFUL THAT EVEN TODAY WE REFER TO HIS THEORIES OF VISION AND HEARING AS A STARTING POINT BEFORE DESCRIBING THE CURRENT ONES.

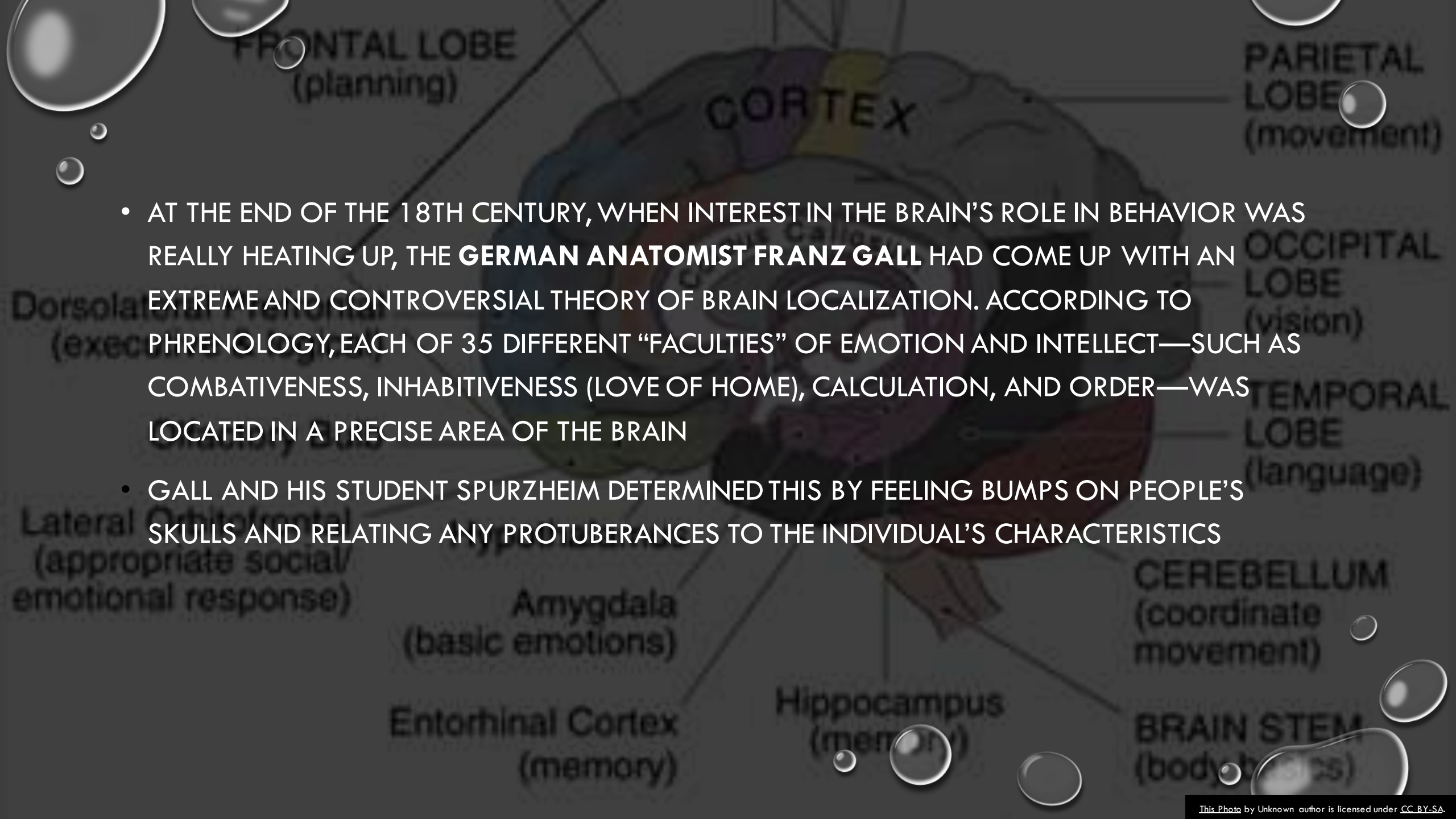
The background features a dark blue and purple gradient with several brain MRI scan slices. Technical text from the scans is visible, including 'Tra>Cor(6.1)>Seq(1)', 'AF', 'RFP', '5cm', 'TP 0', 'TR 6300.0', and 'TE 124.0'. Numerous water droplets of various sizes are scattered across the image, some appearing to float in the foreground. The overall aesthetic is scientific and digital.

THE LOCALIZATION ISSUE OF THE BRAIN

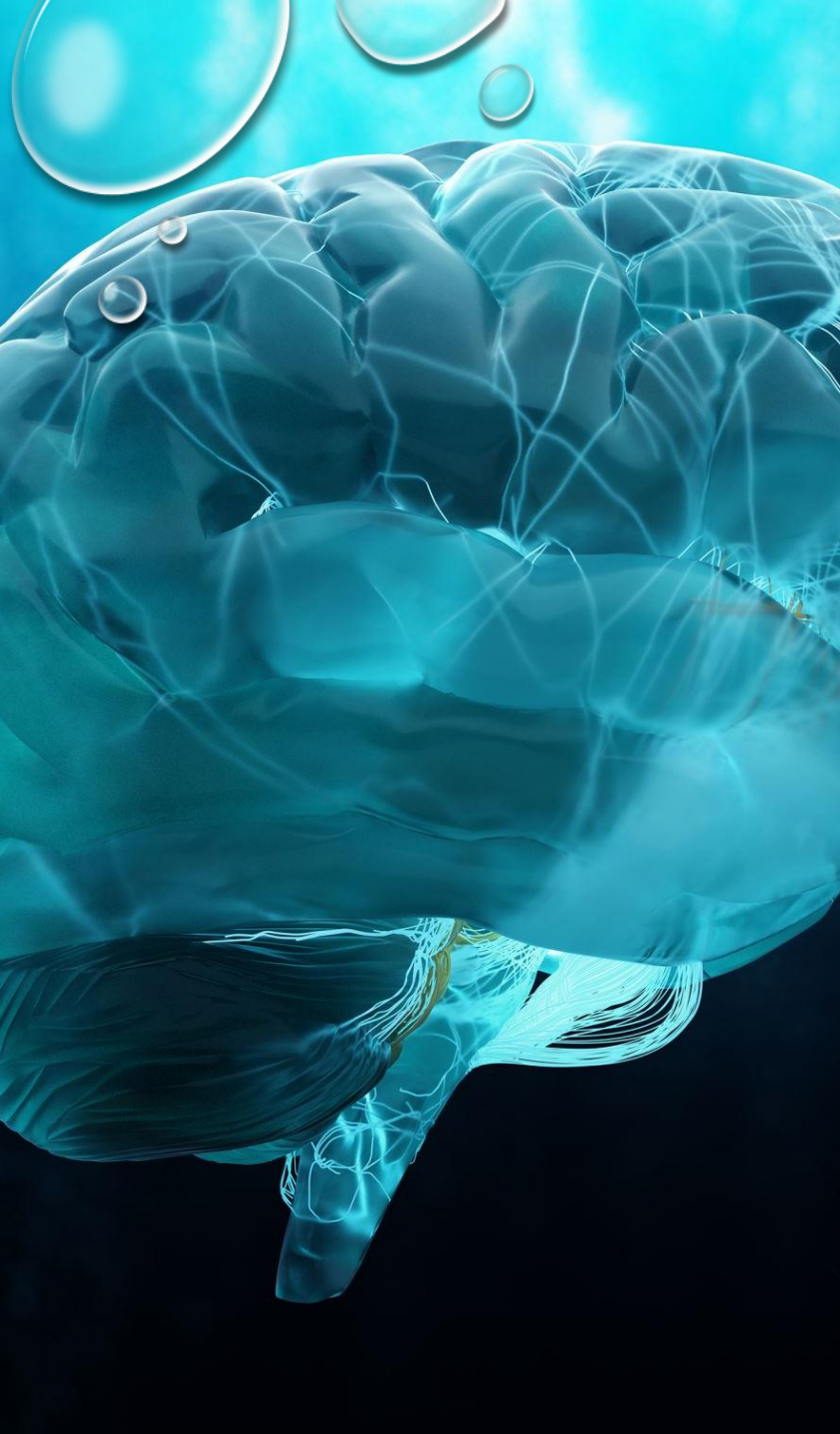
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- THE SECOND IMPORTANT PRINCIPLE TO COME OUT OF THIS PERIOD—LOCALIZATION—EMERGED OVER THE FIRST HALF OF THE 19TH CENTURY. LOCALIZATION IS THE IDEA THAT SPECIFIC AREAS OF THE BRAIN CARRY OUT SPECIFIC FUNCTIONS.
 - FRITSCH AND HITZIG'S STUDIES WITH DOGS GAVE OBJECTIVE CONFIRMATION TO PHYSICIANS' MORE CASUAL OBSERVATIONS DATING AS FAR BACK AS 17TH-CENTURY BCE EGYPT (BREASTED, 1930),
 - BUT IT WAS TWO MEDICAL CASE STUDIES THAT REALLY GRABBED THE ATTENTION OF THE SCIENTIFIC COMMUNITY. IN 1848, PHINEAS GAGE, A RAILROAD CONSTRUCTION FOREMAN, WAS INJURED WHEN A DYNAMITE BLAST DROVE AN IRON ROD THROUGH HIS SKULL AND THE FRONTAL LOBES OF HIS BRAIN.

- AMAZINGLY, HE SURVIVED WITH NO IMPAIRMENT OF HIS INTELLIGENCE, MEMORY, SPEECH, OR MOVEMENT. BUT HE BECAME IRRESPONSIBLE AND PROFANE AND WAS UNABLE TO ABIDE BY SOCIAL CONVENTIONS (H. DAMASIO, GRABOWSKI, FRANK, GALABURDA, & DAMASIO, 1994).

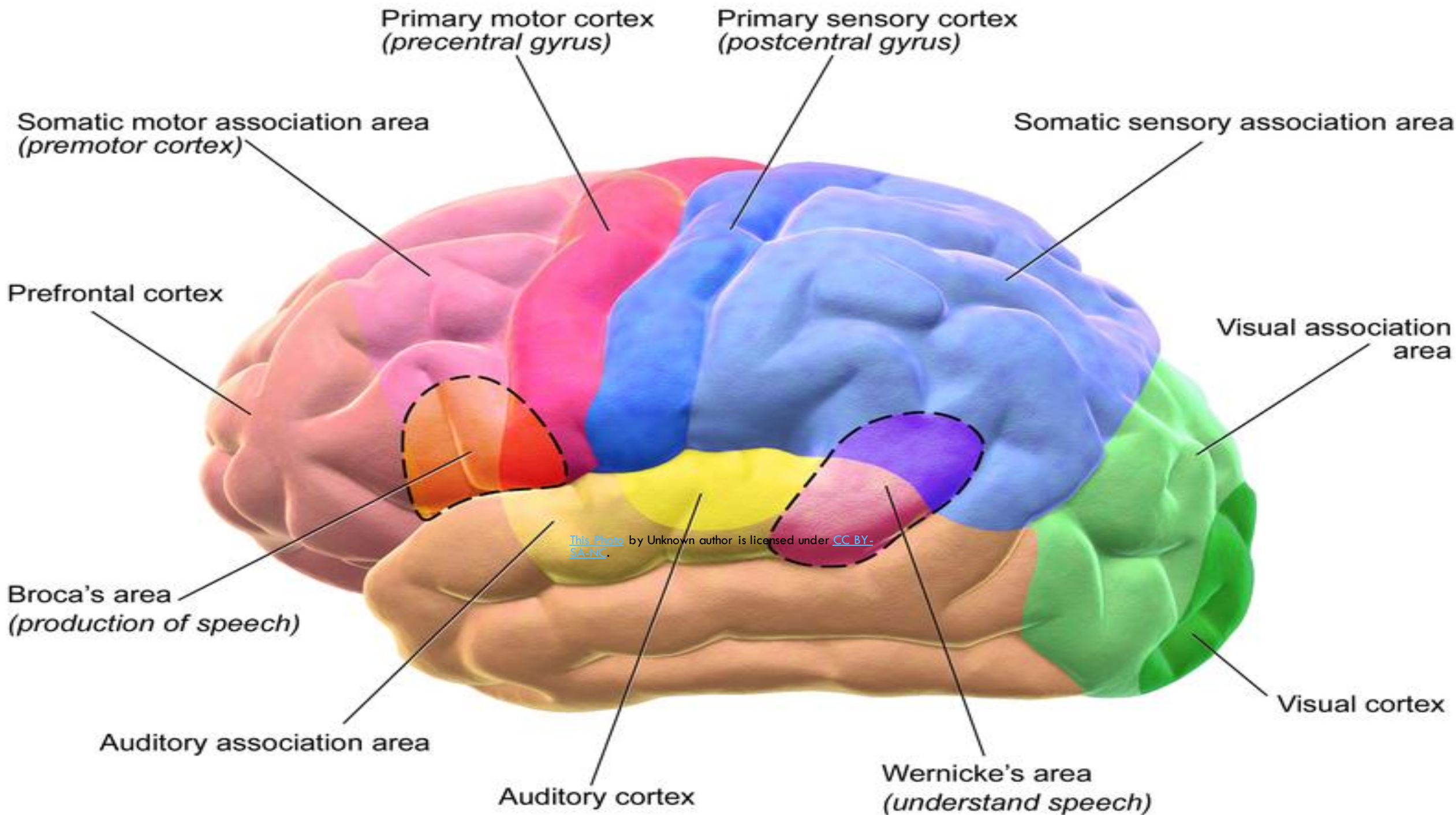
THEN, IN 1861, THE FRENCH PHYSICIAN PAUL BROCA PERFORMED AN AUTOPSY ON THE BRAIN OF A MAN WHO HAD LOST THE ABILITY TO SPEAK AFTER A STROKE. THE AUTOPSY SHOWED THAT DAMAGE WAS LIMITED TO AN AREA ON THE LEFT SIDE OF HIS BRAIN NOW KNOWN AS BROCA'S AREA.

- 
- An anatomical diagram of the human brain with various regions labeled. The labels include: FRONTAL LOBE (planning), CORTICES, PARIETAL LOBE (movement), OCCIPITAL LOBE (vision), TEMPORAL LOBE (language), CEREBELLUM (coordinate movement), BRAIN STEM (body functions), Amygdala (basic emotions), Entorhinal Cortex (memory), Hippocampus (memory), Dorsolateral Prefrontal Cortex (executive functions), and Lateral Orbitofrontal Cortex (appropriate social/emotional response).
- AT THE END OF THE 18TH CENTURY, WHEN INTEREST IN THE BRAIN'S ROLE IN BEHAVIOR WAS REALLY HEATING UP, THE **GERMAN ANATOMIST FRANZ GALL** HAD COME UP WITH AN EXTREME AND CONTROVERSIAL THEORY OF BRAIN LOCALIZATION. ACCORDING TO PHRENOLOGY, EACH OF 35 DIFFERENT "FACULTIES" OF EMOTION AND INTELLECT—SUCH AS COMBATIVENESS, INHABITIVENESS (LOVE OF HOME), CALCULATION, AND ORDER—WAS LOCATED IN A PRECISE AREA OF THE BRAIN
 - GALL AND HIS STUDENT SPURZHEIM DETERMINED THIS BY FEELING BUMPS ON PEOPLE'S SKULLS AND RELATING ANY PROTUBERANCES TO THE INDIVIDUAL'S CHARACTERISTICS

- OTHERS, SUCH AS KARL LASHLEY (1929), TOOK AN EQUALLY EXTREME POSITION AT THE OTHER END OF THE SPECTRUM; EQUIPOTENTIALITY IS THE IDEA THAT THE BRAIN FUNCTIONS AS AN UNDIFFERENTIATED WHOLE. ACCORDING TO THIS VIEW, THE EXTENT OF DAMAGE, NOT THE LOCATION, DETERMINES HOW MUCH FUNCTION IS LOST.
- TODAY'S RESEARCH TELLS US THAT FUNCTIONS ARE AS MUCH DISTRIBUTED AS THEY ARE LOCALIZED; BEHAVIOR RESULTS FROM THE INTERACTION OF MANY WIDESPREAD AREAS OF THE BRAIN.



- UNDERSTAND THAT THE NATURE AND ROLE OF THE MIND ARE STILL DEBATED IN SOME QUARTERS. FOR EXAMPLE, SOME NEUROSCIENTISTS BELIEVE THAT BRAIN RESEARCH WILL BE UNABLE TO EXPLAIN HOW A MATERIAL BRAIN CAN GENERATE CONSCIOUS EXPERIENCE, AND THAT THIS WILL SPELL THE FINAL DOOM OF MATERIALISM. THESE NONMATERIAL NEUROSCIENTISTS INTERPRET THE BRAIN CHANGES THAT OCCUR DURING BEHAVIOR THERAPY AS EVIDENCE OF THE MIND CHANGING THE BRAIN.
- NEUROSCIENCE HAS BEEN ABLE TO EXPLAIN A GREAT DEAL OF BEHAVIOR WITHOUT ANY REFERENCE TO A NONMATERIAL MIND, AND AS YOU EXPLORE THE REST OF THIS TEXT YOU WILL BEGIN TO SEE WHY MOST BRAIN SCIENTISTS WOULD DESCRIBE THEMSELVES AS MATERIAL MONISTS.





TOMORROW LEARNING

NATURE V/S NURTURE

GENETIC THEORY AND BEHAVIOR

ASSESSMENT IN NEUROPSYCHOLOGY

