

## LIMITS OF INQUIRY

I WANT TO JUST SAY A FEW WORDS ABOUT  
WHAT GREEN & FRANKLIN SAY ABOUT WHAT MIGHT  
BE BEYOND OUR ABILITY IN SCIENCE.

GREENE CASTS THIS IN TERMS OF THINGS LIKE

STRING THEORY

MANY WORLDS QUANTUM MECHANICS

THE MULTIVERSE

ALL OF THESE IMPLY THAT REALITY IS VERY  
MUCH NOT WHAT IT SEEMS

OVER THE COURSE OF SCIENCE WE'VE LEARNED  
THAT UNDERSTANDING NATURE HAS REQUIRED  
SWEEPING CHANGES IN OUR UNDERSTANDING  
OF REALITY.

COMMON EXPERIENCE IS NOT A GOOD GUIDE  
FOR AREAS BEYOND OUR EXPERIENCE

THE BASIC ASSUMPTION OF SCIENCE IS THAT  
REGULARITIES AND PATTERNS WILL OCCUR  
AT ALL SCALES

→ BUT THE SAME PATTERNS MAY NOT  
REPEAT AT ALL SCALES

→ SURPRISES

PHYSICAL SCIENCE EXHIBITS GLOBAL STABILITY

NEW UNDERSTANDING DOES NOT USUALLY  
SUPPLANT OLD UNDERSTANDING.

↳ PHYSICS HAS MAINTAINED  
AN IMPRESSIVE COHERENCE

GREENE DISCUSSES WHAT HE CALLS

FIVE CENTRAL QUESTIONS

# IS THE COPERNICAN PATTERN FUNDAMENTAL

OUR EARTH IS NOT CENTRAL

OUR SUN IS NOT CENTRAL

OUR GALAXY IS NOT CENTRAL

OUR UNIVERSE IS NOT CENTRAL?

WE ARE NOT CENTRAL?

→ BUT WE ARE → OBSERVERS

# CAN THE MULTIVERSE BE TESTED?

WE COVERED THIS LAST WEEK

BY INVOKING REALMS BEYOND OUR ABILITY  
TO EXAMINE → ARE WE DOING SCIENCE

STATISTICAL COMPARISON OF ALL POSSIBLE  
UNIVERSES WITH WHAT WE SEE

TYPICAL VS ATYPICAL

+

ANTHROPIC PRINCIPLE

ONLY ONE STANDARD — EXPLAIN OR PREDICT  
EXPERIMENTAL DATA

OUR THEORETICAL IDEAS HAVE OUTSTRIPPED  
OUR TECHNICAL ABILITY TO EXPERIMENT  
IS SCIENCE RESTRICTED TO WHAT WE CAN  
EXPERIMENT ON NOW?

OF COURSE NOT → BUT IF IT IS IMPOSSIBLE  
TO OBSERVE IN  
PRINCIPLE?

# DOES THE MULTIVERSE ALTER OUR IDEA OF WHAT SCIENCE IS?

SCIENCE NEEDS THREE THINGS TO UNDERSTAND  
THE PAST & FUTURE OF A SYSTEM.

- 1) LAW OF NATURE → eg SCHRÖDINGER
- 2) PHYSICAL CONSTANTS → eg  $\hbar$ ,  $m_e$
- 3) INITIAL CONDITIONS

CAN ALL 3 OF THESE BE UNDERSTOOD?  
OR ARE SOME (ALL) OF THEM CONTINGENT?

# SHOULD MATHEMATICS "LEAD" US ?

WE DISCUSSED HOW ONE USUALLY "GETS  
MORE OUT OF MATHEMATICS THAN WE  
PUT IN"

SHOULD WE ACCEPT THE REALITY OF  
THINGS IMPLIED BY MATHEMATICS THAT  
WE CAN NEVER OBSERVE ?



FRANKLIN ADDRESSES A VERY DIFFERENT QUESTION

ARE THERE THINGS THAT WE CAN OBSERVE WHICH  
SCIENCE CANNOT EXPLAIN

ONE IS, TO MY MIND, STILL UNDECIDED

HUMAN CONSCIOUSNESS

THE OTHER, AGAIN TO MY MIND, IS CLEAR

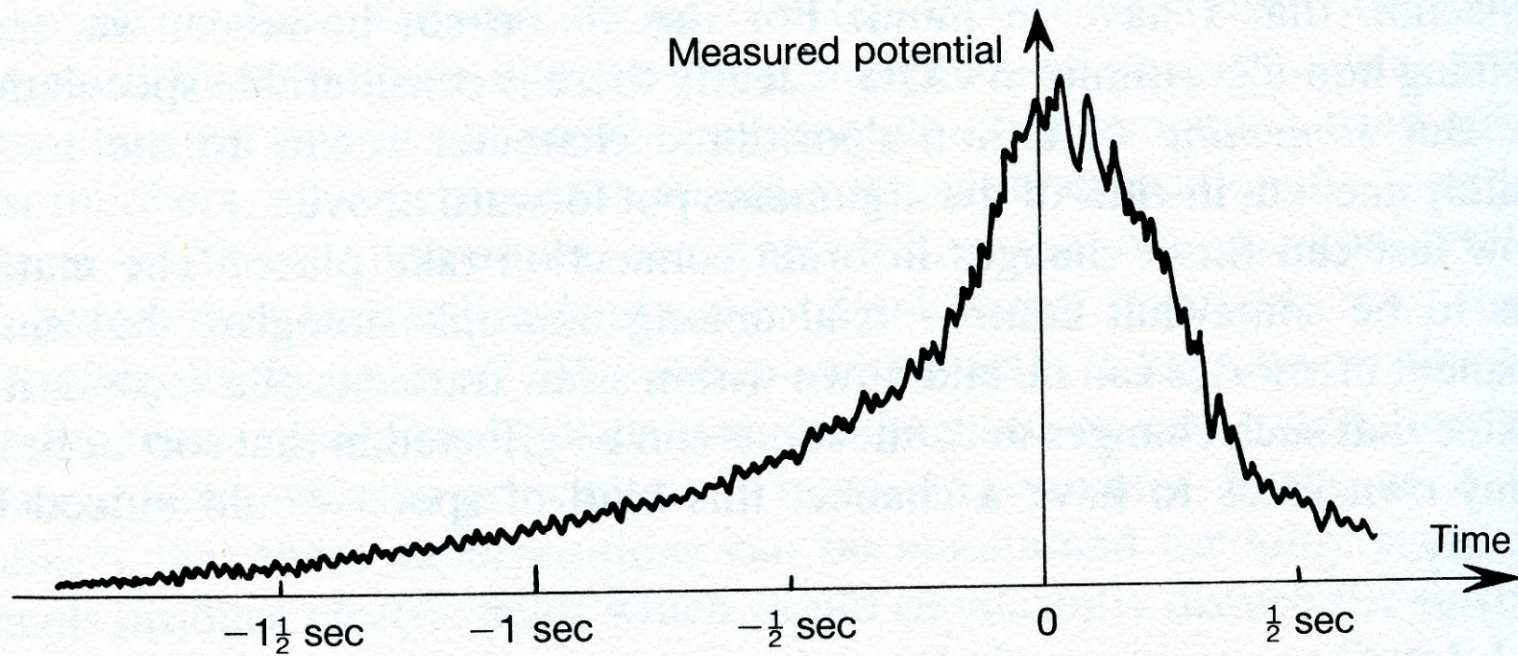
ETHICS

# HUMAN CONSCIOUSNESS

WE UNDERSTAND MUCH ABOUT THE WORKING OF THE BRAIN. I DON'T THINK WE HAVE ANY IDEA HOW PHYSICAL EVENTS ARE CONNECTED TO OUR INTERNAL MENTALITY

EXAMPLE OF SCIENTIST FORCED TO INVESTIGATE WORLD THROUGH BLACK/WHITE MONITOR. SHE KNOWS ALL ABOUT DIFFERENT FREQUENCIES OF LIGHT → COLOURS

CAN SHE EVER UNDERSTAND THE SENSATION OF COLOUR VISION?  
SHE HAD ALL THE PHYSICAL INFORMATION, BUT CONSCIOUSNESS WAS MORE THAN THAT.



*Fig. 10.5.* Kornhuber's experiment. The decision to flex the finger appears to be made at time 0, yet the precursor signal (averaged over many trials) suggest a 'foreknowledge' of the intention to flex.

I HAVE HAD THE EXPERIENCE OF WALKING  
OVER TO PICK UP A PHONE → AND THEN  
HEARING IT RING

THERE CERTAINLY SEEM TO BE STRANGE  
PHENOMENA INVOLVING TIME ORDERING  
IN CONSCIOUSNESS

SINCE WE HAVE DIFFICULTY UNDERSTANDING  
WHAT THE PASSAGE OF TIME IS -----

IF CONSCIOUSNESS IS JUST A TRAIN  
OF CAUSAL EVENTS → WHAT ABOUT  
FREE WILL?

FEYNMAN TALKS ABOUT WHETHER CLASSICAL  
PHYSICS IS REALLY DETERMINISTIC. HE GIVES  
THE EXAMPLE OF A WATERFALL.

YOU CANNOT DETERMINE THE INITIAL  
CONDITIONS OF EACH DROP OF WATER

IN REALITY YOU CANNOT PREDICT  
BEHAVIOURAL DETAILS OF A WATERFALL  
→ AVERAGE, YES.

# ETHICS

FRANKLIN QUOTES DAVID HUME

CANNOT DERIVE "OUGHT" FROM "IS"

STUDIES OF THE EVOLUTIONS OF BEHAVIOUR

(E.G. ALTRUISM) CAN NEVER SHOW US WHY

WE THINK (KNOW?) SOME THINGS ARE

GOOD & SOME EVIL. ALTHOUGH YOU WILL

FIND THIS ASSUMED IN MANY BOOKS,

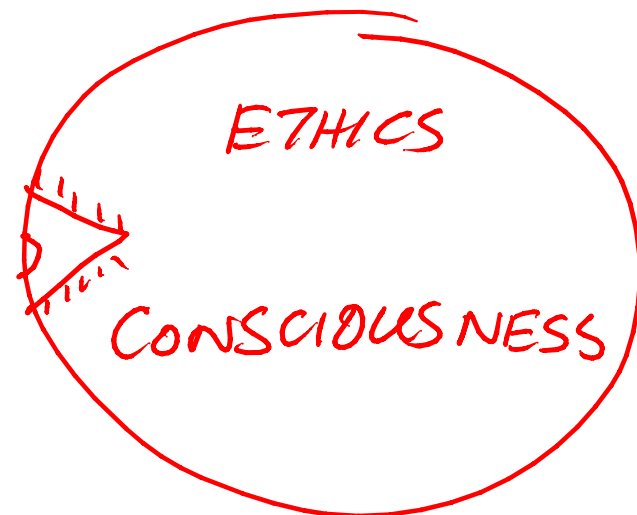
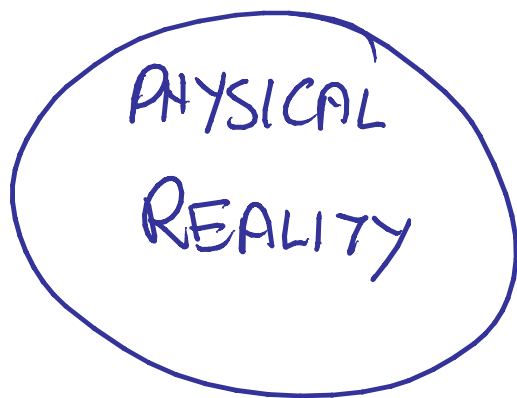
NEWSPAPERS - - - - etc.

FRANKLIN "FLABBY MORALITY" OF SAYING  
THAN THERE CAN BE SOME ETHICAL FEELING  
DERIVED FROM OUR INSIGNIFICANCE IN  
THE UNIVERSE OF HAWKING, SAGAN etc  
SIZE & POSITION ARE NOT MORALLY  
RELEVANT PROPERTIES

"OUR SIZE RELATIVE TO THE UNIVERSE  
SAYS NOTHING ABOUT OUR WORTH OR  
SIGNIFICANCE" HUME'S IS/DOUGHT  
DISTINCTION IMPLIES THAT SCIENCE  
CAN SAY NOTHING ABOUT THIS.

STUDIES OF THE EVOLUTION OF BEHAVIOUR  
ARE SCIENCE. THEY CAN ELUCIDATE WHY  
WE BEHAVE AS WE DO. THEY CAN  
NEITHER SUPPORT NOR UNDERMINE WHAT  
WE OUGHT TO DO.

THE ONLY THING WHICH DISTINGUISHES  
GOOD FROM EVIL IS OUR CONSCIOUS  
MENTALITY





FRANKLIN IF THE IRREDUCIBLE WORTH OF  
PERSONS IS A FACT — MUST THE UNIVERSE  
BE DIFFERENT FROM THE PICTURE THAT  
PHYSICAL SCIENCE GIVES

WHAT MUST THE UNIVERSE CONTAIN IF IT  
INCLUDES NOT ONLY STONES, GALAXIES,  
ATOMS AND BRAINS BUT ALSO THE  
CONSCIOUSNESS OF MORAL WORTH?

PRINCETON PHILOSOPHER PETER SINGER WAS  
ASKED TO IDENTIFY A VALUE OF TODAY  
THAT WILL VANISH IN THE NEXT FEW  
YEARS. HIS ANSWER

"THE SANCTITY OF HUMAN LIFE. ONLY  
ECCENTRICS WILL DEFEND THE VIEW  
THAT EVERY HUMAN LIFE FROM CONCEPTION  
TO DEATH IS SACROSANCT"