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INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS

I N F O R M A L M E E T I N G

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N E U R A L N E T W O R K S

24 - 26 July 1972

(SUMMARIES)

INTERNATIONAL ATOMIC ENERGY AGENCY

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Please note that copies of papers referred to may be obtained direct from the authors and not from the ICTP.

THE POTENTIALITIES OF DIFFERENT MODIFIABLE SYNAPSES

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My paper on the above subject in Proc. Roy. Soc. 168, 361 (1967) needs comment and correction. Almost the only part of the paper useful to neurologists is the theorem that Section 10 of the Appendix states and purports to prove. This proof is faulty.

Definitions: A modifier is a stimulus to a synapse or net which, if repeated a sufficient (not large) number of times, will alter the input-output relations. We shall take account only of alterations that persist after impulses provoked by the modifier have ceased, i.e. alterations due to modification of synapses.

A conditionally effective stimulus to a synapse or net is one that can give a different output, depending on whether or not a modifier has been given.

A synapse or net belongs to Class A if every conditionally effective stimulus to it is a modifier.

Theorem (of Section 10 of my paper). If all modifiable synapses of a finite net belong to class A, then the net must belong to Class A.

The following, I think, is a valid proof.

Suppose R is a finite net whose modifiable synapses all belong to Class A.

Bring R into a state where a single stimulus x to an input or set of inputs will modify it, and find a stimulus y to an input or set of inputs that gives an output altered by the modification. Choose y different from x if possible (if it is not possible, R belongs to Class A).

Now since the response of R to y can be modified by x, there must exist in R at least one modifiable synapse, say S, that is unconditionally accessible to excitation resulting from y and responds to y differently according to whether x has been given.

Since y is a conditionally effective stimulus to S and S belongs to Class A, y must modify S. This modification must modify the response of R (in which case R belongs to Class A) unless R contains at least one other

modifiable synapse, say S', that was unmodified by the first stimulus y (presumably because it was protected by S or an analogue of S), but is unconditionally accessible to excitation resulting from a second stimulus y and responds to a second stimulus y differently according to whether x has been given between the two y's. S' is now analogous to S: y must modify it, and must modify the response of R (in which case R belongs to Class A) unless R contains another synapse S" unmodified by the first two stimuli y but accessible to the third. And so on. If a succession of stimuli y are given, each will modify at least one synapse. When all have been modified, or before, the response of the net to y must be altered, so the net belongs to Class A.