1 Return to Walter
w/slides

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? 1960

Accomplishments of an Artefact

BOX I.

The behaviour of the simplest possible artificial animal containing only two responsive elements equivalent to neurones - Machina Speculatrix. In these slides the track of the creature is shown by the white line due to the light from a candle stuck on his back the shutter of the camera being left open during the whole of each manoeuvre, that is about one minute.

Slide I and 2 Simple goal-seeking.

Started in the dark the creature finds its way into a beam of light and homes on the beam into its feeding hutch.

Slide 3. Pertinacity.

Catching sight of a faraway candle the creature loses itself behind an opaque and polished fire-screen, behind which it circles. On the way it catches sight of the reflection of its candle in the fire screen and spends some time chasing its tail, but later catches another glimpse of the distant candle and homes into an orbit around its original goal.

Slide 4. Discernment

Presented with a remote goal (seen at the top of the slide) the creature encounters a solid obstacle which it cannot move, and although it can still see the candle it devotes itself to circumventing the obstacle (of which it retains a short memory) before it circles round in an orbit and reaches the objective.

Slide 5 Search for an Optimum

Attracted at first by a distant bright light the creaturesapproaches the zone of brilliant illumination where it is repelled by the excessive brilliance of the light and circles round it at a respectful distance, exhibiting a search for optima rather than maxima - the idea of moderation of the classical philosophers.

Slide 6 Free-will

The solution of the dilemma of Buridan's ass. The photoelectric cell which functions as the creature's eye scans the horizon continuously until a light signal is picked up; the scanning stops, and the creature is directed towards the goal. This mechanism converts a spatial situation into a temporal one and in this process the dilemma of two symmetrical attractions is automatically solved, so that by the scholastic definition the creature appears endowed with "free will." It approaches and investigates first one goal and then abandons this to investigate the other one, circling between the two until some other stimulus appears or it perishes for want of nourishment.

Slide 7. Recognition of self

A pilot light is included in the scanning circuit in such a way that the head lamp is extinguished whenever another source of light is encountered. If, however, this other source happens to be a reflection of the headlamp itself in a mirror, the light is extinguished as soon as it is perceived and being no longer perceived, the light is again illuminated, and so forth. This situation sets up a feedback circuit of which the environment is a part, and in consequence the creature performs a characteristic dance which, since it appears

(32)

always and only in this situation, may be regarded formally as diagnostic of self-recognition. This suggests the hypothesis that recognition of self may depend upon perception of one's effect upon the environment.

Slide 8. Social Organisation

The formation of a co-operative and a competitive society. When two creatures are released at the same time in the dark, each is attracted by the other's headlight but each in being attracted extinguishes the source of attraction to the other. The result is a stately circulating movement of minuet-like character; whenever the creatures touch they become obstacles and withdraw but are attracted again in rhythmic fashion. While this evolution was in progress the light in the Feeding Hutch was turned on; the common goal disrupted the co-operative organisation and transformed it into a ruthless competition, in which both creatures jostled for entrance to the source of nourishment.

The addition of a Learning Device to M. Speculatrix

Box 2.

A later model of M. Speculatrix provided with a learning circuit becomes M. Docilis and is now capable of forming conditioned reflexes which follow the classical lines enunciated by Pavlov and elaborated by his pupils.

Slide I.

The creature has the simple task of getting round the stool and finding its way into the feeding hutch. It is then taught that a whistle means touch by blowing a police whistle and kicking it a dozen times or so.

Slide 2.

The stool is removed but the whistle blown at the point when the creature would have touched the stool and it describes an avoiding manoeuvre 'as if' the obstacle were there.

Slide 3.

An attempt to establish discriminating conditioned reflexes by playing two notes, one to imply touch and the other to imply food, set up an experimental neurosis during which the creature retreated into a dark corner and displayed signs of agitation and indecision. After a period of rest however, it finally found its way into the feeding hutch.

Learning of this type requires a performance of seven operations as indicated in the slides 4 and 5.

These can be seen by the neuronic arrangement indicated in Slide 6 which is a functional circuit of the Learning Box in M. Docilis. (A detailed description of this rather elaborate mechanism is given in Chapter 7 of 'The Living Brain').

Box 3

Polygraphic records taken during the performance of simple tasks showing the various bodily and cerebral changes that accompany frustration and success.

Slide I.

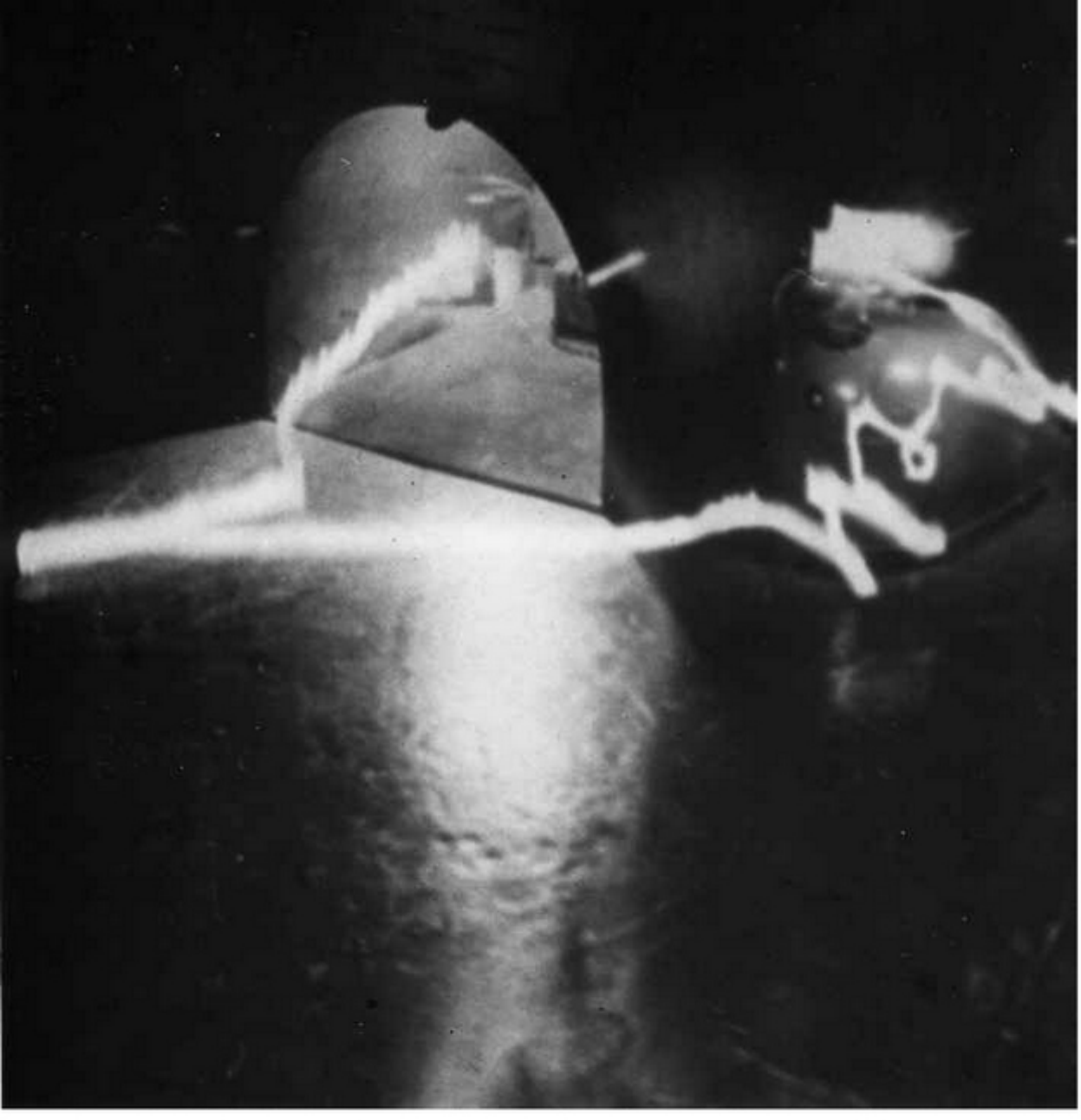
Records of speech, pulse, respiration, skin resistance, neck muscles, pulse pressure, right occipital EEG, left occipital EEG, right hand position and left hand position while a young normal female subject is feeling a H-shaped groove in a block of cement, with her left hand, and her eyes shut, having been asked to identify the form and draw it with her right hand. Her alpha rhythms are suppressed during the first 20 seconds but after this time she sighs (marked 'inspiration') and shortly after makes a face and at the same time her skin resistance begins to fluctuate wildly, her neck becomes stiff and a few seconds later a theta rhythm appears in the left tempero-occipital region. This is shown particularly in the record of the Analyser showing a large amount of energy at 5 c/s.

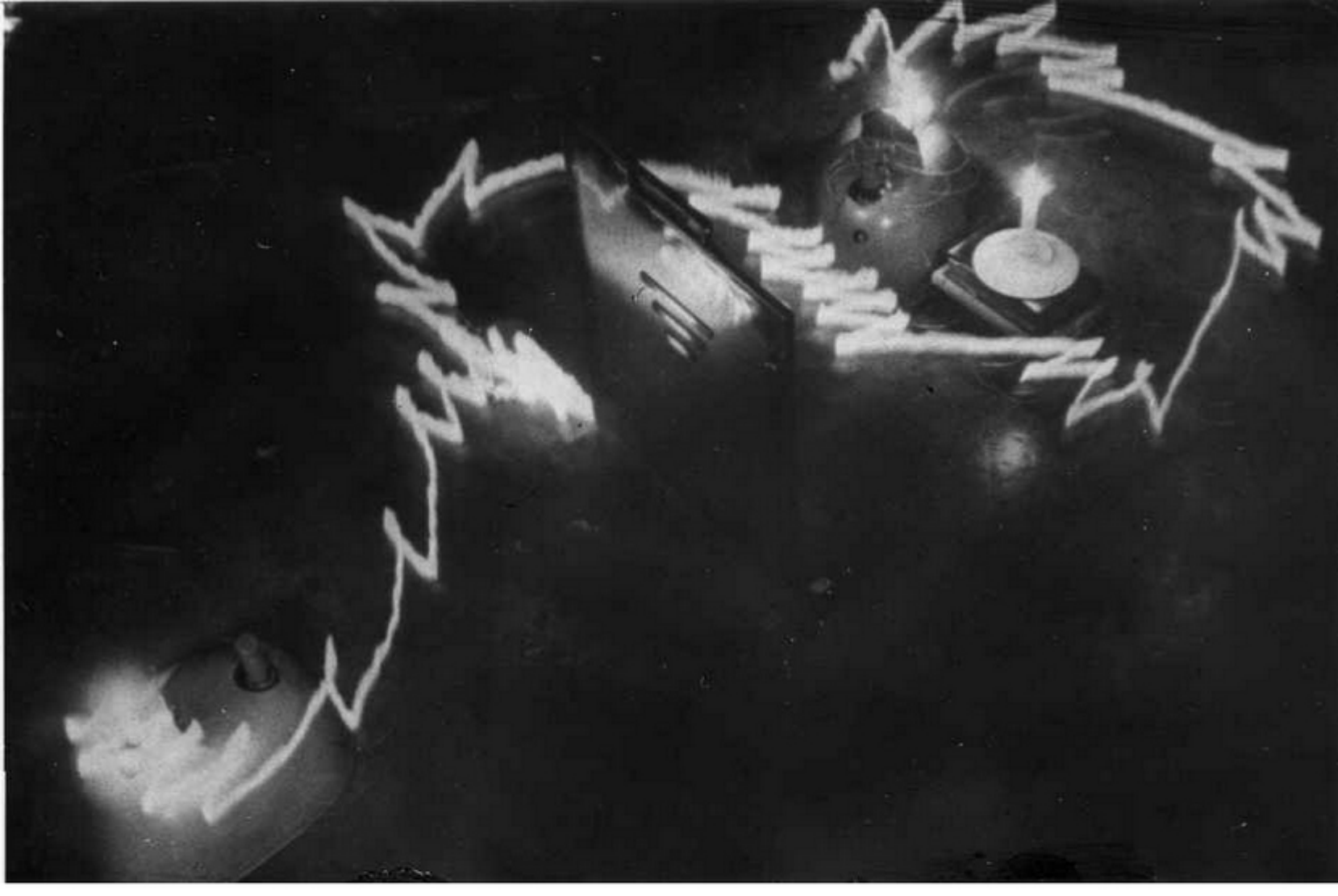
Slide 2.

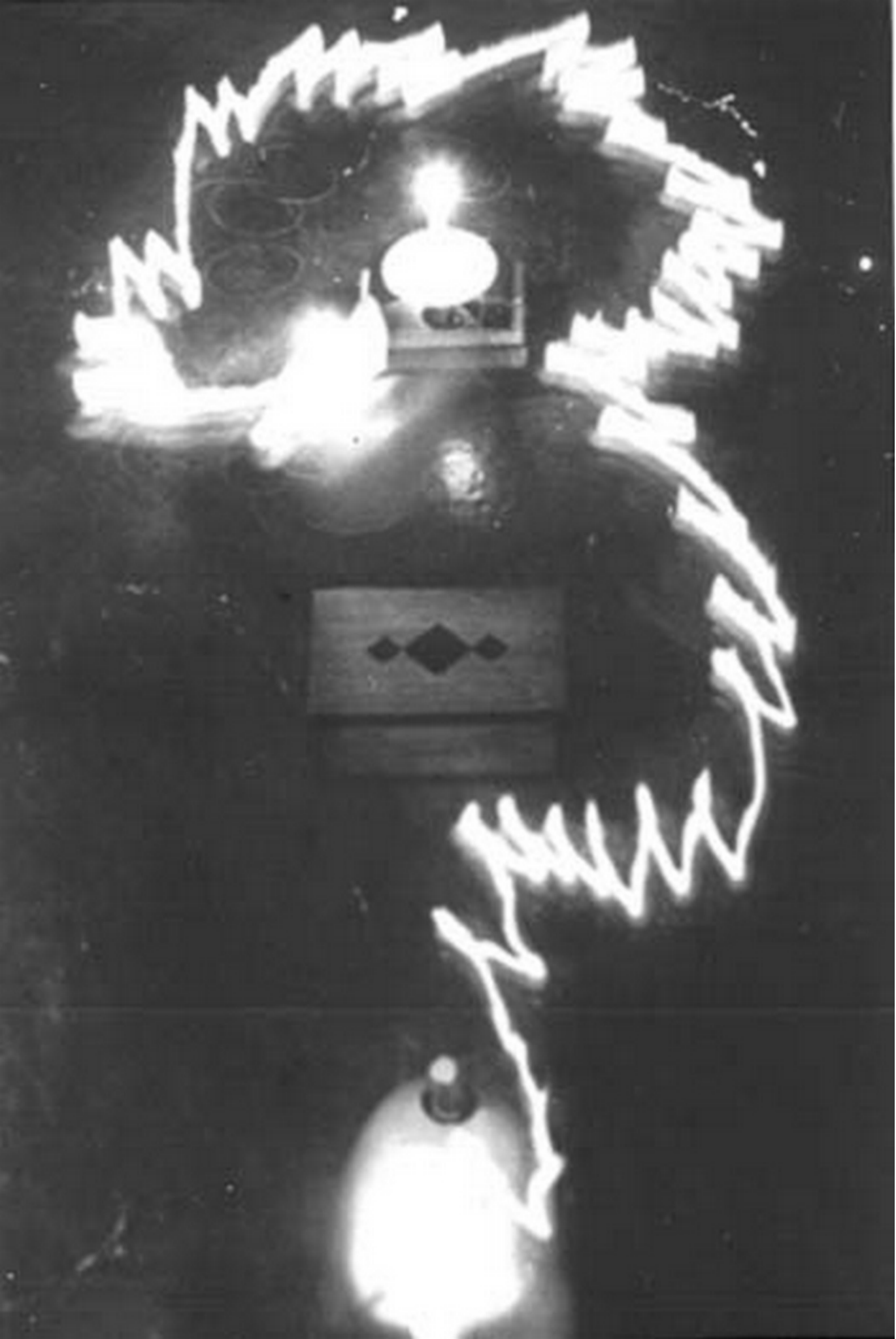
This shows the development of the condition; as the theta rhythm develops the subject becomes more self controlled, the bodily changes dwindle, the theta rhythm then itself diminishes while it drops in frequency, and at the end of the record the correct solution was given and the skin resistance gave one last surge.

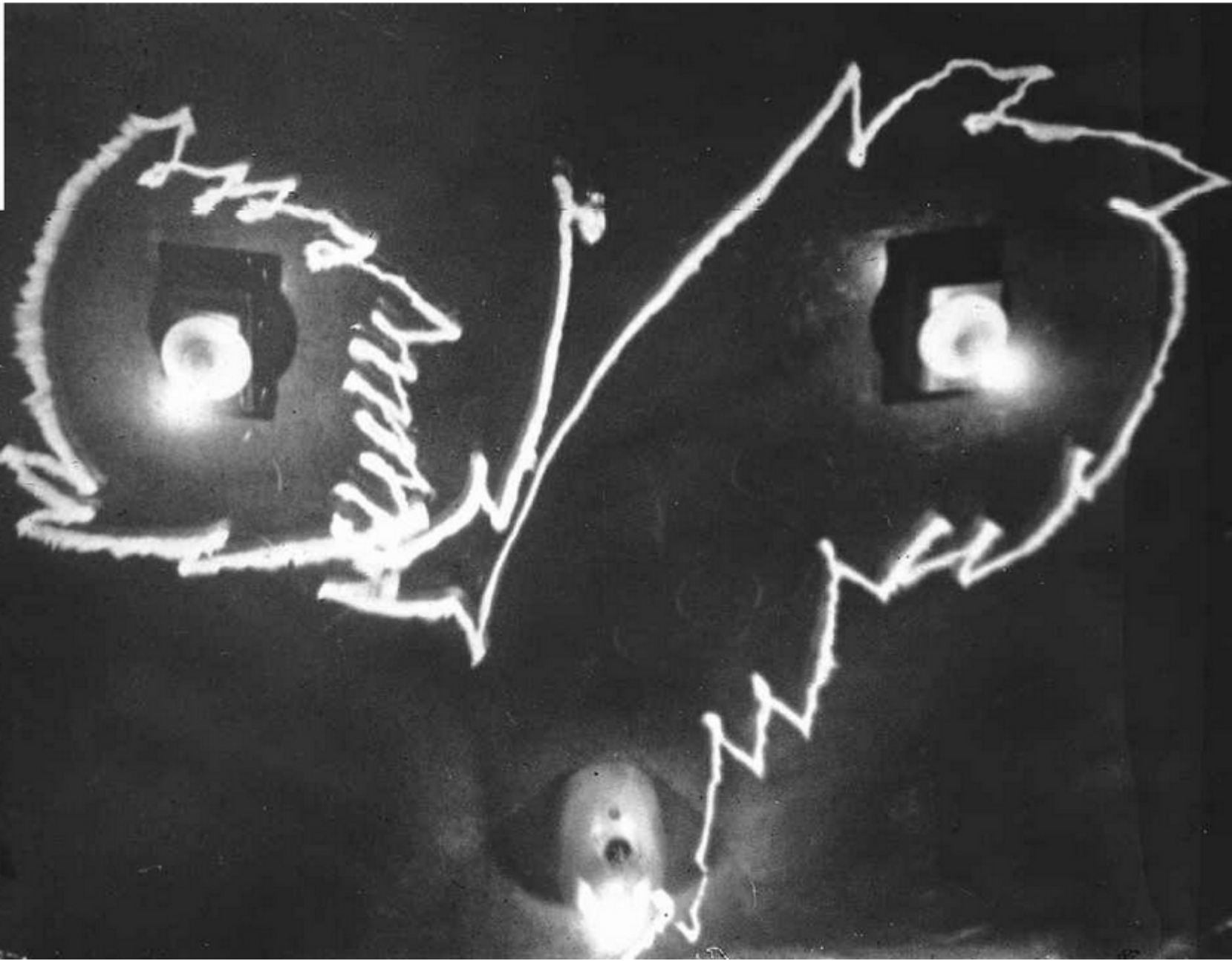
Slide 3.

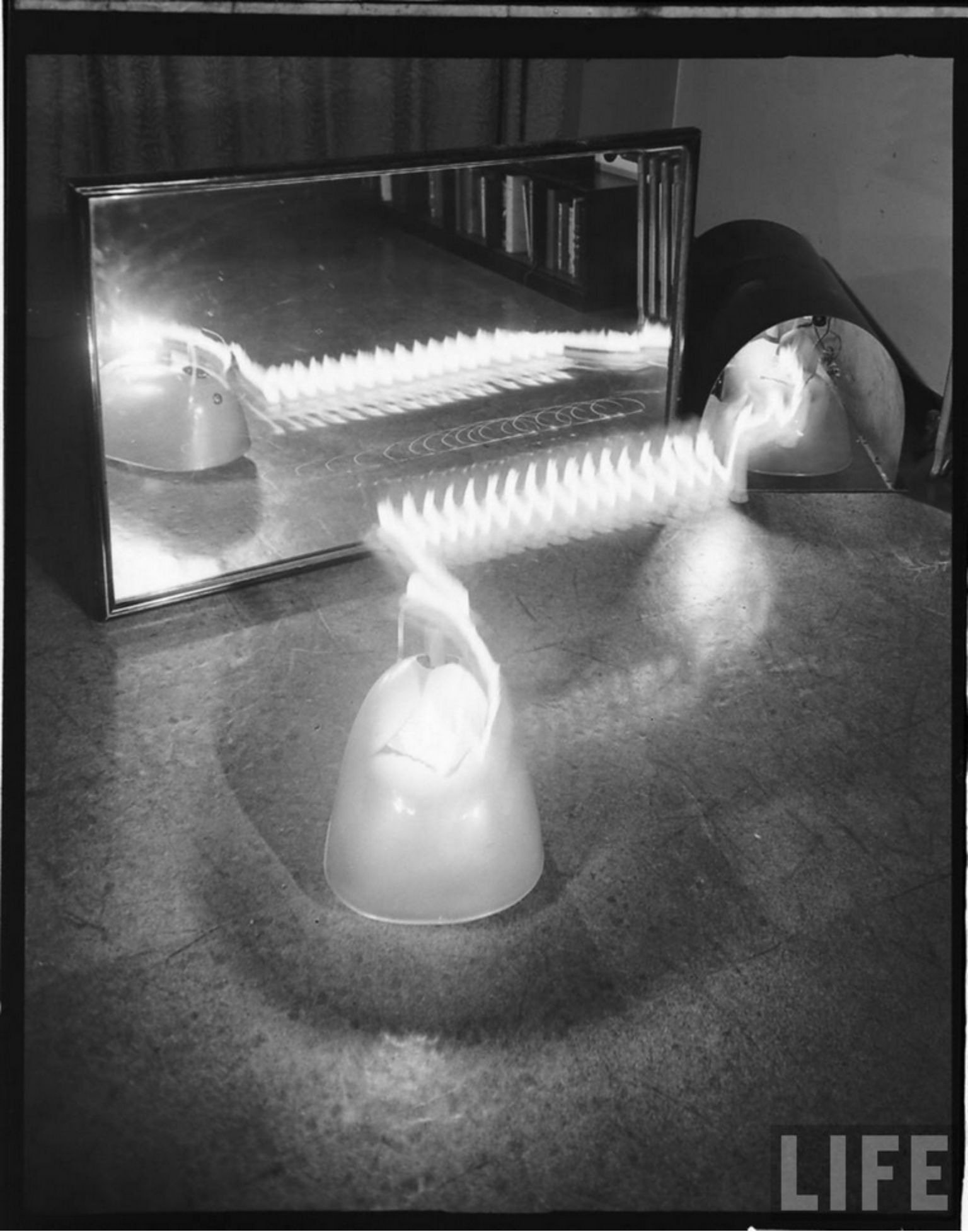
In another young normal female subject, examination during the performance of a word association chain test; the skin resistance showed regular swings, particularly while emotionally charged words were passing through her mind and the frequency pattern of the alpha rhythm changed, the peak shifting from 10 to 11 c/s. When the subject was able to escape from the chain "friend-pry-creature" which had unpleasant associations for her, to the relatively safe symbol 'caterpillar' the skin resistance was stabilised but fell again when she returned to the word 'insect.'







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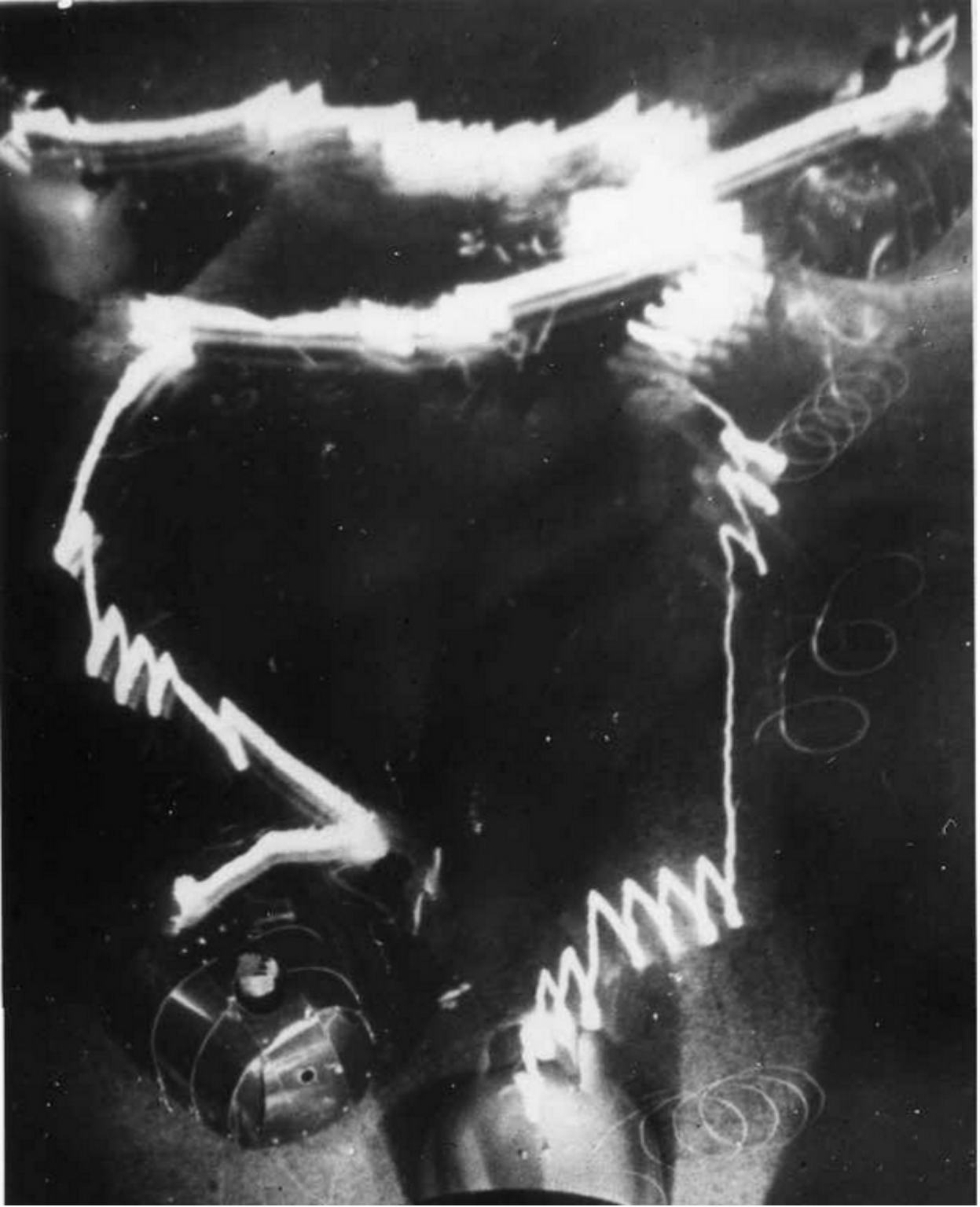
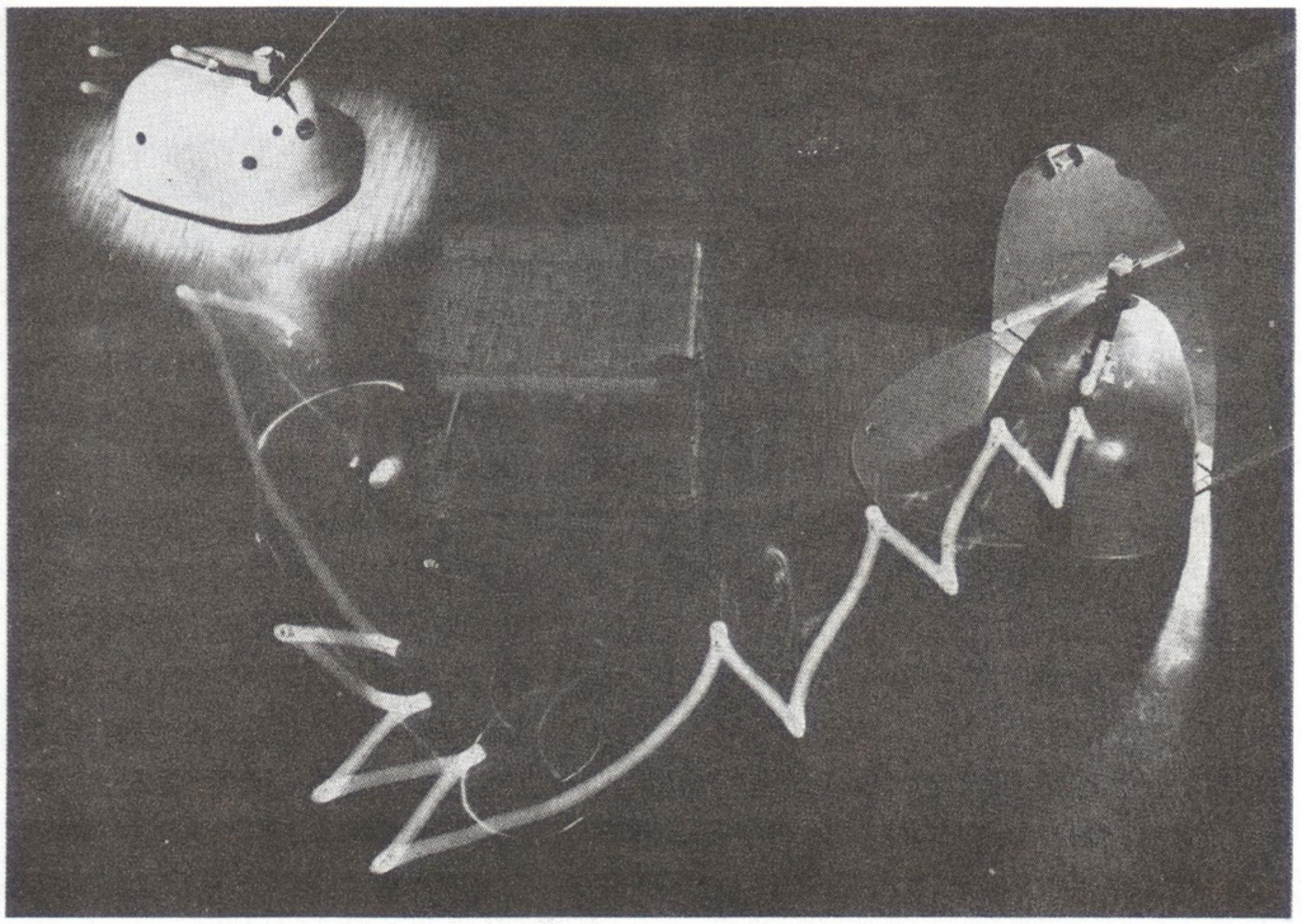
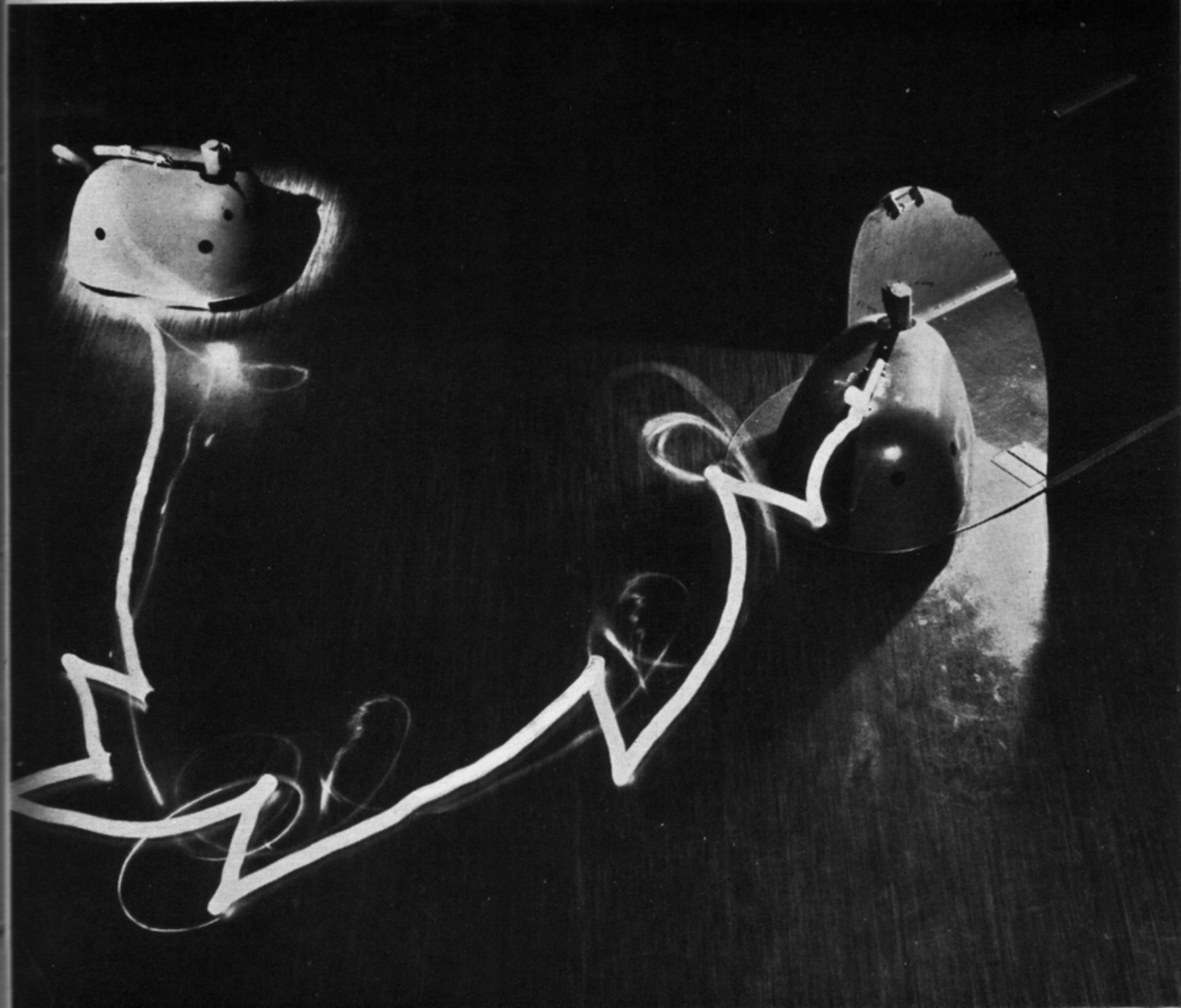
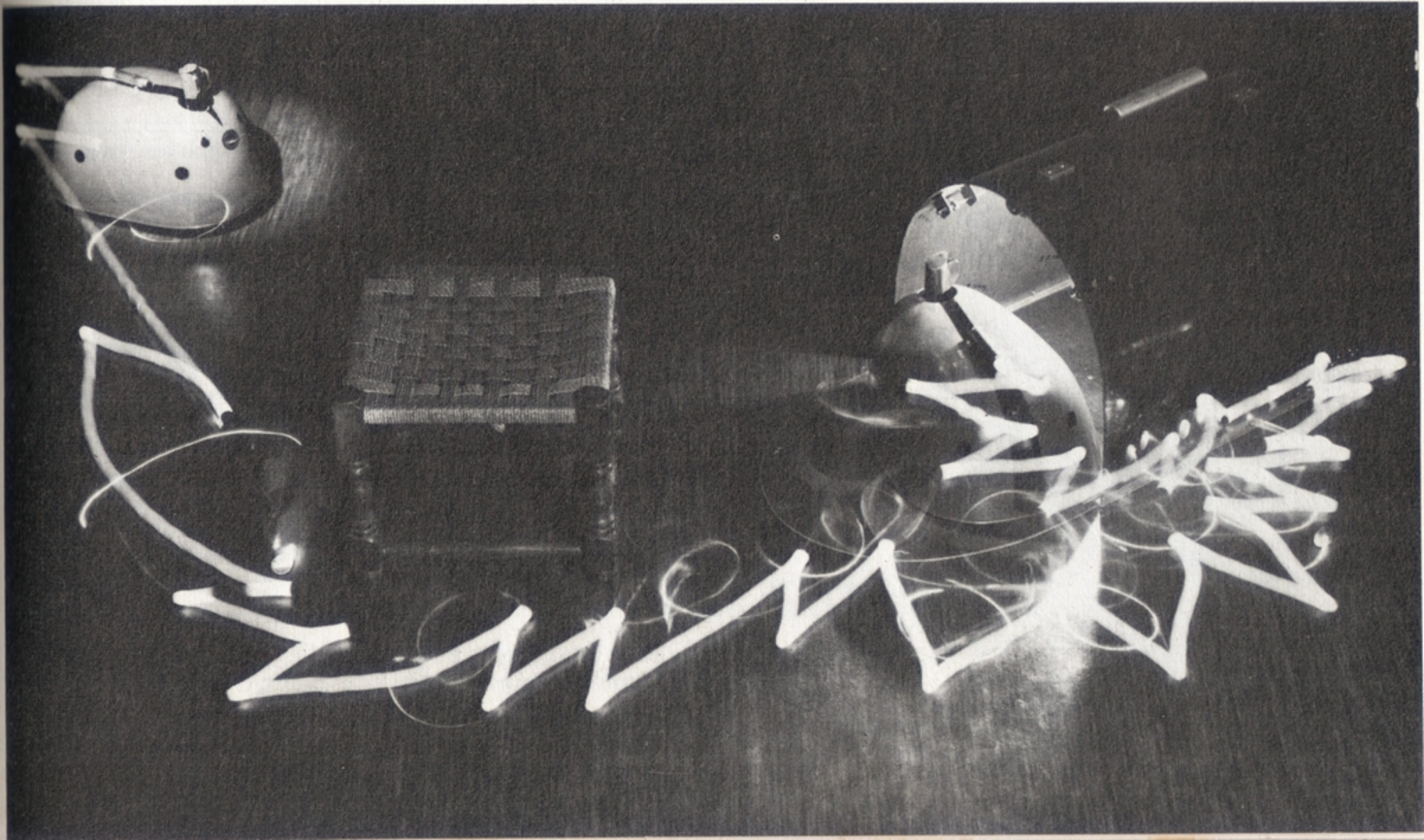
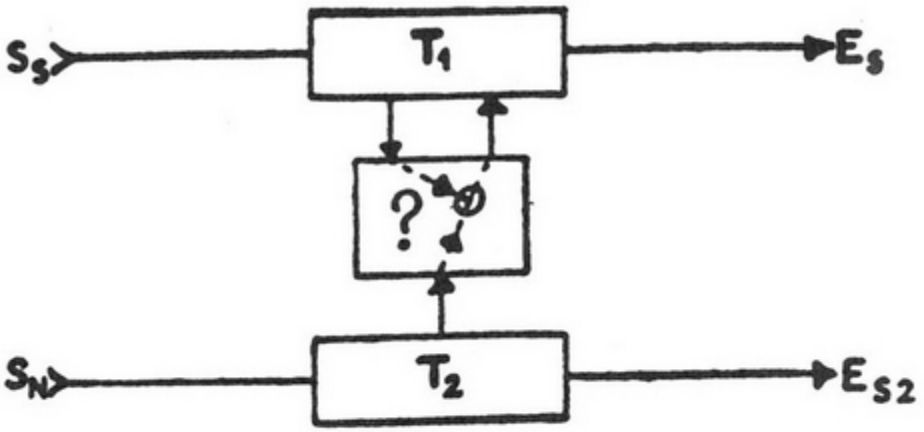


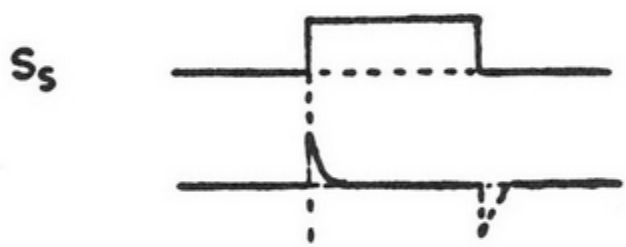




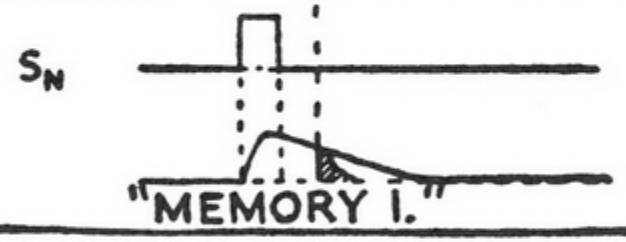


THE FIRST FOUR OF THE SEVEN OPERATIONS OF LEARNING—THE SELECTIVE OPERATIONS

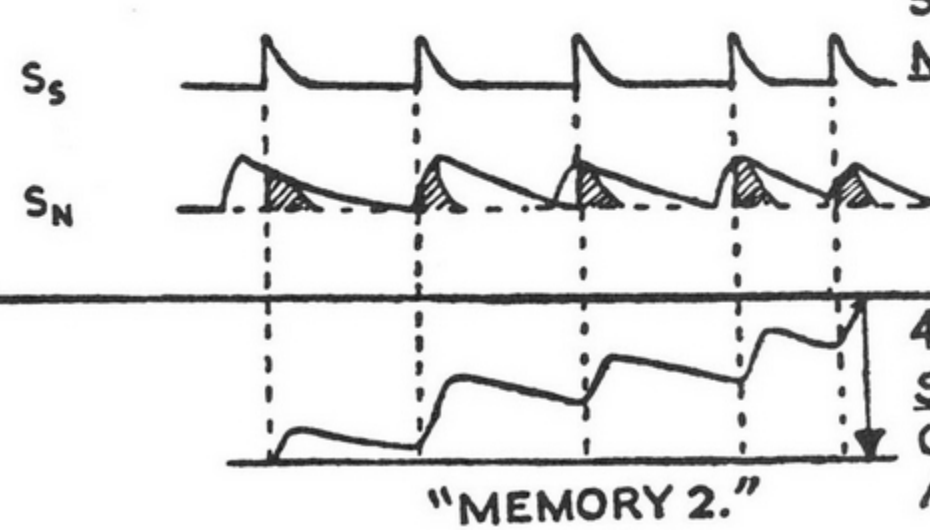




1. DIFFERENTIATION OF SPECIFIC STIMULUS



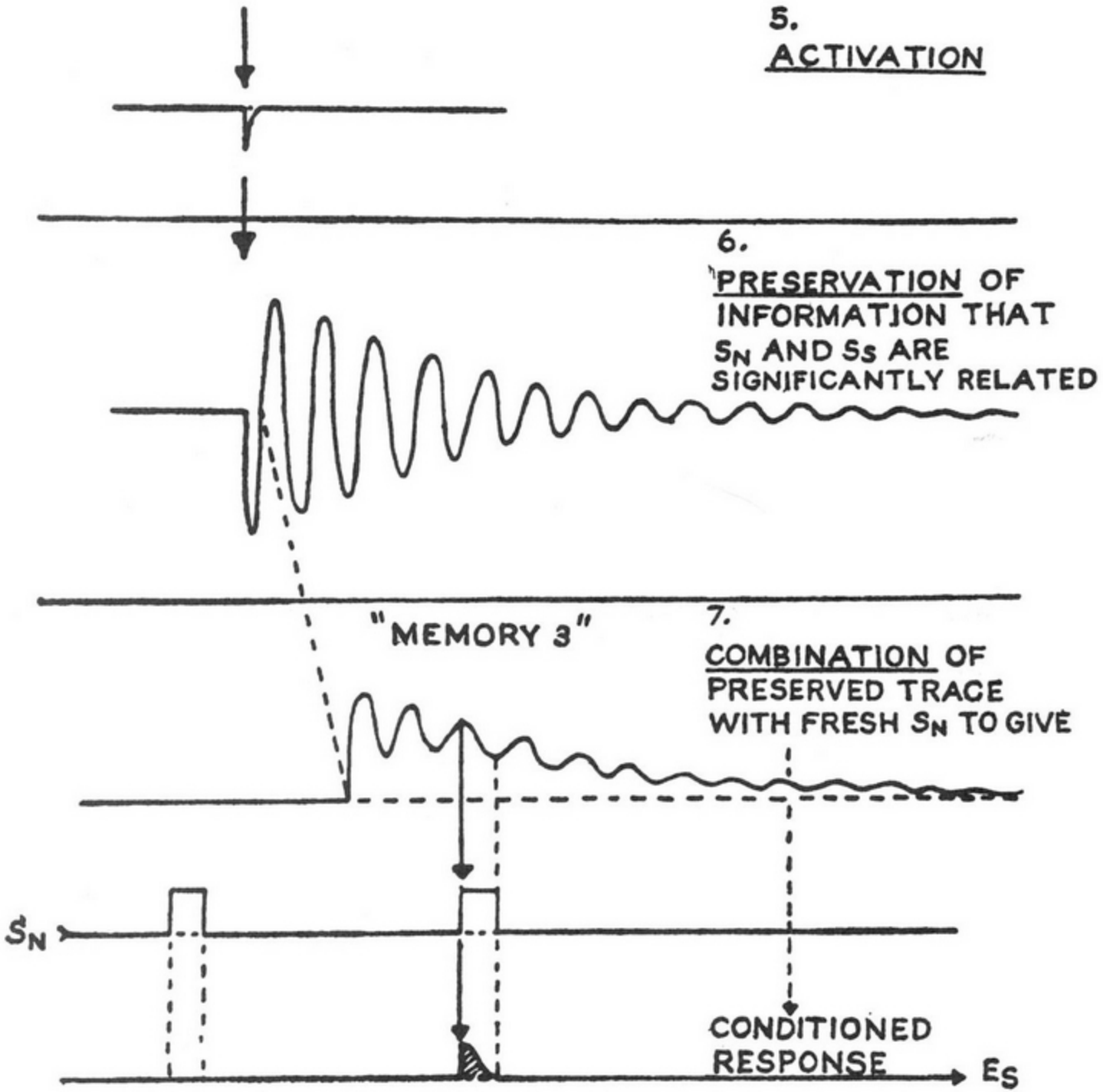
2. EXTENSION OF NEUTRAL STIMULUS



3. MIXING OF 1. AND 2.

4. SUMMATION OF COINCIDENCE AREAS

THE LAST THREE OF THE SEVEN OPERATIONS OF LEARNING—THE CONSTRUCTIVE OPERATIONS



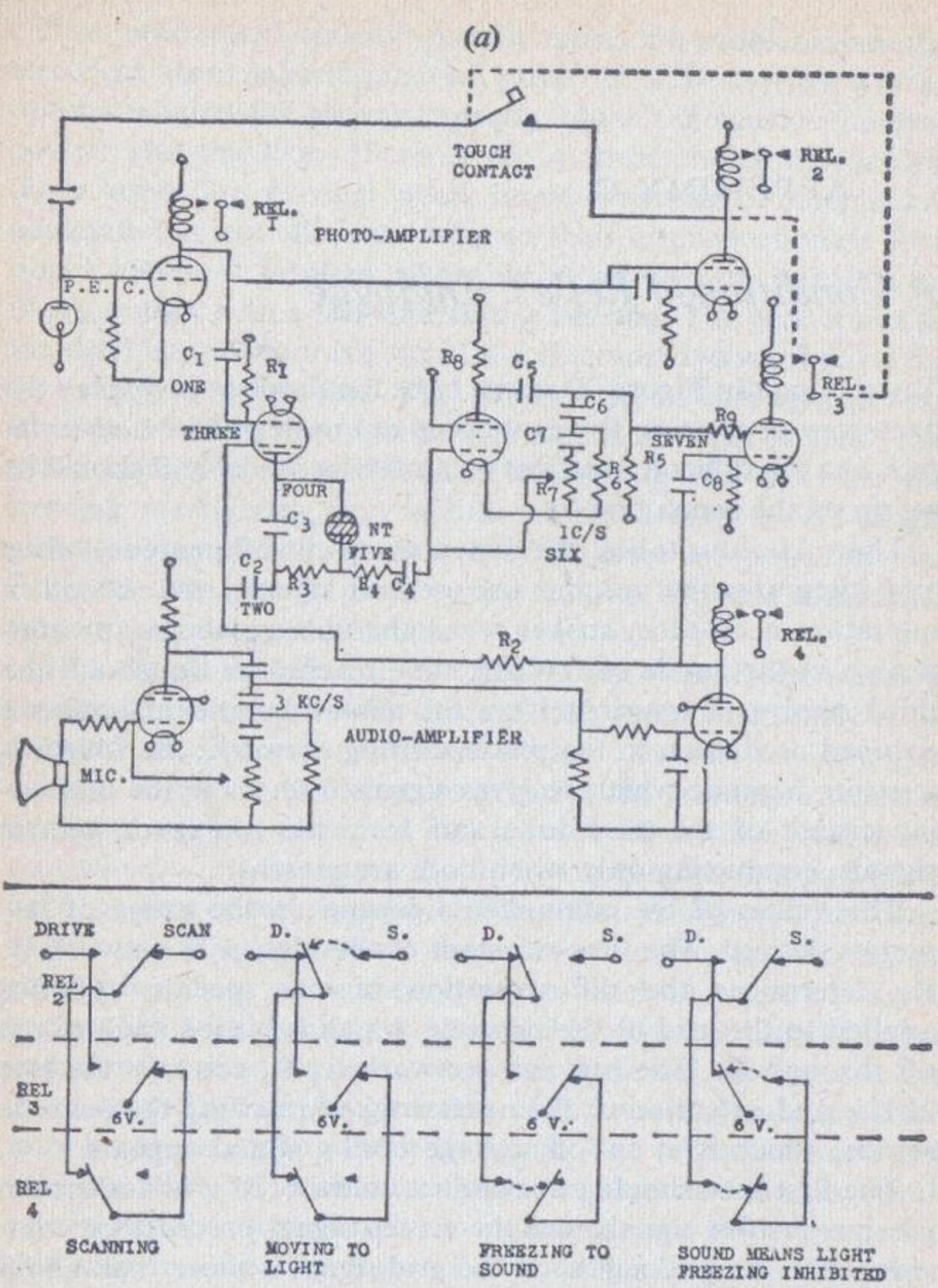


Figure 20. Circuits of *M. Docilis*

(*a*) Functional circuit. The numbers one to seven refer to the operations performed by each element as detailed in Chapter 7, and correspond with those in Figure 12.