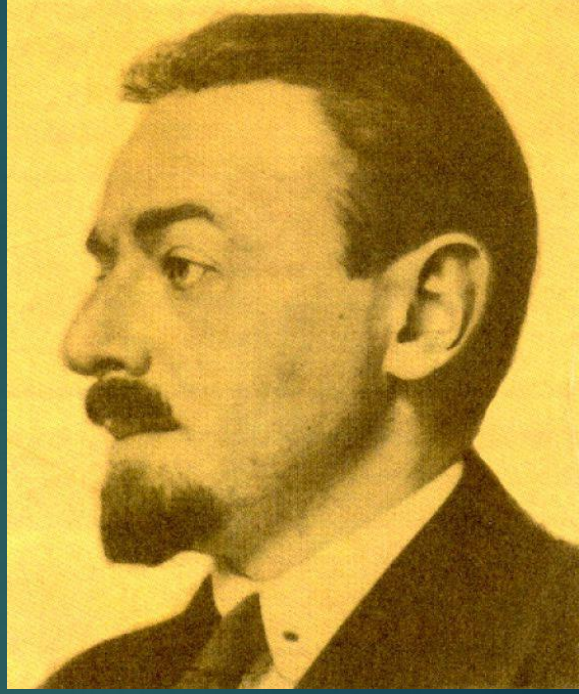
Neurophysiology
and Sensory Systems

Biography of N.A.Bernstein

Nikolai Alexandrovich Bernstein
(1896-1966)



an outstanding Russian neurophysiologist, creator of the doctrine of human motor activity – the theoretical basis of modern biomechanics

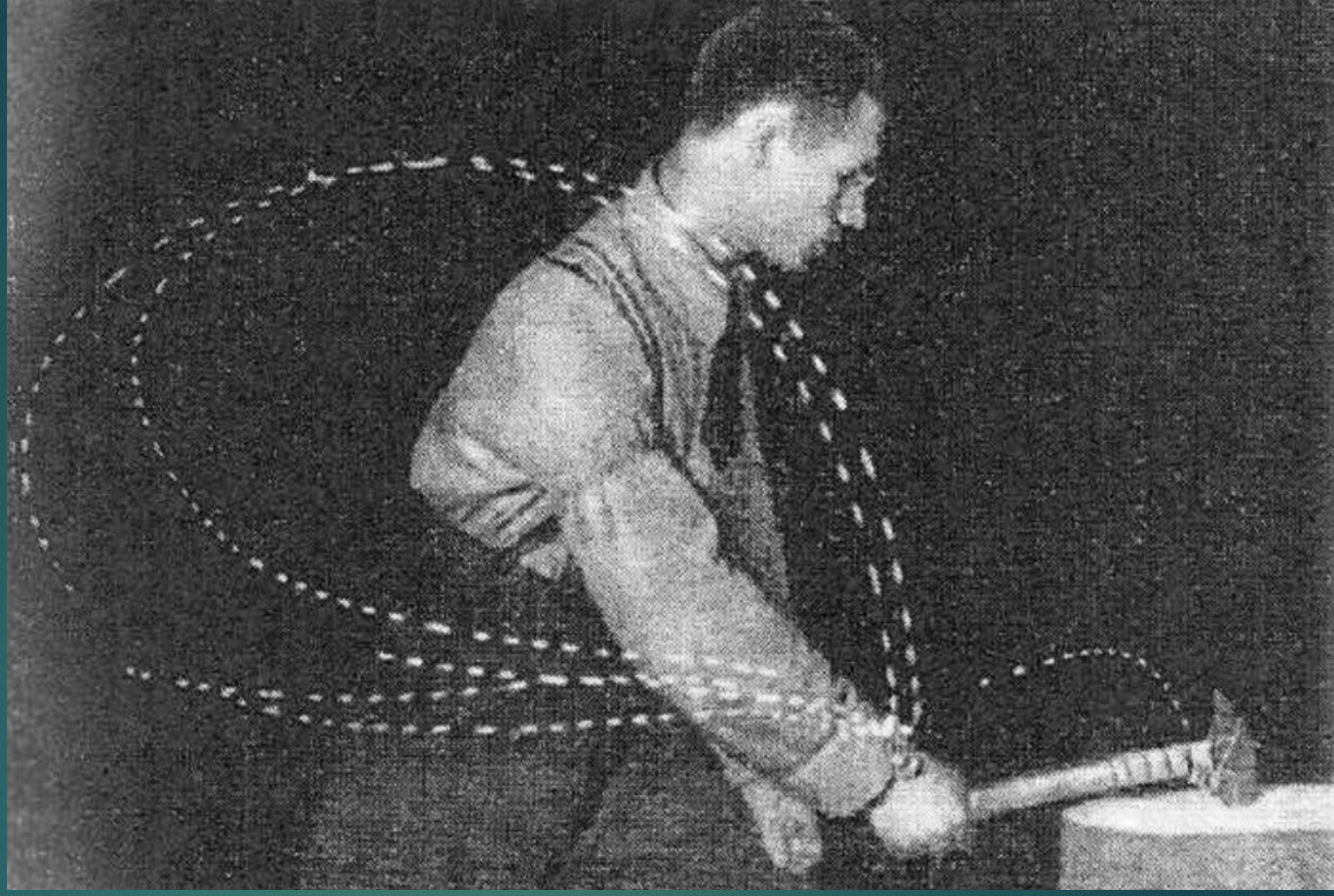
Stages of the professional path [1]

- 1896 – born in Moscow in the family of a psychiatrist
- 1919 – graduated from the Medical Faculty of Moscow State University
- 1919-1921 – military doctor of the Red Army in Kazan
- 1921-1922 – internship at the Moscow Psychological and Medical-Pedological Institutes
- 1923-1931 – employee of the biomechanics laboratory of the Central Institute of Labor, Head of the neuromechanical laboratory
- 1932-1933 – Head of the Laboratory of Biomechanics of the Central Institute of Labor for the Disabled
- 1933-1941 – Head of the Laboratory of Movement Physiology of the All-Union Institute of Experimental Medicine

Stages of the professional path [2]

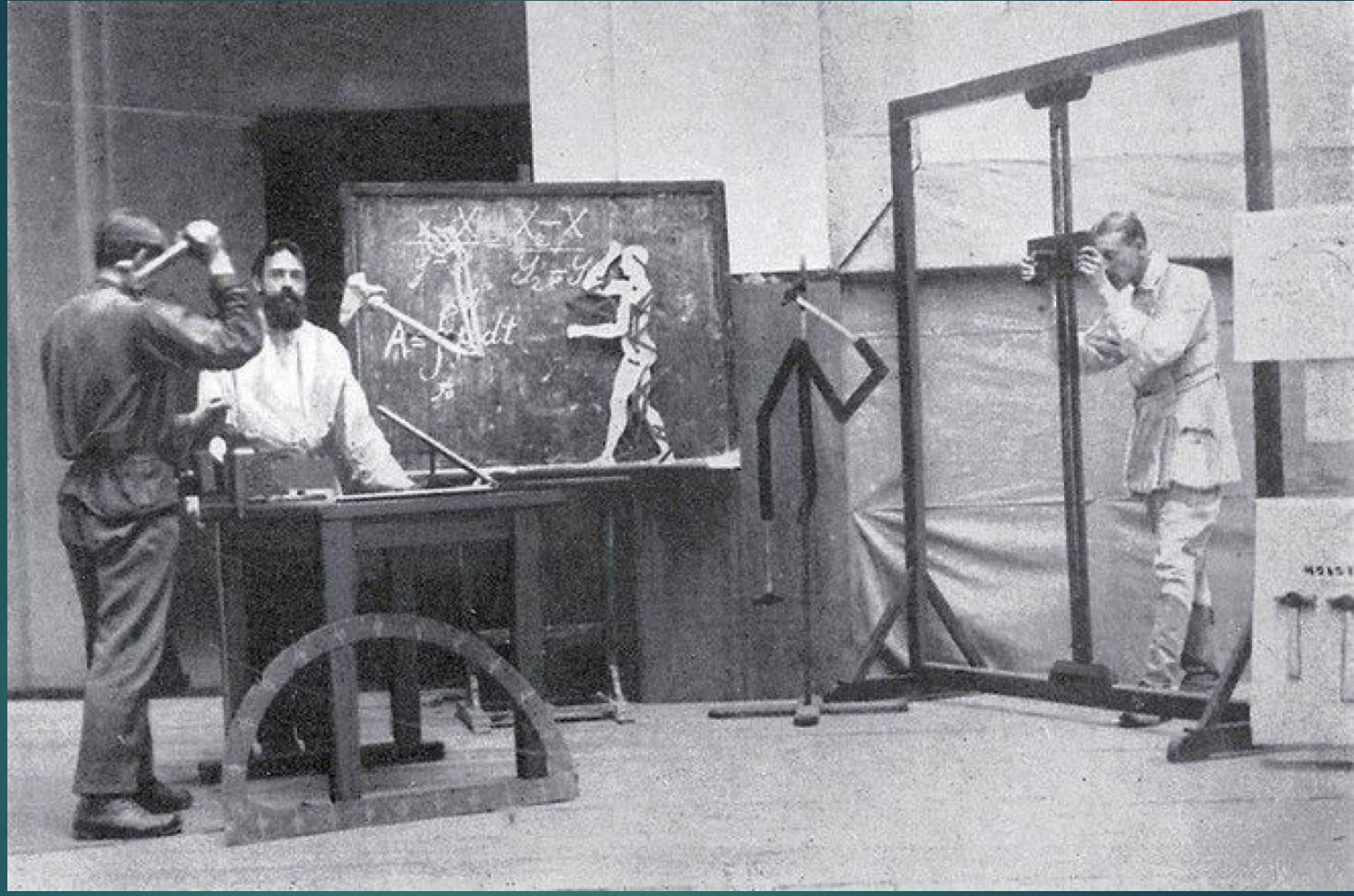
- 1941-1943 – evacuation in Ulan-Ude and Tashkent, worked at the Republican Sanitary Institute of the People's Commissariat of Health of the Uzbek SSR
- Since 1943 – Professor of the Department of Physiology of the State Institute of Physical Culture and the Department of Psychology of Moscow State University
- Since 1949 in the context of the struggle against "cosmopolitanism" removed from experimental work. Rehabilitated in 1953
- In the last years of his life, he focused on theoretical research, the development of a theory of the physiology of activity, and teaching

N.A.Bernstein in the laboratory



Trajectories of movements of the hammer and hand

(laboratory of the Central Institute of Labor, Moscow, 1923)



Recording a cyclogram of a blow with a hammer when cutting by a chisel

(laboratory of the Central Institute of Labor, Moscow, 1923)

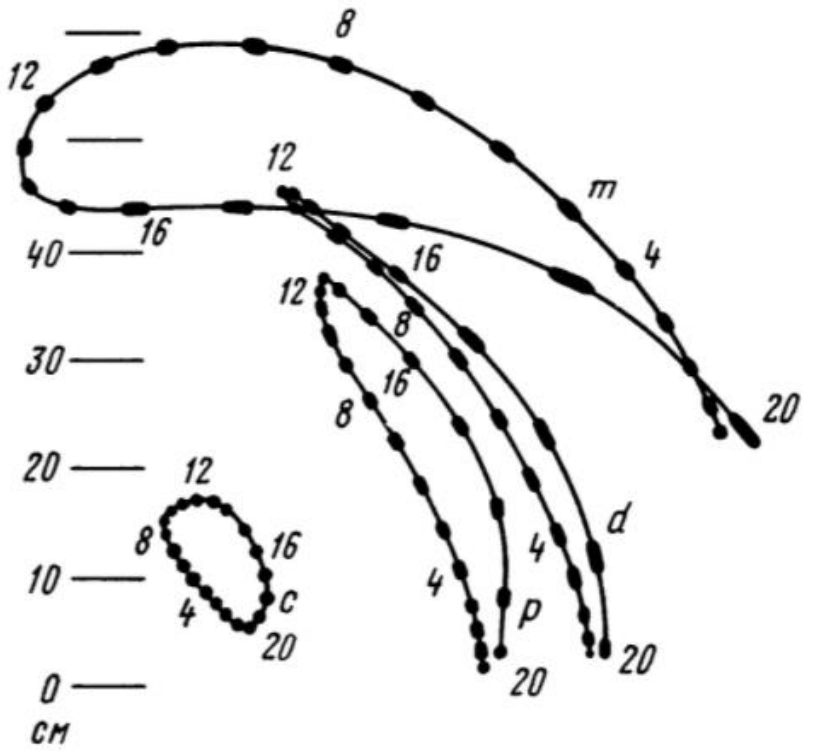


Рис. 15. Циклограмма удара молотком при рубке зубилом

Обозначения траекторий: *m* – центр тяжести молотка; *d* – центр тяжести кисти; *p* — лучезапястное сочленение; *c* — локтевое сочленение. Частота — 30 снимков в секунду (Центральный институт труда, 1923 г.)

Trajectories of movements of the hammer and arm segments when cutting by a chisel on the cyclogram

(Central Labor Institute, Moscow, 1923)

Levels of contstuction of movements according to N.A.Bernstein [1]

- ***A.*** the lowest level, responsible for muscle tone, tonic movements.
  Example: shivering of the body in cold or fear
  [spinal cord, nucleus ruber]
- ***B.*** the level of synergistic movements, their coordination.
  This is the level of "body space", coordination of movements without interaction with the external environment.
  Example: stretching, running in place, squatting
  [thalamus, globus pallidus]
- ***C.*** the level of the spatial field. To perform a movement, information about the surrounding space is needed, obtained through sight, hearing, and touch.
  Example: Tennis game, steeplechase
  [pyramid system, striatum]

Levels of contstuction of movements according to N.A.Bernstein [2]

- ***D.*** the level of subject actions, provides interaction with objects in accordance with their subject meanings. Control over the implementation of not just motor operations, but actions that have a goal, plan, internal logic. This and the next levels are unique to humans.
  Example: tying a tie, juggling
  [parietal cortex and frontal premotor areas]
- ***E.*** the level of coordination of speech and writing, which are no longer united by an object, but by an abstract task, an idea.
  Example: active verbal utterance, spontaneous writing
  [frontal cortex]

The results of the scientific activity of N.A.Bernstein

Area of scientific interests – neurophysiology of motor act

- developed the doctrine of human motor activity
- proposed a block diagram of multilevel control of human locomotions
- clarified the mechanisms of formation of motor skills
- developed the principles of correction of movement disorders, the stages of the formation of sports skills
- improved the technique of registration and analysis of movements

Main works of N.A.Bernstein

- General Biomechanics (1926)
- Studies in the Biodynamics of Locomotion (1934)
- The Problem of the Relationship of Coordination and Localization (1935)
- Modern Searches in the Physiology of the Nervous Process (1936)
- On Agility and Its Development (1947)
- On the Construction of Movements (1947)
- The coordination and regulation of movements (1967)

Achievements and awards of N.A.Bernstein

- Corresponding Member of the Academy of Medical Sciences of the USSR (1946)
- Stalin Prize of the second degree in biology (1948), for the monograph "On the construction of movements"

Bernstein's grave
at Novodevichy cemetery (Moscow)