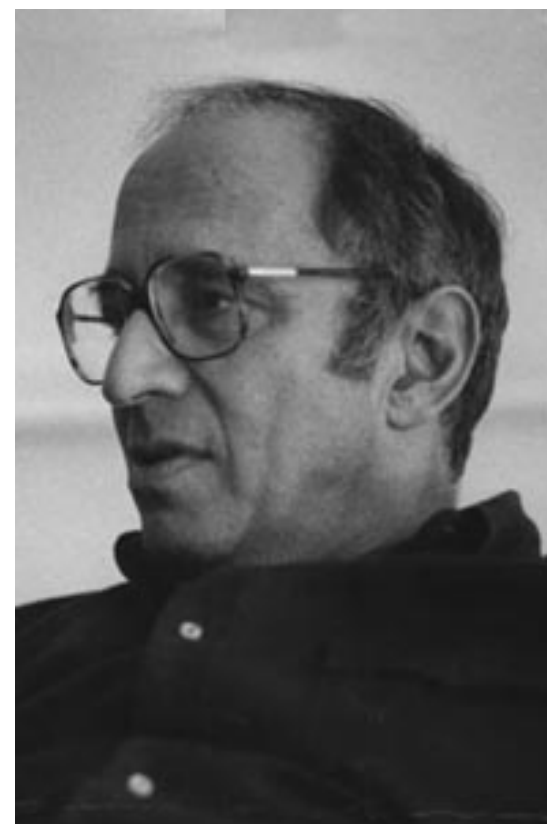




ЛОГИКА И МЕТОДОЛОГИЯ НАУКИ

Т. Кун
СТРУКТУРА
НАУЧНЫХ
РЕВОЛЮЦИЙ



Thomas Samuel Kuhn

(18.07.1922 - 17.06.1996)

**T. S. Kuhn.
THE STRUCTURE OF SCIENTIFIC
REVOLUTIONS**

**Томас Кун
СТРУКТУРА НАУЧНЫХ
РЕВОЛЮЦИЙ**

. 3.

**THE UNIVERSITY OF CHICAGO PRESS.
Chicago 1970**

**«ПРОГРЕСС»
МОСКВА 1977**

СОДЕРЖАНИЕ

От издательства	5
ПРЕДИСЛОВИЕ	7
I. ВВЕДЕНИЕ. РОЛЬ ИСТОРИИ ..	17
II. НА ПУТИ К НОРМАЛЬНОЙ НАУКЕ	28
III. ПРИРОДА НОРМАЛЬНОЙ НАУКИ	44
IV. НОРМАЛЬНАЯ НАУКА КАК РЕШЕНИЕ ГОЛОВОЛОМОК.....	59
V. ПРИОРИТЕТ ПАРАДИГМ	69
VI. АНОМАЛИЯ И ВОЗНИКНОВЕНИЕ НАУЧНЫХ ОТКРЫТИЙ	79
VII. КРИЗИС И ВОЗНИКНОВЕНИЕ НАУЧНЫХ ТЕОРИЙ.....	96
VIII. РЕАКЦИЯ НА КРИЗИС	110
IX . ПРИРОДА И НЕОБХОДИМОСТЬ НАУЧНЫХ РЕВОЛЮЦИИ	128
X. РЕВОЛЮЦИИ КАК ИЗМЕНЕНИЕ ВЗГЛЯДА НА МИР	151
XI. НЕРАЗЛИЧИМОСТЬ РЕВОЛЮЦИЙ	181
XII. РАЗРЕШЕНИЕ РЕВОЛЮЦИИ.....	190
XIII. ПРОГРЕСС, КОТОРЫЙ НЕСУТ РЕВОЛЮЦИИ.....	210
ДОПОЛНЕНИЕ 1969 ГОДА.....	227
1. Парадигмы и структура научного сообщества	229
2. Парадигмы как наборы предписаний для научной группы	236
3. Парадигмы как общепризнанные образцы	244
4. Неявное знание и интуиция	249
5. Образцы, несоизмеримость и революции.....	258
6. Революции и релятивизм.....	267
7. Природа науки	270
С. Р. Микулинский, Л, А. Маркова. Чем интересна книга Т. Куна «СТРУКТУРА НАУЧНЫХ РЕВОЛЮЦИЙ»	274

ПРЕДИСЛОВИЕ

15

« »

¹ : . Koyre. Etudes Galileennes, 3 vols. Paris, 1939; . Meyerson. Identity and Reality. New York, 1930; H. Metzger. Les doctrines chimiques en France du debut du XVIIe a la fin du XVIIIe siecle. Paris, 1923; H. Metzger. Newton, Stahl, Boerhaave et la doctrine chimique. Paris, 1930; A. Maier. Die Vorlaufer Galileis im 14. Jahrhundert («Studien zur Naturphilosophie der Spatscholastik». Rome, 1949).

2.

3.

«
(Entstehung und Entwicklung einer wissenschaftlichen Tatsache. Basel, 1935),

X.

1951
» (The Quest for Physical Theory).

10

2

: «The Child's Conception of Causality». London, 1930;
«Les notions de mouvement et de vitesse chez l'enfant». Paris, 1946.

3 : «Language,
Thought, and Reality—Selected Writings of Benjamin Lee Whorf». New York, 1956.

«Two Dogmas of Empiricism»,
: «From a Logical Point of View». Cambridge, Mass., 1953, p. 20—46.

« »

(1958/59)

«

».

».

«

»

4 : . S. uhn. *The Copernican Revolution: Planetary Astronomy in the Development of Western Thought*. Cambridge, Mass., 1957, p. 122—132, 270—271.

: «Conservation of Energy as an Example of Simultaneous Discovery». — «Critical Problems in the History of Science», ed. M. Clagett. Madison, Wis., 1959, p. 321—356; «Engineering Precedent for the Work of Sadi Carnot». — «Archives internationales d'histoire des sciences», XIII (1960), p. 247—251; «Sadi Carnot and the Cagnard Engine». — «Isis», LII (1961), p. 567—574.

I
Введение
РОЛЬ ИСТОРИИ

()

« »

« »

« ».

(),

(),

?

« »

?

?

?

II

(« »),

—

?

?

?

(,)

III, IV, V

VI, VII VIII

—

() —
(commitments),

IX

) (

) (

(

)

XI

. XII

XIII

«

» «

».

?

grosso modo *,

?

(). —

*

II

НА ПУТИ К НОРМАЛЬНОЙ НАУКЕ

« »

—

—

(

XIX
)

: « » , « » « »
« » , « » « »
« »

« »
« ».

—

«) ()», « () (»

ay

?

?

V

XVIII

XIX

« »

1.

XVII

ad hoc*

2.

1 J. P. Desaguliers. The History and Present State of Discoveries Relating to Vision, Light, and Colours, London, 1772, p. 385—390.

*

2 V. Rieu. Histoire de la lumière. Paris, 1956, chaps. I—IV.

XVIII

3.

XVII—XVIII

1 D. Roller and D. H. D. Roller. The Development of the Concept of Electric Charge: Electricity from the Greeks to Coulomb («Harvard Case Histories in Experimental Science», Case 8, Cambridge, Mass., 1954); I. ... hen. Franklin and Newton: An Inquiry into Speculative Newtonian Experimental Science and Franklin's Work in Electricity as an Example Thereof. Philadelphia, 1956, chaps. VII—XII.

: T. S. ... uhn. The Function of Dogma in Scientific Research, in: A. C. Crombie (ed.), «Symposium on the History of Science». University of Oxford, July 9—15, 1961. Heinemann Educational Books, Ltd.

« »,

« »,

« »

()

«

»

7. 40- XVIII

8.

7 D. Roller and D. H. Roller. Op. cit., p. 51—54.

8
hen. Op. cit., . 491-494, 531-543.

) (

9.

9
1759

(ibid., . 543—546, 548—554).

: « ...» 10.

11.

10 . . . 2, . 117.
11

« »
» (. Farrand (ed), Benjamin Franklin's Memoirs. Berkeley, Calif., 1949, . 384-386).

XVIII — XIX
« » : Ch. . Gilispie. The Encyclopedie and the Jacobin Philosophy of Science: A Study in Ideas and Consequences.— «Critical Problems in the History of Science», ed. . Clagett, Madison, Wis., 1959, p. 255—289; The Formation of Lamarck's Evolutionary Theory. — «Archives internationale d'histoire des sciences», XXXVII, 1956, p. 323—338.

) raison d'etre* (

* (.),—

XVII

XVIII

XIX

XVI—XVII

XVIII

1740

XVIII

XVI XVIII
12

1740

1780

XIX

XVII

III

ПРИРОДА НОРМАЛЬНОЙ НАУКИ

?

?

« »

« » « »

, « m , amas, amat»*

: «laudo, laudas, laudat»**

* (). — ** ().

exa

« » (

1.

CO

?

?

?

—

—

2.

« »

2

3.

« »

3 : A. W 1f. A History of Science, Technology, and Philosophy in the Eighteenth Century. 2d ed. London, 1952, p. 103—105. : N. R. Patterns of Discovery. Cambridge, 1958, p. 100—102.

M. L. Foucault. Methode generale pour mesurer la vitesse de la lumiere dans l'air et les milieux transparents. Vitesses relatives de la lumiere dans l'air et dans l'eau...—«Comptes rendus... de l'Academie des sciences», XXX, 1850, p. 551—560; . L. w n. Jr., et al Detection Free Neutrino: A. Confirmation.—«Science», CXXIV, 1956, . 103-104.

« »

XVIII

90-

4.

4 . 1741 1901 «Gravitation Constant and Mean Density of the Earth».—«Encyclopaedia Britannica», 11th ed. Cambridge, 1910—1911, XII, p. 385—389.

(
) 5.

(

.)

6.

7.

⁵ : «The Physical Treatises of Pascal». New York, 1937, (« ») .164.

6D. Roller and D. H. D. Roller. The Development of the Concept of Electric Charge: Electricity from the Greeks to Coulomb. (« Harvard Case Histories in Experimental Science», Case 8, Cambridge, Mass., 1954), p. 66—80.

⁷ T. S. uhn. The Function of Measurement in Modern Physical Science. —«Isis», LII, 1961, p. 161—193.

ap

8.

?

8 . S. u h n. The Caloric Theory of Adiabatic Compression. «Isis», XLIX, 1958, p. 132—140.

(ad hoc)

XVIII

« »,

« »

o6p

« »

XVIII

« »,

9.

9. — used 1. A. Program toward Rediscovering the Rational Mechanics of the Age of Reason. — «Archive for History of the Exact Sciences», I, 1960, p. 3—36; Reactions of Late Baroque Mediaevalists to Success, Conjecture, Error, and Failure in Newton's «Principia». — «Texas Quarterly», X, 1967, p. 281—297; — L. Hankins. The Reception of Newton's Second Law of Motion in the Eighteenth Century. — «Archives Internationales d'histoire des sciences», XX, 1967, p. 42—65:

(

)

10.

XVIII

XIX

¹⁰Wolf. Op. cit, . 75—81, 96-101; W. Whewel. History i Inductive Sciences, rev. ed. London, 1847, II, p. 213—271,

XVIII

« »

« » « »

« »

11.

« ».

IV

**НОРМАЛЬНАЯ НАУКА
КАК РЕШЕНИЕ ГОЛОВОЛОМОК**

ре

-
?

XVIII

« - » «
 »
 - —
 , —
 « - »
 « - ».
 « - »,
)

XVII
 1

: L. S. ubi . Some Unsolved Problems of the Scientific Career. —
 «American Scientist», XLI, 1953, p. 596—613; XLII, 1954, p. 104—112.

« » (« »),

2.

XVIII

1750

3.

?4

XVIII XIX

5.

3 W. Whewell. *History of the Inductive Sciences*, rev. ed. London, 1847, II, p. 101—105; 220—222.

4

5. I. Newton. *Franklin and Newton: An Inquiry into Speculative Newtonian Experimental Science*. Franklin's Work in Electricity as an Example Thereof, Philadelphia. 1956, chap. VII, p. 255—257; p. 275—277.

6.

XVII 7.

XIX

8.

9.

1630

6

7. J. L. L. Les doctrines chimiques en France du début du XVII^e siècle à la fin du XVIII^e siècle, Paris, 1923, p. 359—361; M. A. R. I. e Boas. *Robert Boyle and Seventeenth-Century Chemistry*. Cambridge, 1958, p. 112—115.

8. L. Königsberger. *Hermann von Helmholtz*. Oxford, 1906, p. 65—66.

9. J. E. M. E. I. N. H. A. R. D. *Chromatography: A Perspective*. — «Science», CX, 1949, p. 387—392.

10.

V

ПРИОРИТЕТ ПАРАДИГМ

(quasi-standard)

po . . .

1.

?

»?

«

« », « » « »?2

« »,

1 n i. Personal Knowledge. Chicago, 1958, V VI.

2L. Wittgenstein. Philosophical Investigations. N. Y., 1953, . 31-36.

« »,

« », « »,

« » « »,

()

XVII

XIX

3.

4.

3. H. Metzger. Les doctrines chimiques en France du début du XVII^e à la fin du XVIII^e siècle. Paris, 1923, p. 24—27, 146—149; J. Boas. Robert Boyle and Seventeenth-Century Chemistry. Cambridge, 1958, chap. II. — W. F. Cannon. The Uniformitarian-Catastrophist Debate. — «Isis», LI, 1960, I W -65; G. I. 11 i s p i . Genesis and Geology. Cambridge, Mass., 1951. chaps. IV—V.

4. J. Ullin. La crise de la physique quantique. Paris, 1950, chap. II.

5.

6.

?

5. R. Dugas. La théorie physique au sens de Boltzmann et ses prolongements modernes. Neuchâtel, 1959, p. 158—184; 206—219.

6. Planck. Maxwell's Influence in Germany. — «James Clerk Maxwell: A Commemoration Volume, 1831—1931», Cambridge, 1931, p. 45—65, 58—63; S. P. Thompson. The Life of William Thomson Baron Kelvin of Largs. London, 1910, II, p. 1021—10:7.

6. Documentary History of the Problem of Fall from Kepler to Newton. — «Transactions of the American Philosophical Society», XLV, 1955, p. 329—395.

f. Brunei. L'introduction des théories de Newton en France au XVIII^e siècle. Paris, 1931; From the Closed World to the Infinite Universe. Baltimore, 1957, chap. XI.

mh

7.

VI

АНОМАЛИЯ И ВОЗНИКНОВЕНИЕ НАУЧНЫХ ОТКРЫТИЙ

70-

XVIII

1.

... N. 1d . The Eighteenth Century Revolution in Science—the First Phase. Calcutta, 14:11 chap. V.

... Daumas Lavoisier, theoricien et experimentateur. Paris, 1955, chaps. II-III.

... S. u h n. The Historical Structure of Scientific Discovery.—«Science», CXXXVI, June 1, 1962, p. 760—764,

2.

« 1774 »,

1775

1774

1775

«

]...

2.

1777

?

?

2 Uno Bocklund. A Lost Letter from Scheele to Lavoisier. – "Lychnos", 1957-1958, p 39-62.

3 J. Conant. The Overthrow of the Phlogiston Theory: The Chemical Revolution of 1775-1789. – "Harvard Case Histories in Experimental Science", Case 2. Cambridge. Mass., 1950, p 23.

(

80-

XVIII

),

? 1774

1775

1775

«

1776

1777

».

1777

»

«

»

«

1777 4. ?
 1810 60- XIX.
 « »
 ()
 OC
 1774
 1777
 X

4H.Metzger. La philosophie de la mati re chez Lavoisier. Paris, 1935; Daumas. Op. cit., chap. VII.

()
 ?
 1777
 ()
 1772
 5.

5 : . G u 1 . Lavoisier—the Cniria Year: The Background and Origin of His First Experiments on Coni bustion in 1772. Ithaca, N. Y., 1961. cn

6. L.W.Taylor. *Physics, the Pioneer Science*. Boston, 1941, p. 790-794; T.W. halmers. *Historic Researches*. London, 1949, p. 218-219.

7 E. .Whittaker. *A History of the Theories of Aether and Electricity*, I, 2d ed. London, 1951, p. 358, n. 1.

?

*

1895

?

?

8.

*

—

—

8 S.P.Thompson. The Life of Sir William Thomson Baron Kelvin of Largs London, 1910, II, p. 1125.

90-

XIX

)

(

9.

10.

9Conant. Op. cit., p. 18-20.

10K.K.Darrow. Nuclear Fission. – "Bell System Technical Journal", XIX, 1940, p. 267-289.

Ra, Ac, Th. Ba, La, Ce,

" (.Hahn and F.Strassman. ber den Nachweis und das Verhalten der bei der Bestrahlung des Urans mittels Neutronen entstehended) Erdalkalimetalle. – "Die Naturwissenschaften", XXVII [I 939], S. 15).

?

XX

" (theory-induced).

XIX

11.

(

)

12.

11 : I.B.Cohen. Franklin and Newton: An Inquiry into Speculative Newtonian Experimental Science and Franklin's Work in Electricity as an Example Thereof. Philadelphia, 1956, p. 385-386, 400-406, 452-467, 506-507. : Whittaker. Op. cit., p. 50-52.

12 J.S.Bruner and L.Postman. On the Perception of Incongruity: A Paradigm. - "Journal of Personality", XVIII, 1949, p. 206-223.

10

!"13.

13 Ibid., p. 218.

КРИЗИС И ВОЗНИКНОВЕНИЕ НАУЧНЫХ ТЕОРИЙ

?

1.

2.

3.

1 A.R.Hall. *The Scientific Revolution, 1500-1800*. London, 1954, p. 16.

2 M.Clagett. *The Science of Mechanics in the Middle Ages*. Madison, Wis., 1959, Parts II-III.

"Etudes Galiléennes". Paris, 1939;

I.

3 : S.Kuhn. *Newton's Optical Papers*, in: "Isaac Newton's Papers and Letters in Natural Philosophy", ed. I.B.Cohen. Cambridge, Mass., 1958, p. 27-45.

: E.T.Whittaker. *A History of the Theories of Aether and Electricity*, I, 2d ed. London, 1951, p. 94-109; W.Whewell. *History of the Inductive Sciences*, rev. ed. London, 1847, II, p. 396-466.

XIX

4.

4 : S.P.Thompson. *Life of William Thomson Baron Kelvin of Largs*. London, 1910, I, p. 266-281.

: F.Reiche. *The Quantum Theory*. London, 1922, chaps. I-II.

XVIII

5.

XIII

* XVI

"De revolutionibus",**

⁵ J.L.E. Dreier. A History of Astronomy from Thales to Kepler, 2d. ed. N.Y., 1953, chaps. XI-XII.

* X (1221-1284) -

** "De revolutionibus orbium coelestium libri VI". Norimbergae, 1543;

400- , 1947.-

XVI

"De revolutionibus"

6.

70-

XVIII

⁶ S.Kuhn. The Copernican Revolution. Cambridge. Mass., 1957, p. 135-143.

XVII

1756

" (2)

7.

70-

XVIII

⁷ J.R.Partington. A Short History of Chemistry, 2d ed. London, 1951, p. 48-51, 78-85, 90-120.

8.

*

XVII

?

()

XVIII

⁸ : J.R.Partington and D.McKie. Historical Studies on the Phlogiston Theory. – "Annals of Science", II, 1937, p. 361-404, III, 1938, p. 1-58, 337-371; IV, 1939, p. 337-371,

*

XVII

XVIII

1772

XVIII

⁹ H.Guerlac. Lavoisier – the Crucial Year. Ithaca, N.Y., 1961.

.35.

10.

XVIII
XIX

90- 1815 XIX

¹⁰ M.Jammer. Concepts of Space: The History of Theories of Space in Physics, Cambridge, Mass., 1954, p. 114-124.

" " "

" " "

" " "

" " "

11.

XIX

11 J.Larmor. Aether and Matter... Including a Discussion of the Influence of the Earth's Motion on Optical Phenomena. Cambridge, 1900, p. 6-20, 320-322.

12.

13.

1890

12 R. .Glazebrook. James Clerk Maxwell and Modern Physics, London, 1896, chap. IX. : "A Treatise on Electricity and Magnetism", 3d. ed. Oxford. 1892, p. 470.

13 : .Kuhn. Op. cit., chap. VII.

14.

1905

14Whittaker. Op. cit., I, p. 386-410; II (London, 1953), p. 27-40.

15.

(

),

(

XVII

),

16.

XVIII-XIX

15 .: .L.Heath. Aristarchus of Samos: The Ancient Copernicus. Oxford, 1913, Part II.

.: A.Koestler. The Sleepwalkers: A History of Man's Changing Vision of the Universe. London, 1959, p. 50.

16 Partington. Op. cit., p. 78-85.

VIII РЕАКЦИЯ НА КРИЗИС

ad hoc,

. B X

2.

: N R Hanson. Patterns of Discovery. Cambridge, 1958, p.99-105.

2 T.S.Kuhn. The Essential Tension: Tradition and Innovation in Scientific Research, in: "The Third (1959) University of Utah Research Conference on the Identification of Creative Scientific Talent", ed. Calvin W. Taylor (Salt Lake City, 1959), p. 162-177.

: F.Barron. The Psychology of Imagination. – "Scientific American", CXCIX, September 1958, p. 151-166, esp. 160.

"

:

?

(

),

?

?

ad hoc)

"5.

"6.

⁵ : .S.Kuhn. The Copernican Revolution. Cambridge, Mass., 1957, p. 138.

⁶ A.Einstein. Autobiographical Note, in: "Albert Einstein: Philosopher-Scientist", ed. P.A.Schilpp, Evanston, Ill., 1949, p. 45.

"7.

?

⁷ R.Kronig, The Turning Point, in: "Theoretical Physics in the Twentieth Century: A Memorial Volume to Wolfgang Pauli", ed. M.Fierz and V.F.Weisskopf. N.Y., 1960, p. 25, 25-26.

1925

"8.

"9.

⁸ : .S.Kuhn. The Copernican Revolution. Cambridge, Mass., 1957, p. 138.

⁹ A.Einstein. Autobiographical Note, in: "Albert Einstein: Philosopher-Scientist", ed. P.A.Schilpp, Evanston, Ill., 1949, p. 45.

10.

?

?

10 : J.L.E.Dreyer. A History of Astronomy from Thales to Kepler, 2d ed., N.Y., 1953, p. 380-393.

. J.Priestley. Experiments and Observations on Different Kinds of Air. London, 1774-1775.

V

()

XVII

XX

11.

12.

11 XVII : R.Dugas. La m canique au XVIIe si cle. Neuchatel, 1954, . XI. XIX

: R.Dugas. Histoire de la m canique. Neuchatel, 1950, p. 419-443.

12 T.S.Kuhn. A Function for Thought Experiments, in: "M langes Alexandre Koyr ", ed. R.Taton and I.B.Cohen. Hermann, Paris, 1964.

.) (

13.

13 : V.R n hi. Histoire de la lumi re. Paris, 1956, chap. VII.
 : J.Priestley. The History and Present State of Discoveries Relating to Vision, Light and Colours. London, 1772, p. 498-520.

14.

15.

14 A.Einstein. Loc. cit

15

(H.C.Lehman. Age and Achievement. Princeton, 1953)

IX

**ПРИРОДА И НЕОБХОДИМОСТЬ
НАУЧНЫХ РЕВОЛЮЦИЙ**

VI

?

?

?

(
)

V

XX

(,) ,

()
XX

()

?

?

XI

.)

.(

IV

VII

1.

2.

3.

4.

()

3 J. .Conant. Overthrow of the Phlogiston Theory. Cambridge, 1950, p. 13-16;
J.R.Partington. A Short History of Chemistry, 2d ed. London, 1951, p. 85-88.

H.Metzger. Newton, Stahl, Boerhaave et la doctrine chimique. Paris, 1930. Part II.

4
R. .raithwaite. Scientific Explanation. Cambridge, 1953, p. 50-87, . 76.

?

?

?

.)

.

?

XVII

XVII

5.

XVII

5 .: M.Boas. The Establishment of the Mechanical Philosophy. – "Osiris", X, 1952, p. 412-541.
.: Ibid., p. 483.

XVII

6.

XVIII

XVII

XVIII

6 R.Dugas. La m canique au XVIIe si cle, Neuchatel, 1954, p. 177-185, 284-298, 345-356.

7.) (

40- XVIII " " (effluvium),

XIX

7 I. Cohen. Franklin and Newton: An Inquiry into Speculative Newtonian Experimental Science and Franklin's Work in Electricity as an Example Thereof. Philadelphia, 1956, chaps. VI-VII.

8.

XIX

9.

XIX

8 .: Ibid., chaps. VIII-IX. .: Metzger. Op. cit., part I.

9 E.Meyerson. Identity and Reality. New York, 1930, chap. X.

),

" " " "

10.

11.

10 E.T.Whittaker. A History of the Theories of Aether and Electricity, II. London, 1953, p. 28-30

11 : . . . Gillispie. The Edge of Objectivity: An Essay in the History of Scientific Ideas. Princeton, 1960.

XVIII

XX

1.

VI

2.

¹ G.M.Stratton. Vision without Inversion of the Retinal Image. – "Psychological Review", IV, 1897, p. 341-360, 463-481. X.
H. A. Carr. An Introduction to Space Perception. New York, 1935, p. 18-57

² : A.H.Hastorf. The Influence of Suggestion on the Relationship between Stimulus Size and Perceived Distance. – "Journal of Psychology", XXIX, 1950, p. 195-217; J.S.Bruner, L.Postman and J. Rodrigues. Expectations and the Perception of Color. – "American Journal of Psychology", LXIV, 1951, p. 216-227.

3.

()

(

),

1781

),

(

1801

20

50

XIX

5.

?

5 R.Wolf. Geschichte der Astronomie. München, 1877, S. 513-515, 683-693.

6.

XVI

7.

6 J.Needham. Science and Civilization in China, III. Cambridge, 1959, p. 423-429; 434-436

7 T.S.Kuhn. The Copernican Revolution. Cambridge, Mass., 1957, p. 206-209.

XVII

XVII

8.

XVIII

XVII

8 D.Roller and D.H.D.Roller. The Development of the Concept of Electric Charge. Cambridge, Mass., 1954, p. 21-29.

9.

9

VII

() ,

10.

?

90° ,

11.

XIV

10 G.Galilei. Dialogues concerning Two New Sciences. Evanston. Ill., 1946, p. 80-81, 162-166.

11 Ibid., p. 91-94, 244

;

12.

XIV

?

?

?

12 M.Clagett. The Science of Mechanics in the Middle Ages. Madison, Wis., 1959, p. 537-538, 570.

?

III

(
),

16.

17.

" "

¹⁶ I.S.Kuhn. A Function for Thought Experiments, in: "Mélanges Alexandre Koyre", ed. R.Taton and I.B.Cohen. Hermann, Paris, 1964.

¹⁷ A.Koyre. Etudes Galiléennes. Paris, 1939, I, p. 46-51; "Galileo and Plato". – "Journal of the History of Ideas", IV, 1943, p. 400-428.

18.

" "

¹⁸ Clagett. Op. cit., chaps. IV, VI and IX.

XVIII

XIX

(

(

-

).

(

)

)

XVIII

20.

XVIII

20 H.Metzger. Newton, Stahl, Boerhaave et la doctrine chimique. Paris, 1930, p. 34-68.

21.

XVIII

XVIII

21 Ibid., p. 124-129, 139-148. : L.K.Nash. The Atomic-Molecular Theory ("Harvard Case Histories in Experimental Science", Case 4). Cambridge, Mass., 1950, p. 14-21.

22.

23.

()

²² J.R.Partingt n. A Short History of Chemistry. 2d ed. London, 1951, p. 161-163.

²³ A.N.Meldrum. The Development of the Atomic Theory: (1) Berthollet's Doctrine of Variable Proportions.

24.

facto*

ipso

²⁴ J.R.Partingt n. A Short History of Chemistry. 2d ed. London, 1951, p. 161-163.

2,6

56% 72%

1,3,

25.

26.

²⁵ A.N.Meldrum. The Development of the Atomic Theory: (1) Berthollet's Doctrine of Variable Proportions. "Manchester Memoirs", LIV, 1910, p. 1-16.

XI

НЕРАЗЛИЧИМОСТЬ РЕВОЛЮЦИЙ

nauseam.*

ad

) (

||

1.

2.

()

1 L. .Nash. The Origins of Dalton's Chemical Atomic Theory. "Isis", XLVII, 1956, p. 101-116.

2 : F.Cajori (ed.). Sir Isaac Newton's Mathematical Principles of Natural Philosophy and His System of the World. Berkeley, Calif., 1946, p. 21.

Two New Sciences, Evanston, Ill., 1946, p. 154-176.

),

"

" " "

" "?

" "

4.

XII

РАЗРЕШЕНИЕ РЕВОЛЮЦИЙ

?

),

(

?

?

2.

² K.R.Popper. The Logic of Scientific Discovery. N.Y., 1959, esp. chaps. I-IV.

XIX

XX

(

)

" (

),

3.

3

Frank. Einstein, His Life and Times. N.Y., 1947, p. 142-146.

... Nordmann. Einstein and the Universe. N.Y., 1922, chap. IX.

?

9.

10.

9 ...: E. .Burt. The Metaphysical Foundations of Modern Physical Science, rev. ed. N.Y., 1932, p. 44-49.

10 ... (R. Strutt, 4th Baron Rayleigh. John William Strutt, Third Baron Rayleigh [New York, 1924], p. 23.)

11.

* 1627 ... II, " 1576-1612 ... Kuhn. Op. cit., p. 219-225. 11 ...: F.Reiche. The Quantum Theory. London. 1922, chaps. II, VI-IX.

60

12.

13.

« »

14.

« », « » « »

¹³ . . Whittaker. A History of the Theories of Aether and Electricity. I, 2d ed. London, 1951, p. 108.

¹⁴ Ibid., II, 1953, p. 151—180. (.)

(15.)

16.

15

: J. L. ... D ... A History of Astronomy from Thales to Kepler, 2d ed. N. Y., 1953.

: J. R. Partington and D. ... Historical Studies of the Phlogiston Theory. — «Annals of Science», IV, 1939, p. 113—149.

16

: J. R. ... -tington. A Short History of Chemistry, 2d ed. London, 1951, p. 134.

: ... Geschichte der Chemie. III. Braunschweig. 1845, p. 294—296.

()

13. ПРОГРЕСС, КОТОРЫЙ НЕСУТ РЕВОЛЮЦИИ

—
, ipso facto

?

?

« »

—
« ».

« ... » « ... »

?

CO

?

||)

(

« ... »

?

?

?

XI

»,

3,

«1984

«

»,

?

coxp

o

coxp

?

p ecce

« »

?

?

?

», «

«

»,

1859

« »

()

4.

4 L. E i s e l e . Darwin's Century: Evolution and the Men Who Discovered It. N. Y., 1958, chaps. II, IV—V.

5. «

»

«

»

«

?

», «

»

XII

?

?

?

?

?

?—

1.

2.

3.

1

2

3

XVIII

< >

: Reflection on My Critics», in: I. Lakatos and A. Musgrave (eds.). Criticism and the Growth of Knowledge. Cambridge, 1970; Second Thoughts on Paradigms, in: F. Suppe (ed.). The Structure of Scientific Theories, Urbana, Ill., 1974.

«Reflections»,

—«Growth of Knowledge»; «Second Thoughts».

8*

4.

« »

2- ;3-

« »

5-

4-

« »

4-

4

: a s t m . The Nature of a Paradigm, in: «Growth of Knowledge»; D. S h a p e r . The Structure of Scientific Revolutions.—«Philosophical Review», LXXIII, 1964 p. 383—394.

« »,

pax.

5-

0

— 6- 7- 6-

7-

1.

« »

()

5.

5 W. . Hagstrom. The Scientific Community. N. Y., 1965, ch. IV and V; D. J. Price and D. de B. Beaver. Collaboration in an Invisible College. — «American Psychologist», XXI, 1966, p. 1011—1018; D. Crane. Social Structure in a Group of Scientists: A Test of the «Invisible College» Hypothesis. — «American Sociological Review», XXXIV, 1969, p. 335—352; N. . M u 1 1 i n s. Social Networks among Biological Scientists, Ph. D. diss., Harvard University, 1966, and «The Micro-Structure of an Invisible College: Tin' Phage Group» (, 1968).

?

6.

h

6. Garfield. The Use of Citation Data in Writing the History of Science, Philadelphia. Institute of Scientific Information, 1964; M. M. Kessler. Comparison of the Results of Bibliographic Coupling and Analytic Subject Indexing.—«American Documentation», XVI. 1965, p. 223—233; D. J. Price. Networks of Scientific Papers. — «Science», CIL, 1965, p. 510—515.

II

()

()

« ».

()

« » « »

XIX

experimentale). To,

(physique

1920

XIX

25 ()

2. Парадигмы как наборы предписаний для научной группы

« »

7.

).

—

? (

.)

—

« »

« »

« »:« »

; « » —

« »,

() (z) (, , z).

$$: F = \quad | = V/R.$$

: « » « ».

=RI2.

R I,

F =

$$I = V/R$$

« »,

« ».

e,

8.

8 . . . Brown. Electric Current in Early Nineteenth-Century French Physics.—«Historical Studies in the Physical Sciences», I, 1969, p. 61— 103; . S chagrin. Resistance to Ohm's Law. — «American Journal "1 Physics», XXI, 1963, p. 536—547.

?

»,

?

«

«

»

«

».

:

;

:

;

—

—

XIX

10.

3. Парадигмы как общепризнанные образцы

F=m

?

F =

F=m

$$mg = m \frac{d^2 s}{dt^2}$$

$$mg \sin \theta = -ml \frac{d^2 \theta}{dt^2}$$

$$m_1 \frac{d^2 s_1}{dt^2} + k_1 s_1 = k_2 (s_2 - s_1 + d)$$

F=m

F=m

?

F =

F =

()

(

),

(law-sketch).

u . . . : R. D u g a s. A History of Mechanics. Neuchatel, 1955, p. 135—136, 186—193; D. Bernoulli. Hydrodynamica; sive de viribus et motibus fluidoruni, commentarii opus academicurn, Strasbourg, 1738. Sec. III.

XVIII

. . . : . Truesdell. Reactions of Late Baroque Mechanics to Success, Conjecture, Error. and Failure in Newton's «Principia», — « Quarterly», X, 1967, p. 238—258,

XVIII

vis viva,

: «
».

« » « ».

« ».

4. Неявное знание и интуиция

12,

; « ?»

oro

pa

«

»

1794

?

F=m

?

13.

6e

()

:« !»

?

()

,u

|

()

« »

« »

p

14.

(
)

()

14

«Second Thoughts»,

()

p,

)

« »

5. Образцы, несоизмеримость и революции

15. XII

*5
«Reflections».

«

»

16:

(-)

?

«

?»

«

»,

: «
«

».

«
»)

» (

«

»,

17.

o

17

: W. V. . Q u i n . Word and Object. Cambridge, Mass.—N. Y., 1960, chaps. I, II, Ho

: . . . N i d a. Linguistics and Ethnology in Translation Problems, in: D. Hymes (ed.). Language and Culture in Society. N. Y., 1964, p. 90—97.

()

:«
».

(
« »),

« »

()

« »
« »

—)

6. Революции и релятивизм

18.

« » « ».

21.

(
)
()

21

: . S. u h n. Comment [on the Relations of Science and Art]. — «Comparative Studies in Philosophy and History», XI, 1969, p. 403-412,

ЧЕМ ИНТЕРЕСНА КНИГА Т. КУНА «СТРУКТУРА НАУЧНЫХ РЕВОЛЮЦИЙ»

« —»

1970 () 1962

a

?

?

?

?

», «

« »; «

?

XIX

XX

« »

—

) (

(,) ,

XVII

1957

50-

«

».

«

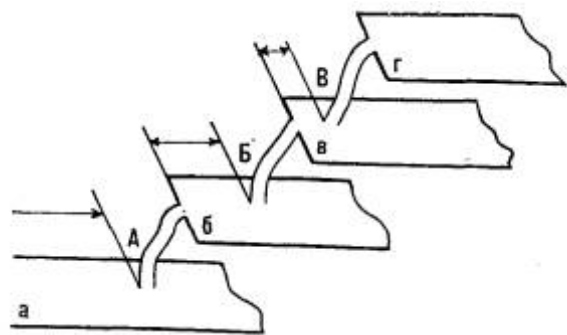
».

«

XX

»

1964



«

», 1964, 9..

:«

)

(

« »

»¹.

«

»,

«

»

«

»

1 ...
», 1964, 9, . 35—36.

—«

40—50

«

»,

1969

—«

«

«

»,

».

«

»,

«

»

1 J.Watkins. Against «Normal Science». — In: «Criticism and the Growth of Knowledge». Edited by I. Lakatos and A. Musgrave Cambridge, 1970, p. 31.

1.

«

»².

?

¹ . R. Popper. Normal Science and its Dangers. — In: «Criticism...», p. 53.

² .. Masterman. The Nature of a Paradigm.—In: «Criticism...»

«

»

. «

»

1 . Popper. Normal Science and its Dangers.—In: «Criticism...», p. 52.

1971),

—«

» (« »,

) (

« »

«

»,

УКАЗАТЕЛЬ

<p>. 50</p> <p>181, 185</p> <p>165</p> <p>243</p> <p>99</p> <p>86, 94, 97, 106, 110, 115, 116, 126, 134, 135, 242, 243</p> <p>— 115, 116, 242</p> <p>— 22, 23, 80, 95</p> <p>— 98, 103</p> <p>— 110, 111</p> <p>107, 108</p> <p>28, 34, 97, 100, 104,</p> <p>160—164, 166—168, 177, 185,</p> <p>188, 214, 269</p> <p>34, 166</p> <p>. 48, 49, 54</p> <p>. 46</p> <p>. 51</p> <p>. 112</p> <p>. . 201</p> <p>X. 120</p> <p>. 54, 248, 249</p> <p>. 177—179, 195, 265</p> <p>. . 230</p> <p>. 34, 101</p> <p>. 66, 67, 75, 143, 189</p> <p>. . 157</p> <p>. 34, 50—51, 53, 67,</p> <p>188, 189</p> <p>. 81</p> <p>. 214</p> <p>. 124, 202, 242</p> <p>47, 206</p>	<p>. . 138</p> <p>. 208</p> <p>. . 239</p> <p>. 92, 153</p> <p>. 76</p> <p>. 34</p> <p>. 161</p> <p>. 35, 36, 39, 223</p> <p>. 211</p> <p>191—194</p> <p>. . 136</p> <p>. 71, 72</p> <p>. 42 . 49, 55</p> <p>. 157</p> <p>253, 254, 255</p> <p>259, 260, 262, 266</p> <p>. 20, 51, 54, 76, 97, 124, 158, 160—164, 166—168, 177, 185,</p> <p>247, 248, 261</p> <p>. . 56</p> <p>. 232</p> <p>. . 55</p> <p>. 118</p> <p>107, 108, 140, 141</p> <p>. 66</p> <p>- . . 179</p> <p>107, 108, 140, 141</p> <p>X. 84, 103</p> <p>. . 56</p> <p>. 156, 157</p> <p>. 34</p> <p>- 154, , 155</p> <p>. . 39, 75, 147</p> <p>. . 106</p> <p>59—65, 113, 114, 117, 139, 180, 186, 190, 191, 193, 200,</p> <p>217, 218, 228, 233, 238, 241, 247, 267, 268, 269, 273</p>
---	---

. X. 212
. 32, 33, 42
. 17 . 108 X. 54, 143, 197, 248
. 54
. 112, 146, 174—180, 184, 185, 187, 235, 251, 261
. 40, 199, 224, 225, 235
. 89
. 32
. 66, 143, 163, 170, 197, 255
. 104, 197
. 153
. 50, 51
— 239
« » 237—244
. 156
. 80, 83
210, 214, 233
. 99, 123, 206
. 64
. 57, 76, 124, 144, 248
. 278
. X. 225
. 32, 42
253, 254
— - 246
- 247
45, 68, 100, 182, 233
224
164, 165, 169, 254, 257, 258
165, 249
• 70, 72
39, 223, 269
. 42, 50, 54, 101
. 153
. 39, 87, 129, 198

. 55, 12 201, 202, 205
.. 232
. 66
. 108
. 36, 97, 162, 168
. 115
. 49
. 8, 20, 76, 97, 166, 167
41, 99, 222, 231, 232, 252, 262, 263
— 181, 182, 183, 196, 197
— 262—264
. 14, 15, 81, 89, 138
112, 113, 116, 177
. 13, 23, 29, 48, 97—100, 102, 104, 106—108, 113, 117, 118,
122, 129, 130, 157, 158. 197, 198, 202, 203, 205, 206, 208, 235, 261
X. 206
. 33, 37, 65, 92, 97, 145, 198
. 230
100, 102, 107, 109, 116. 119—124, 165, 200,
— 12, 102, 103, 106, 107
— 103, 119, 125, 126
. 119
. 86, 129
. 9, 263
. 62
. 42, 50, 51, 57, 59, 60
. 13, 33, 51, 52, 67, 80, 97, 100, 106, 112, 116, 110, 124, 158, 166,
167, 188, 197, 203, 272, 274—292
. 15, 270
. 75
. 9
; 8
. 23, 28, 45, 70, 81, 82, 84—89, 96, 100—10;), 113, 121, 124,
129, 146, 160. 162, 169, 174, 188, 189, 19-1, 196, 202, 205, 206, 214
. 55, 56

.28
.243, 285, 286, 289, 290
. .224
. .55
.105
. .76, 104
37, 90, 91, 145, 159
.126
. .279
212
156 . .47, 106, 113
.8
. .105
.108
. .24, 45, 66, 70, 75, 87, 97, 105, 106, 113, 116, 146, 147,
148, 236
.102, 206
. .125
. .230
. .292
.279
.228, 237, 283, 285—287
.8, 146
. .66
. .80, 177, 179, 180
« . .240
.8, 66, 75, 83, 138, 146, 175
.48
. .279, 281, 292
23—25
72, 247, 272
240, 241
143
. .105
.11

164
.15, 192
.227
17—22, 26, 79, 132, 133, 142, 143, 174, 183, 210, 219, 222, 223,
228, 234, 272
— 20—23, 210, 211, 212, 235, 272
23—25, 75, 76, 127, 141, 173, 183, 218, 219, 234,
235, 239
80—85, 90, 94—95
10—11, 21—23, 29, 42, 43, 46, 61, 69, 77, 78, 212—
222, 228—235
169, 262
. .14, 15, 176, 178, 185
. .263 .158
. .15
99 . .32, 39
.196
22—25, 29, 30, 45, 68, 79, 94, 95
— 28, 45, 46, 49, 52, 57, 59, 76, 113, 114
— 60, 79
71, 72, 98, 99.
.23, 24, 28, 30, 31, 32, 34, 48, 49, 53—56, 65, 70, 76, 78, 97—99,
103, 104, 106, 108, 111, 112, 115, 135—137, 139, 140, 142—144, 147, 148
163, 185, 196, 198, 202, 206, 214, 217, 227, 235, 236, 245, 253, 269
« . .244, 247—250, 252, 253, 258 «
» 199, 200, 259, 264—266
. .239
165—173, 187, 193
— 193
161, 162
219
80—89
85-88
251, 253, 255—257

47, 49, 50, 80, 90, 97
 31
 11, 28, 29, 30, 31, 34, 38, 39, 44, 45, 70, 107, 112, 113, 119,
 125, 126, 130, 131, 138, 139, 141, 142, 148, 149, 191, 204—209, 272
 — 10, 11, 28, 29, 44, 46, 149, 228, 229, 236, 237
 — 76, 77, 90, 98, 119, 120, 122, 128, 142, 200, 201
 — 194—209
 . . 101, 102, 108, 138, 177, 180, 206
 . 118
 263—267
 . 8, 9
 . 30, 76, 199, 202
 35, 211
 139
 . 50
 128, 129, 130
 . 71, 249
 . . 193, 243, 267, 282, 283, 284, 285, 287
 . 92, 93, 153
 122, 233
 63, 64, 68, 122
 — 69, 70, 73
 . . 230, 232
 65—68, 138, 236—240
 . 31, 39, 81—85, 87—89, 96, 101, 113, 120, 121, 123—125,
 160, 162, 163, 194, 198, 205, 209
 77—78
 . 177, 179, 180, 195, 265
 28, 29, 45, 97—100, 108, 113, 117, 136, 202, 203, 205
 . . 204
 . 108
 . 98, 202
 . . . 201
 267—270
 . 143
 . . 85—88, 129

. . 177, 179
 . 153
 . . X. . 33, 36, 37, 42, 51, 159
 . 31, 125
 II 202
 . 38
 . 212
 . X. 9
 154—162
 . . 78
 216—218
 . 224
 21, 255—257
 145, 146
 251, 252, 255—257, 262
 . . 105
 . . 153
 . . 85
 74, 237
 — 242
 — 19, 24, 25, 45, 79, 110, 131, 132, 134, 135,
 141, 142, 268, 269
 — 258—262
 — 79, 80, 110, 114, 115, 187, 193, 194
 103
 30, 31, 104, 203
 31
 174—176
 19, 87, 101—103, 135, 137, 206
 223—225
 32—34,
 . . 76, 87, 98, 135
 . 86 . 51
 . 54, 248
 . 259, 285, 287
 . . 184

. 244
. . 86, 92, 97, 107, 116, 147, 204
. 75
. . 42
. 143
. . 9
. 282, 283, 284, 285
32
186, 187, 216, 217
18, 31, 67, 73, 74, 112, 215—220, 247
. 55, 65, 97, 115
193, 194
. 217
. 15, 270, 285—287
. . 205
123, 124
. 106, 113
. 9
. 196
. 28, 32—34, 37—40, 42, 91, 145, 159, 164
. . 30, 105, 203, 204, 205
. 48, 49, 205
. . 89
. . 54
. . 49, 112, 120, 154
. X. 153
. 32, 159
. . 65, 230
. . 15, 33
. . 105
. . 97
241—243, 268
220 "
. . 85
. 224
170, 173
. 239

. 228, 242, 267
. . 81, 83, 101
. 242
. . 48
. 217, 244
. 55, 56
. 23, 24, 30, 48, 70, 107, 113, 118, 122, 124, 126, 136, 137, 140,
141, 148, 189, 196, 202, 204, 206, 214, 217, 235, 239, 242, 269
. 224
49—52
117, 121, 127, 203, 218
. 279
104—106, 147
. 30, 121
. . . 56