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Rare and important books & manuscripts in science and medicine, by Christian Westergaard.

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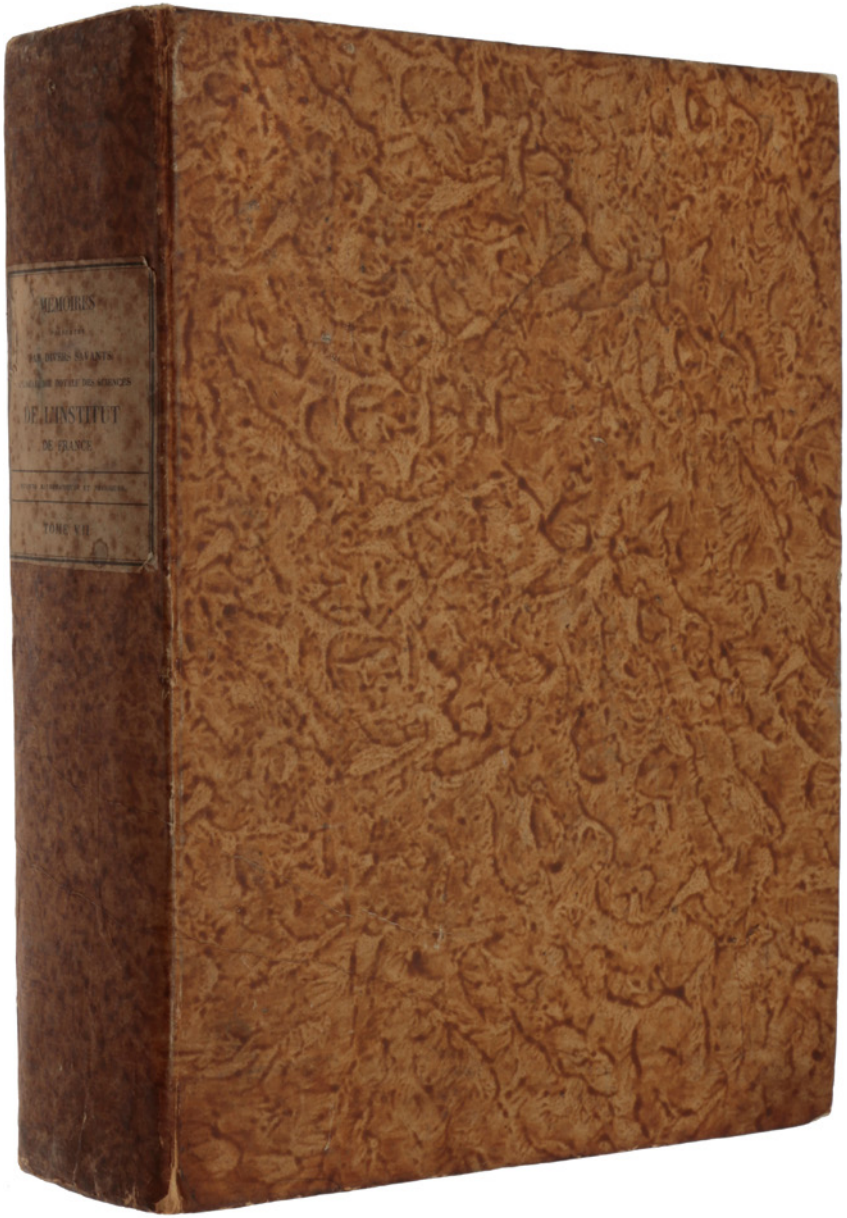
'A MONUMENT MORE LASTING THAN BRONZE' (LEGENDRE)

ABEL, Niels Henrik. *Mémoire sur une propriété générale d'une classe trés-étendue de fonctions transcendantes, présenté à l'Académie le 30 Octobre 1826, pp. 176-264 in: Mémoires présentés par divers savants a l'Académie Royale des Scines de l'Institute de France … Tome Septième.* Paris: Imprimé par autorisation du roi a l'Imprimerie Royale, 1841.

$14,000

First edition, journal issue, of "the most important single result in the theory of integrals of algebraic functions … Abel's theorem" (Bottazzini & Gray, p. 236), a result which Legendre called 'a monument more lasting than bronze'. It can be regarded as the birth of algebraic geometry.

http://sophiararebooks.com/5197



PMM 72 - 'GIVE ME A PLACE TO STAND, AND I WILL MOVE THE EARTH'

ARCHIMEDES. *Opera, quae quidem extant, omnia . . . nuncque primum & Graece Latine in lucem edita . . . adiecta quoque sunt Eutocii Ascalonitae in eosdem Archimedis libros commentaria item Graece & Latine, nunquam antea excusa.* Basle: Joannes Hervagius, 1544.

$120,000

First edition of one of the key scientific books of the Renaissance, representing a decisive step forward in the history of mathematics. This book constitutes "the first printing of the original Greek text of seven Archimedean mathematical texts, accompanied by Jacopo de Cremona's Latin translation from a manuscript corrected by Regiomontanus, and the commentaries (in both Greek and Latin) of the sixth-century mathematician Eutocius of Ascalon" (Norman).

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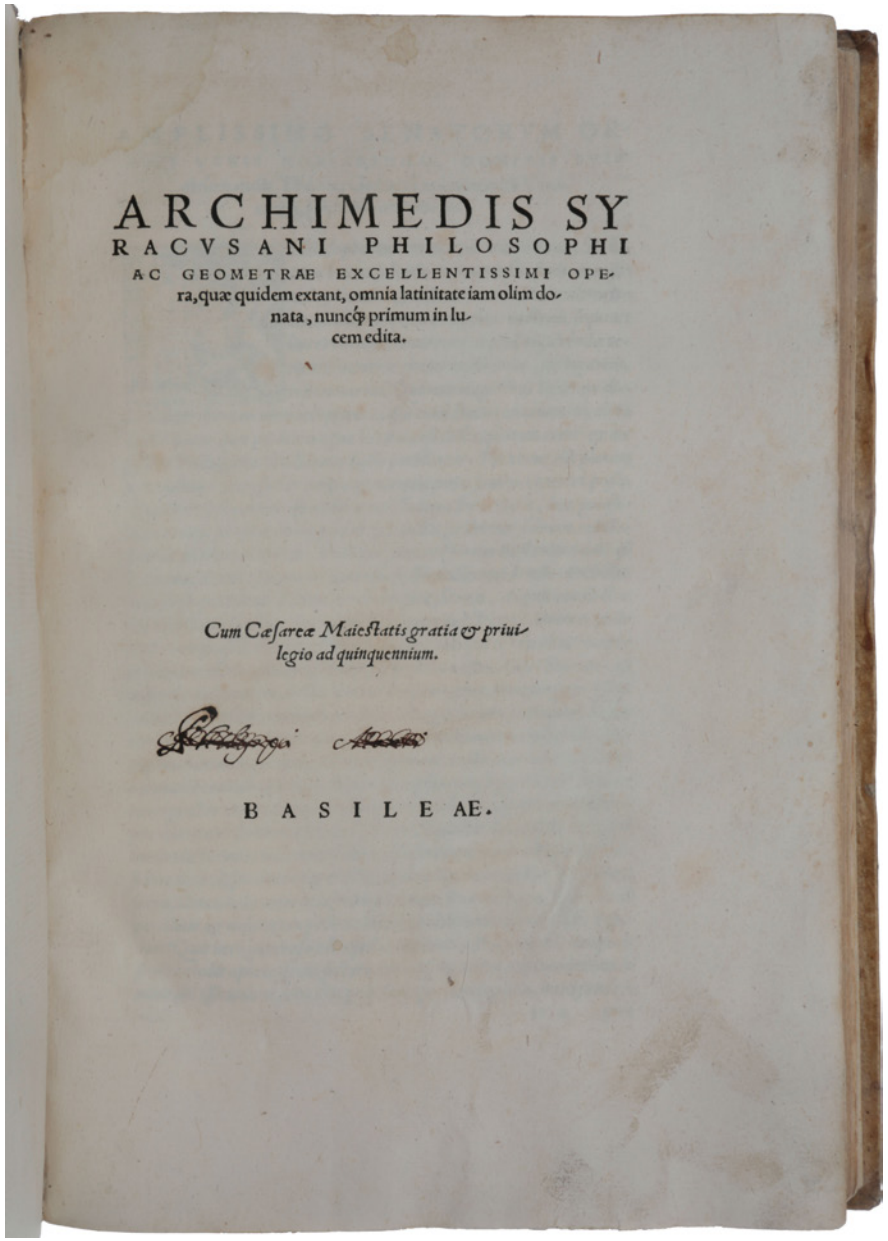


ARCHIMEDIS SY
RACVSANI PHILOSOPHI
AC GEOMETRAE EXCELLENTISSIMI OPE-
ra, quæ quidem extant, omnia latinitate iam olim do-
nata, nunc q̃ primum in lu-
cem edita.

*Cum Cæsareæ Maiestatis gratia & priui-
legio ad quinquennium.*

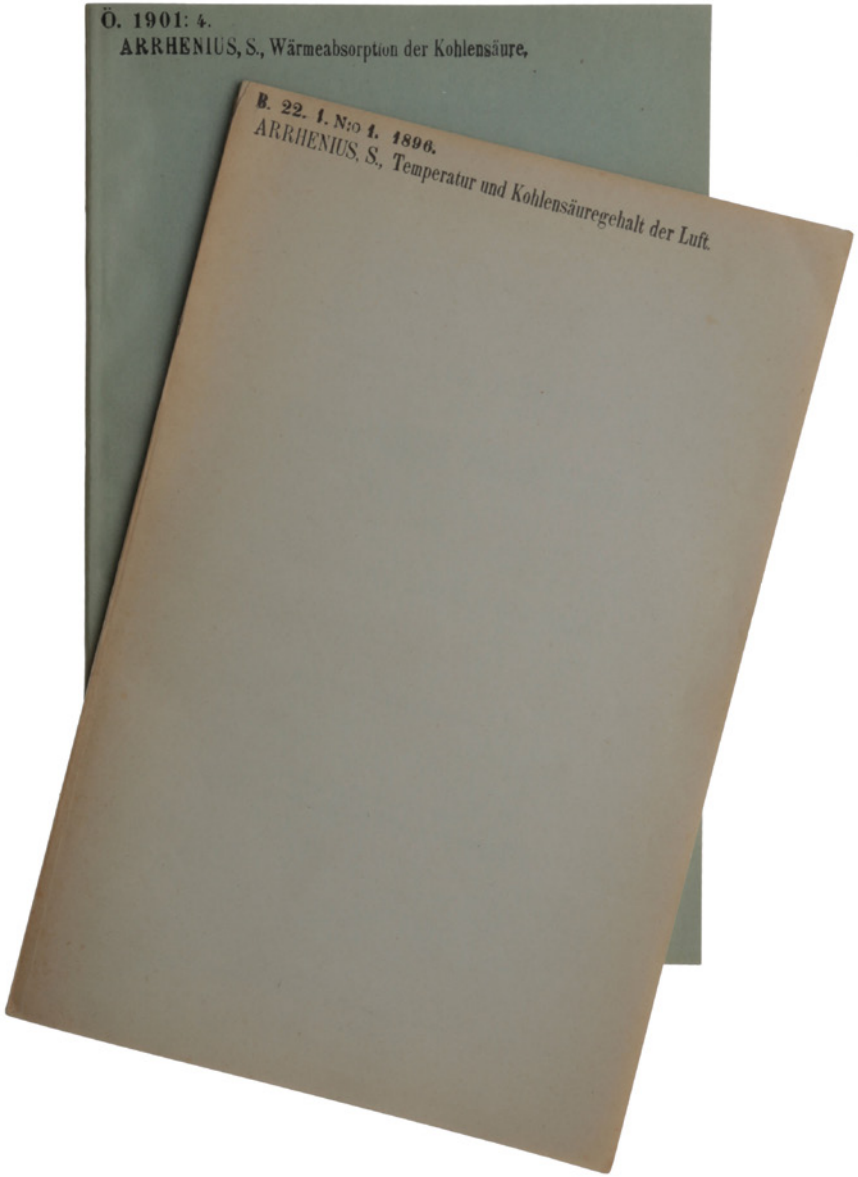
BASILEAE.

FIRST QUANTITATIVE ESTIMATE OF ANTHROPOGENIC GLOBAL WARMING

ARRHENIUS, Svante. *Ueber den Einfluss des atmosphärischen Kohlensäuregehalts auf die Temperatur der Erdoberfläche. Offprint from: Bihang Till K. Svenska Vet.-Akad. Handlingar, Bd. 22, No. 1 (January, 1896). [With:] Ueber die Wärmeabsorption durch Kohlensäure und ihren Einfluss auf die Temperatur der Erdoberfläche. Offprint from: Ofversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, 58th Year, 1901, no. 1.* Stockholm: Norstedt & Söner, 1896 & 1901.

$3,500

First edition, offprint issues, of Arrhenius' landmark papers on climate change. Arrhenius was the first to quantify the influence of changes in the concentration of carbon dioxide in the atmosphere on the temperature of the earth's surface. His first estimate of a man-made global temperature change was published in 1896 in the first offered paper. Refined calculations of the human impact on climate were published by Arrhenius in the last two offered papers. The conclusions of Arrhenius' 1896 paper are now part of the mainstream of climate change science.



http://sophiararebooks.com/5202

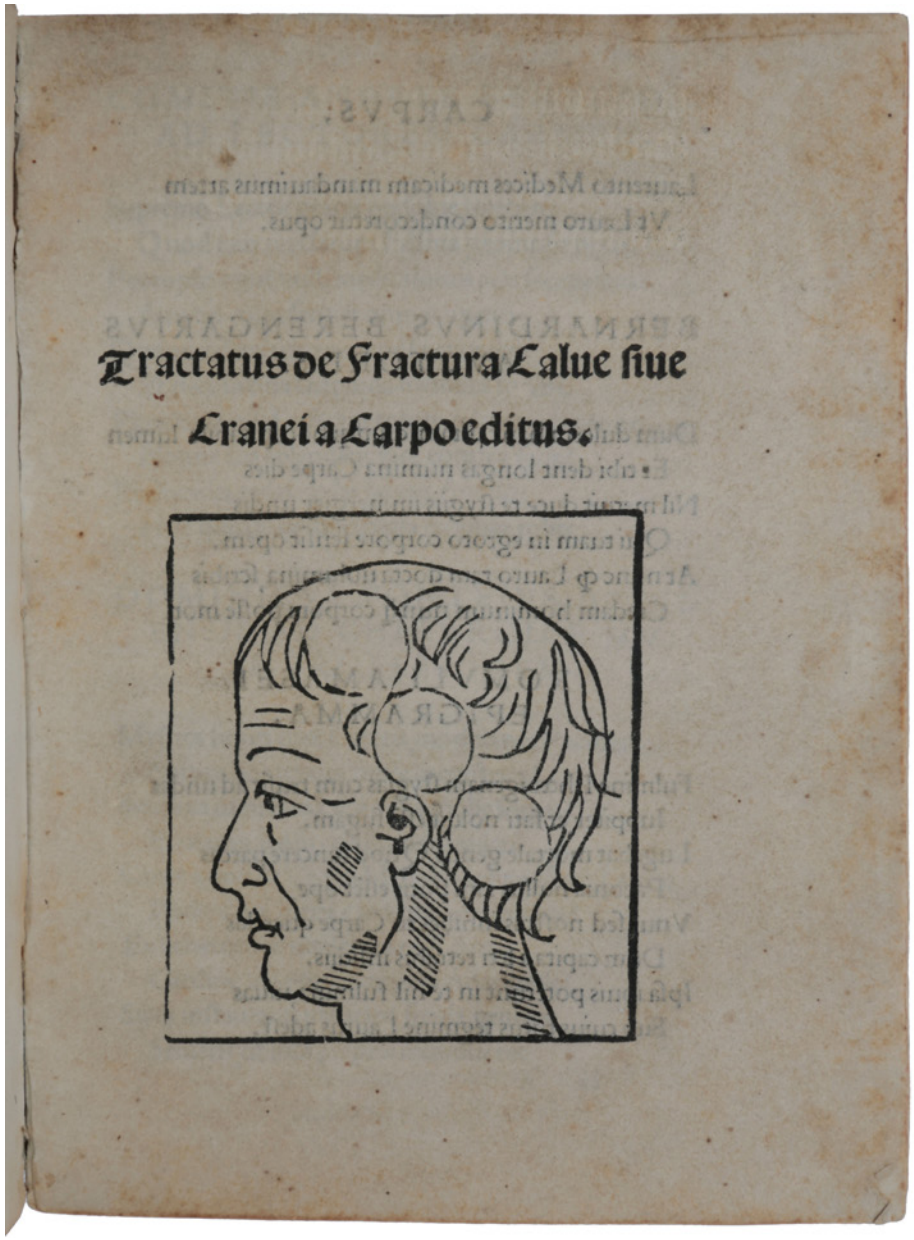
THE FIRST SEPARATE TREATISE ON HEAD INJURIES

BERENGARIO da CARPI, Jacopo. *Tractatus de Fractura Calve sive Cranei.* Bologna: Hieronymus de Benedictis, 10 December 1518 [colophon].

$80,000

First edition of the first separate treatise on head injuries and their neurosurgical treatment. Berenagrio's "greatest contribution to medicine was to write the most important work on craniocerebral surgery of the 16th century, the *Tractatus de Fractura Calvae sive Cranei* (*Treatise on Fractures of the Calvaria or Cranium*), in which he described an entire set of surgical instruments to be used for cranial operations to treat head traumas that became a reference for later generations of physicians. This was a systematic treatise covering the mechanisms, classification, and medical and surgical treatment of head traumas, and can be considered a milestone in the history of neurotraumatology" (Di Ieva *et al.*).

http://sophiararebooks.com/5182

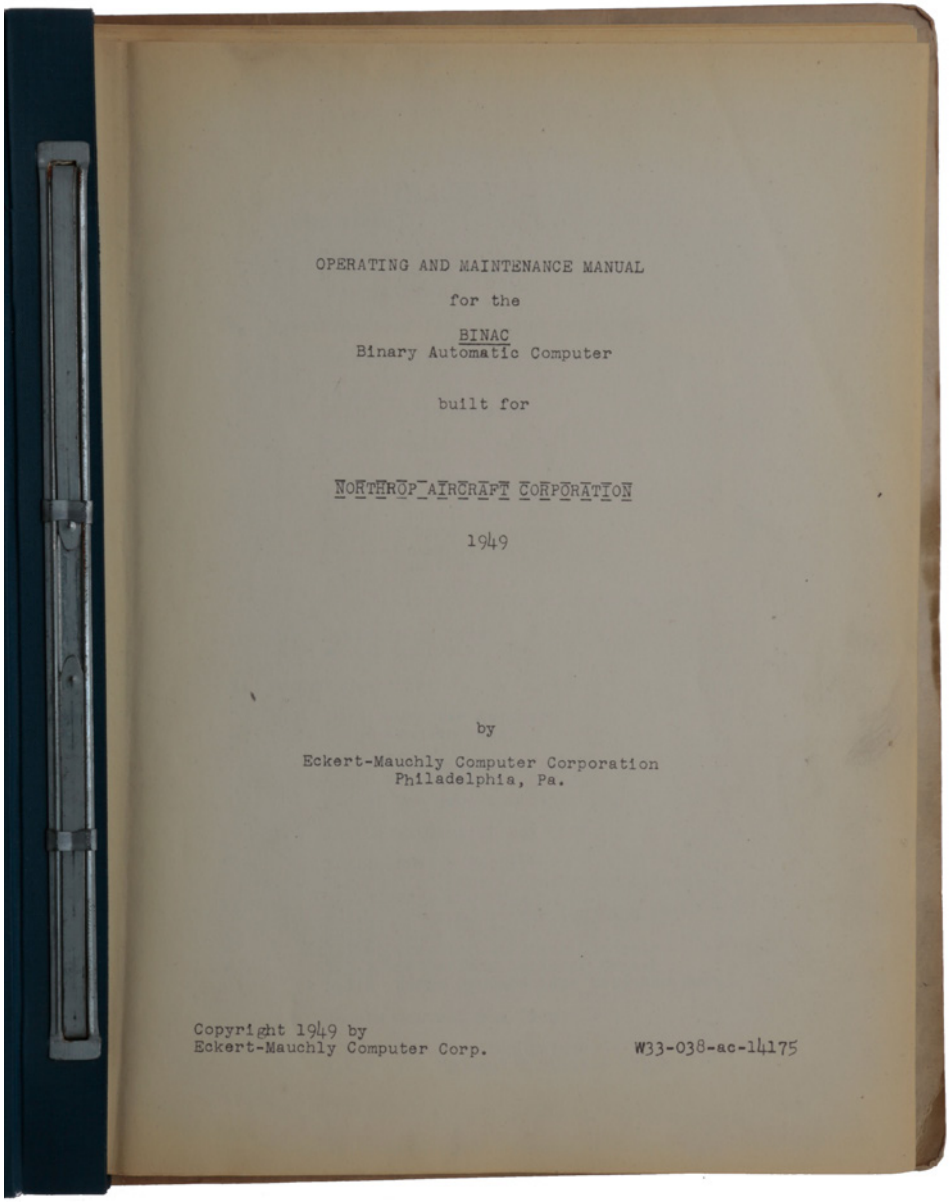


THE FIRST ELECTRONIC COMPUTER MANUAL – THE ONLY KNOWN COPY

BINAC [Chapline, Joseph D.] *Operating and maintenance manual for the BINAC binary automatic computer built for Northrop Aircraft Corporation 1949. [With:] The BINAC. A product of the Eckert-Mauchly Computer Corp. 1949.* Eckert-Mauchly Computer Corp.: Philadelphia, 1949.

$30,000

The only copy of the BINAC manual known to exist, and the only record of how the machine actually operated. This is the world's first electronic computer manual. It is here accompanied by a very rare copy of the machine's sales brochure. BINAC (BINary Automatic Computer) was an early electronic computer designed for Northrop Aircraft Inc. by the Eckert–Mauchly Computer Corporation; it was the first operational stored-program computer in the United States.



OPERATING AND MAINTENANCE MANUAL

for the

BINAC
Binary Automatic Computer

built for

NORTHROP AIRCRAFT CORPORATION

1949

by

Eckert-Mauchly Computer Corporation
Philadelphia, Pa.

Copyright 1949 by
Eckert-Mauchly Computer Corp.

W33-038-ac-14175

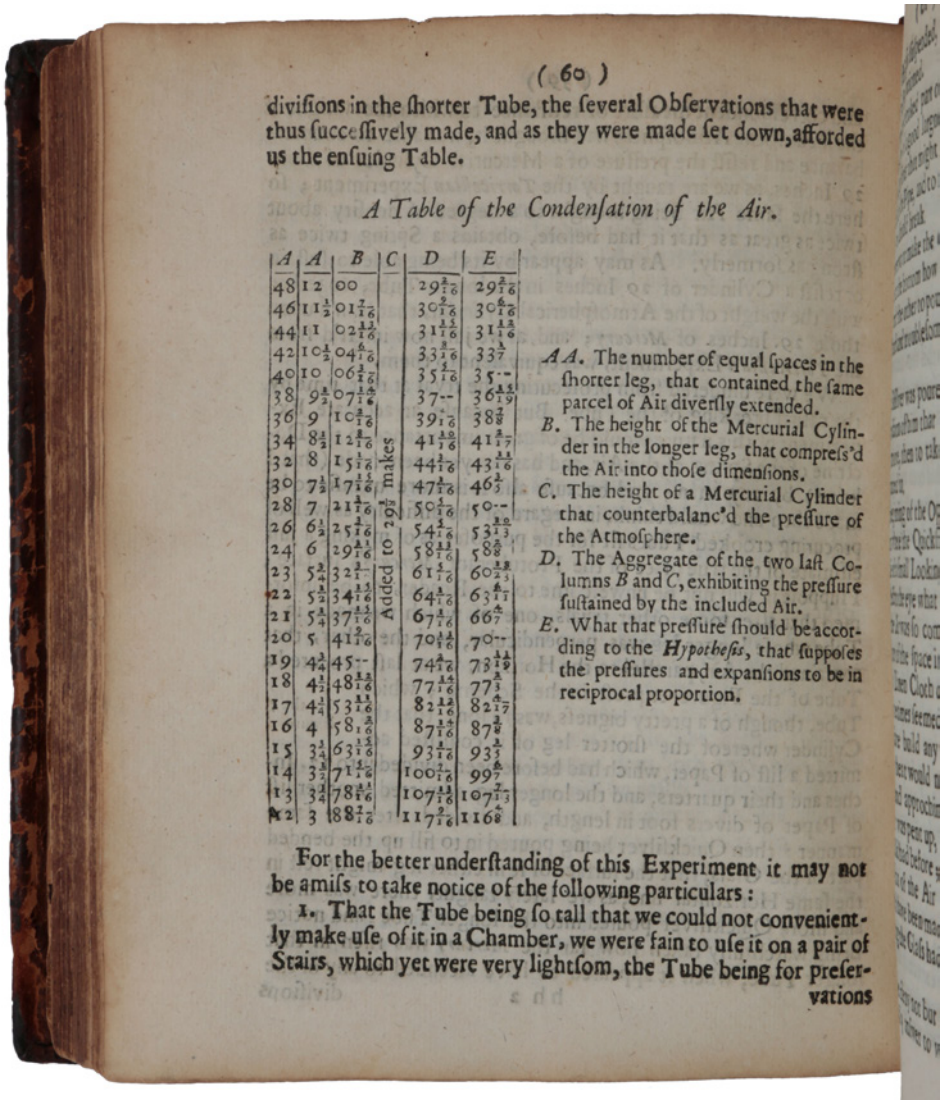
http://sophiararebooks.com/5190

PMM 143 - BOYLE'S LAW

BOYLE, Robert. *New experiments physico-mechanical, touching the spring of the air, and its effects: (made, for the most part, in a new pneumatical engine)...* Oxford: H. Hall for T. Robinson [and London: J.G. for Thomas Robinson], 1662.

$28,000

Second edition, containing the first announcement of Boyle's law; this is contained in the *Defence* … against the objections of Franciscus Linus, one of the two appendices appearing for the first time in this second edition of *New Experiments*. Boyle's eponymous law, that the volume of a gas is inversely proportional to its pressure, is his most important achievement in experimental physics. Not only does Boyle here enunciate a fundamental law of physics, he supports it with the evidence of verifiable experiments. It exemplifies perfectly the methodology of what is now known as the scientific method: hypothesis tested by experimental proof.



(60)

divisions in the ſhorter Tube, the ſeveral Obſervations that were thus ſucceſſively made, and as they were made ſet down, afforded us the enſuing Table.

A Table of the Condenſation of the Air.

A	A	B	C	D	E
48	12	00		$29\frac{2}{16}$	$29\frac{2}{16}$
46	$11\frac{1}{2}$	$01\frac{7}{16}$		$30\frac{9}{16}$	$30\frac{6}{16}$
44	11	$02\frac{13}{16}$		$31\frac{15}{16}$	$31\frac{13}{16}$
42	$10\frac{1}{2}$	$04\frac{6}{16}$		$33\frac{8}{16}$	$33\frac{1}{7}$
40	10	$06\frac{3}{16}$		$35\frac{5}{16}$	35--
38	$9\frac{1}{2}$	$07\frac{14}{16}$		37--	$36\frac{15}{19}$
36	9	$10\frac{3}{16}$		$39\frac{1}{16}$	$38\frac{7}{8}$
34	$8\frac{1}{2}$	$12\frac{8}{16}$		$41\frac{10}{16}$	$41\frac{3}{17}$
32	8	$15\frac{1}{16}$	Added to $29\frac{1}{2}$ makes	$44\frac{1}{16}$	$43\frac{11}{16}$
30	$7\frac{1}{2}$	$17\frac{15}{16}$		$47\frac{1}{16}$	$46\frac{1}{5}$
28	7	$21\frac{1}{16}$		$50\frac{1}{16}$	50--
26	$6\frac{1}{2}$	$25\frac{1}{16}$		$54\frac{1}{16}$	$53\frac{10}{13}$
24	6	$29\frac{11}{16}$		$58\frac{11}{16}$	$58\frac{5}{8}$
23	$5\frac{1}{2}$	$32\frac{1}{1}$-		$61\frac{5}{16}$	$60\frac{18}{23}$
22	$5\frac{1}{2}$	$34\frac{15}{16}$		$64\frac{1}{16}$	$63\frac{6}{11}$
21	$5\frac{1}{2}$	$37\frac{11}{16}$		$67\frac{1}{16}$	$66\frac{4}{7}$
20	5	$41\frac{9}{16}$		$70\frac{11}{16}$	70--
19	$4\frac{1}{2}$	45--		$74\frac{1}{16}$	$73\frac{14}{19}$
18	$4\frac{1}{2}$	$48\frac{13}{16}$		$77\frac{14}{16}$	$77\frac{1}{3}$
17	$4\frac{1}{2}$	$53\frac{11}{16}$		$82\frac{12}{16}$	$82\frac{4}{17}$
16	4	$58\frac{1}{16}$		$87\frac{10}{16}$	$87\frac{1}{8}$
15	$3\frac{1}{2}$	$63\frac{15}{16}$		$93\frac{1}{16}$	$93\frac{1}{3}$
14	$3\frac{1}{2}$	$71\frac{5}{16}$		$100\frac{1}{16}$	$99\frac{6}{7}$
13	$3\frac{1}{2}$	$78\frac{11}{16}$		$107\frac{11}{16}$	$107\frac{7}{13}$
12	3	$88\frac{7}{16}$		$117\frac{9}{16}$	$116\frac{4}{8}$

AA. The number of equal ſpaces in the ſhorter leg, that contained the ſame parcel of Air diverſly extended.

B. The height of the Mercurial Cylinder in the longer leg, that compreſs'd the Air into thoſe dimenſions.

C. The height of a Mercurial Cylinder that counterbalanc'd the preſſure of the Atmoſphere.

D. The Aggregate of the two laſt Columns *B* and *C*, exhibiting the preſſure ſuſtained by the included Air.

E. What that preſſure ſhould be according to the *Hypotheſis*, that ſuppoſes the preſſures and expanſions to be in reciprocal proportion.

For the better underſtanding of this Experiment it may not be amiſs to take notice of the following particulars:

1. That the Tube being ſo tall that we could not conveniently make uſe of it in a Chamber, we were fain to uſe it on a pair of Stairs, which yet were very lightſom, the Tube being for preſer-

vations

http://sophiararebooks.com/5165

UNIQUE PRE-PUBLICATION PRESENTATION COPY

CABEO, Niccolò. *Philosophia magnetica, in qua magnetis natura penitus explicatur, et omnium quae hoc lapide cernuntur, causae propriae afferuntur. Nova etiam pycis constrtuitur, quae propiam poli elevationem, sum suo meridiano, ubique demonstrat.* Ferrara: Francesco Suzzi, 1629.

$55,000

First edition, a unique **pre-publication presentation copy** by Cabeo to his teacher Jacobo Corrado, of the first extensive study of magnetism since William Gilbert's *De Magnete* (1600); it contains the first notice of electrical repulsion. Corrado's name is handwritten on the title page, which is in an unfinished state, the coat-of-arms at the head having been left un-engraved; in addition, there is an eleven-line manuscript dedication on the second leaf, which is blank but usually contains the Privilege of the Emperor Charles V.


PHILOSOPHIA
MAGNETICA
IN QVA MAGNETIS
natura penitus explicatur,
ET OMNIVM QVAE HOC LAPIDE
cernuntur causæ propriæ afferuntur:
NOVA ETIAM PYXIS
CONSTRVITVR,
QVÆ PROPRIAM POLI
ELEVATIONEM,
Cum suo meridiano, vbique demonstrat.
AVCTORE NICOLAO CABEO
FERRARIENSI SOC. IESV.
AD PERILL: ET EX
IACOBVM CORADVM
I: V: D:
Ferrariæ apud Franciscum Succum superiorum permissu. 1629.

http://sophiararebooks.com/5178

CASSINI'S EXTREMELY RARE FIRST PUBLISHED WORK - PROVING THAT COMETS ARE CELESTIAL PHENOMENA

CASSINI, Gian Domenico [Jean-Dominique]. *Ad principem Franciscum Estensem … de Cometa anni 1652 & 1653.* Modena: Bartolomeo Soliani, 1653.

$38,500

First edition, exceptionally rare, of the remarkable first publication of the great observational astronomer Gian Domenico Cassini, in which he demonstrated for the first time by observing their parallax that comets are celestial phenomena and not, as Aristotle had claimed, ignited exhalations from the earth. We have been unable to trace any other copy of this work in commerce, and only a handful of institutional copies.

http://sophiararebooks.com/5203

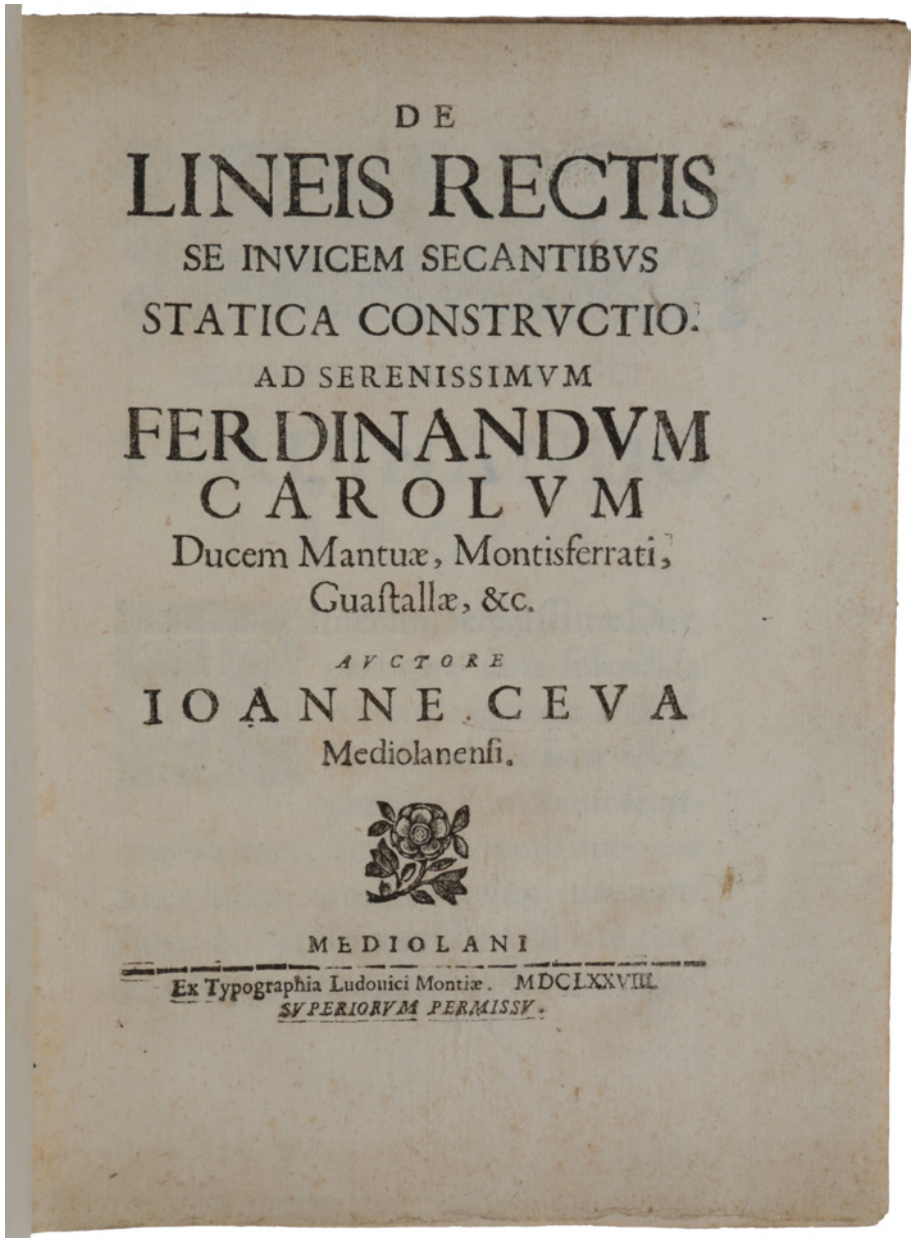
CEVA'S THEOREM

CEVA, Giovanni Benedetto. *De lineis rectis se invicem secantibus statica construction [Staticæ constructionis liber primus [-secundus]].* Milan: Lodovico Monza, 1678.

$9,500

First edition, rare, of Ceva's first and most important book, famous for 'Ceva's theorem', which states that lines from the vertices of a triangle to the opposite sides are concurrent precisely when the product of the ratios in which the sides are divided is 1. This was "one of the most important results on the synthetic geometry of the triangle between Greek times and the 19th Century" (MacTutor).

http://sophiararebooks.com/5193



DE
LINEIS RECTIS
SE INVICEM SECANTIBVS
STATICA CONSTRVCTIO.
AD SERENISSIMVM
FERDINANDVM
CAROLVM
Ducem Mantuæ, Montisferrati,
Guastallæ, &c.
AVCTORE
IOANNE CEVA
Mediolanensi.

MEDIOLANI
Ex Typographia Ludouici Montiæ. MDCLXXVIII.
SVPERIORVM PERMISSV.

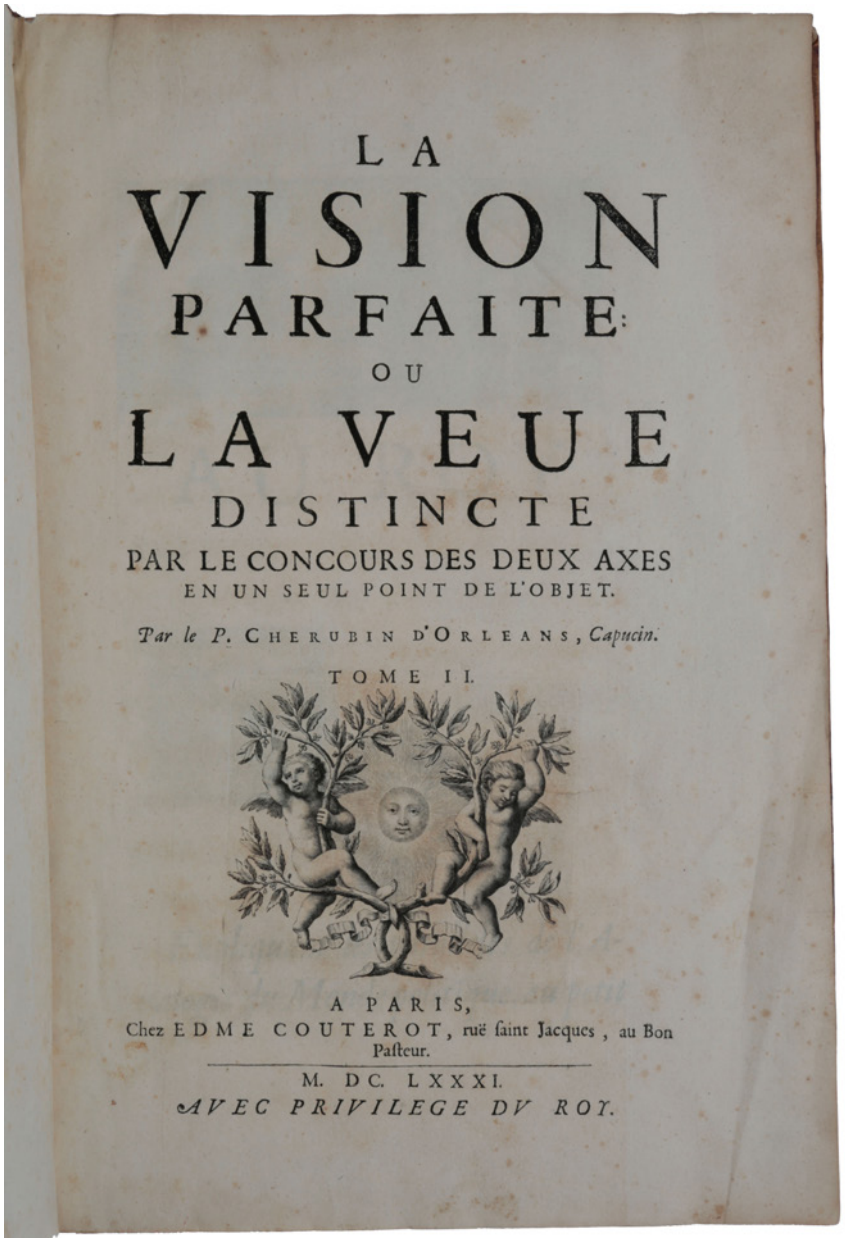
THE BINOCULAR TELESCOPE – WITH THE RARE SECOND VOLUME

CHÉRUBIN D'ORLÉANS (Père). *La vision parfaite, ou le concours de deux axes de la vision en un seul point de l'objet. [With:] La vision parfait, ou la Veue distincte par le concours de deux axes de la vision en un seul point de l'objet.* Paris: Sébastien Mabre-Cramoisy; Edme Conterot, 1677; 1681.

$42,000

First edition, complete with the very rare second volume, of "the first work to describe a binocular telescope" (Clay & Court, *History of the Microscope*, p. 82). *La Vision Parfaite* expounds the author's theory that optimal vision requires the unity of the two axes of human vision in a single point, provides geometrical demonstrations for the underlying optics, and shows how this theory should be adapted in the design and construction of specific instruments – telescopes, microscopes and spectacles, all pictured in the full-page plates.

http://sophiararebooks.com/5186



LA
VISION
PARFAITE:
OU
LA VEUE
DISTINCTE
PAR LE CONCOURS DES DEUX AXES
EN UN SEUL POINT DE L'OBJET.

Par le P. CHERUBIN D'ORLEANS, *Capucin.*

TOME II.

A PARIS,
Chez EDME COUTEROT, ruë ſaint Jacques, au Bon Paſteur.

M. DC. LXXXI.
AVEC PRIVILEGE DV ROY.

DARWIN'S BEAGLE ZOOLOGICAL SPECIMENS DESCRIBED

DARWIN, Charles (editor). *The zoology of the voyage of H.M.S. Beagle, under the command of Captain Fitzroy, R.N., during the years 1832 to 1836. Five parts in three volumes.* London: Smith, Elder & Co., 1840-39-41-42-43.

$120,000

First edition of the important report on the zoological collections obtained by members of the *Beagle* expedition, 'edited and superintended' by Darwin. Darwin contributed a geological introduction to Part 1, the *Fossil Mammalia*, and a geographical introduction to Part II, the *Mammalia*. He also contributed notices of habits and ranges throughout the text *of Mammalia* and *Birds,* and there are frequent notes, mostly from his labels, in the text of the *Fish* and the *Reptiles.*

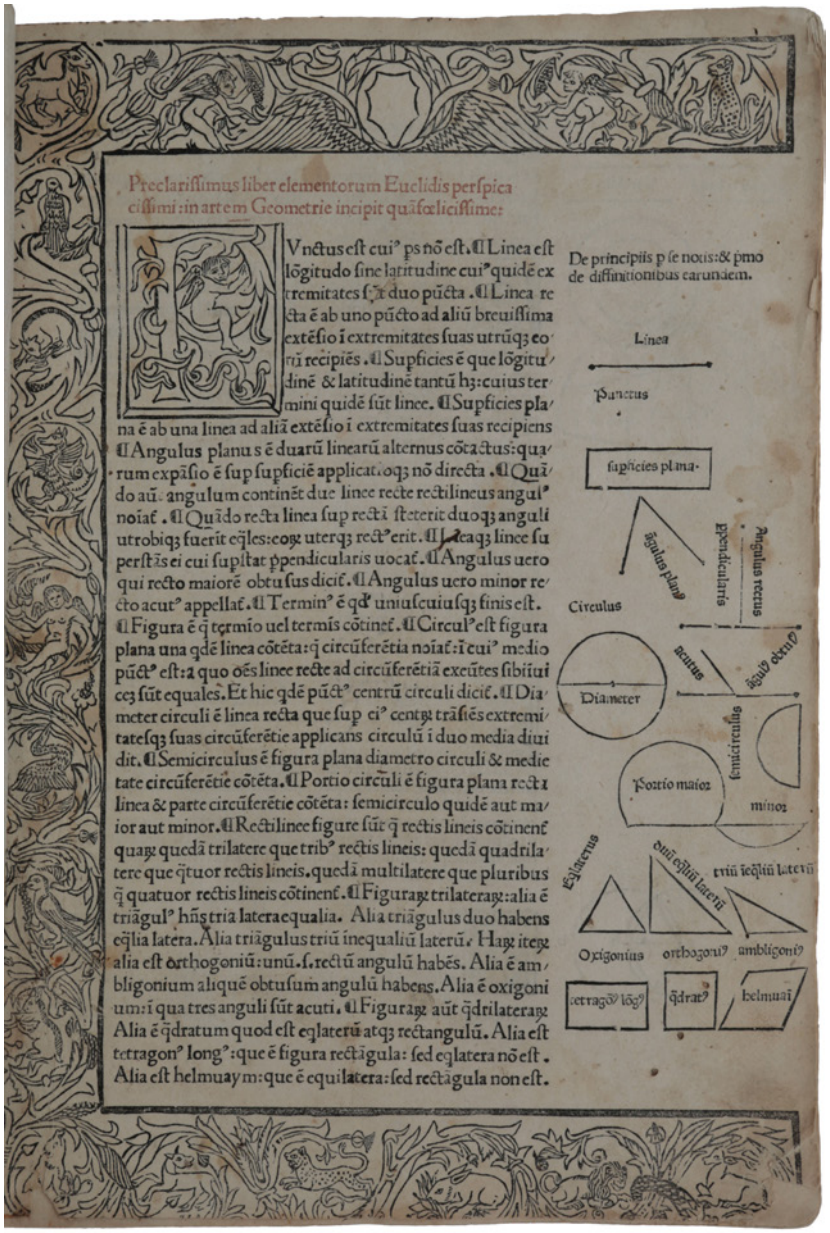
http://sophiararebooks.com/5200

SECOND EDITION OF EUCLID'S ELEMENTS – RARER THAN THE FIRST

EUCLID. *Preclarissimus liber elementorum Euclidis perspicacissimi: in artem geometrie incipit quamfoelecissime.* [Colophon:] Vicenza: Leonardus de Basilea and Gulielmusde Papia, 20 June 1491.

$95,000

A fine copy, with wide margins, of the second edition of the "oldest mathematical textbook still in common use today" (PMM), "much more uncommon than the *edtio princeps*" (Thomas-Stanford, p. 5), and especially rare in an unrestored contemporary binding as here. This book "has exercised an influence upon the human mind greater than that of any other work except the Bible" (*DSB*). Euclid's *Elements* is the only work of classical antiquity to have remained continuously in print, and to be used continuously as a textbook from the pre-Christian era to the 20th century. It is the foundation work not only for geometry but also for number theory.



http://sophiararebooks.com/5194

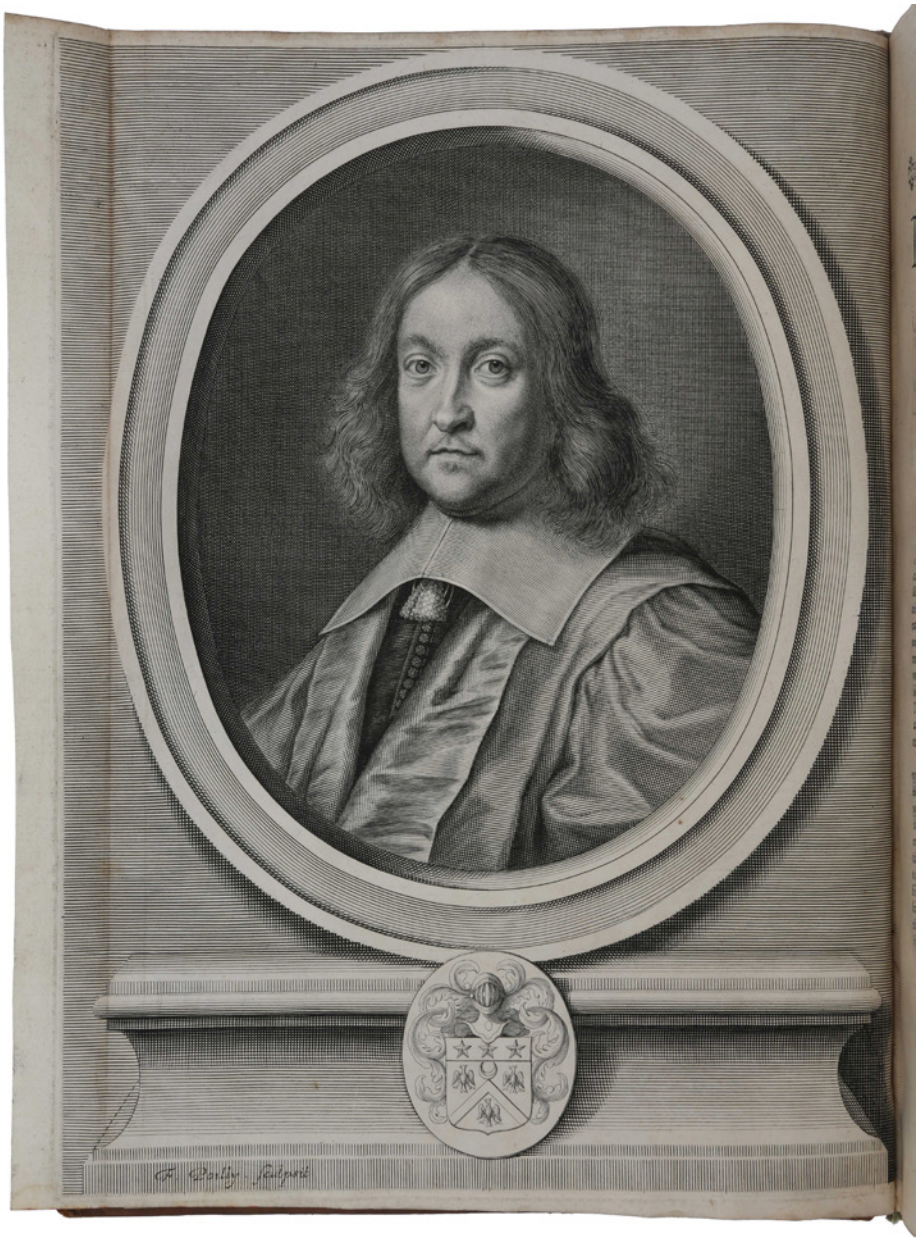
FERMAT'S THEOREM – EXTREMELY RARE LARGE PAPER COPY WITH PORTRAIT

[FERMAT, Pierre de]. DIOPHANTUS of Alexandria. *Arithmeticorum libri sex, et de numeris multangulis liber unus. Cum commentariis C.G. Bacheti V.C. & observationibus D.P. de Fermat senatoris Tolosani … Accessit doctrinae analyticae inventum novum, collectum [by J. de Billy] ex varijs ... Fermat epistolis [ed. Samuel de Fermat].* Toulouse: Bernard Bosc, 1670.

$100,000

First edition, the superb Macclesfield copy printed on large and thick paper and with the engraved frontispiece portrait of Fermat (intended only for the few large paper copies), of Fermat's annotated edition of Diophantus' *Arithmetica.* This is the first printing of Fermat's contributions to the theory of numbers, of which he is the undisputed founder, including his famous statement of 'Fermat's last theorem.' Since most of Fermat's work in number theory remained unpublished in his lifetime, "it was neither understood nor appreciated until Euler revived it and initiated the line of continuous research that culminated in the work of Gauss and Kummer in the early nineteenth century" (DSB).

http://sophiararebooks.com/5170

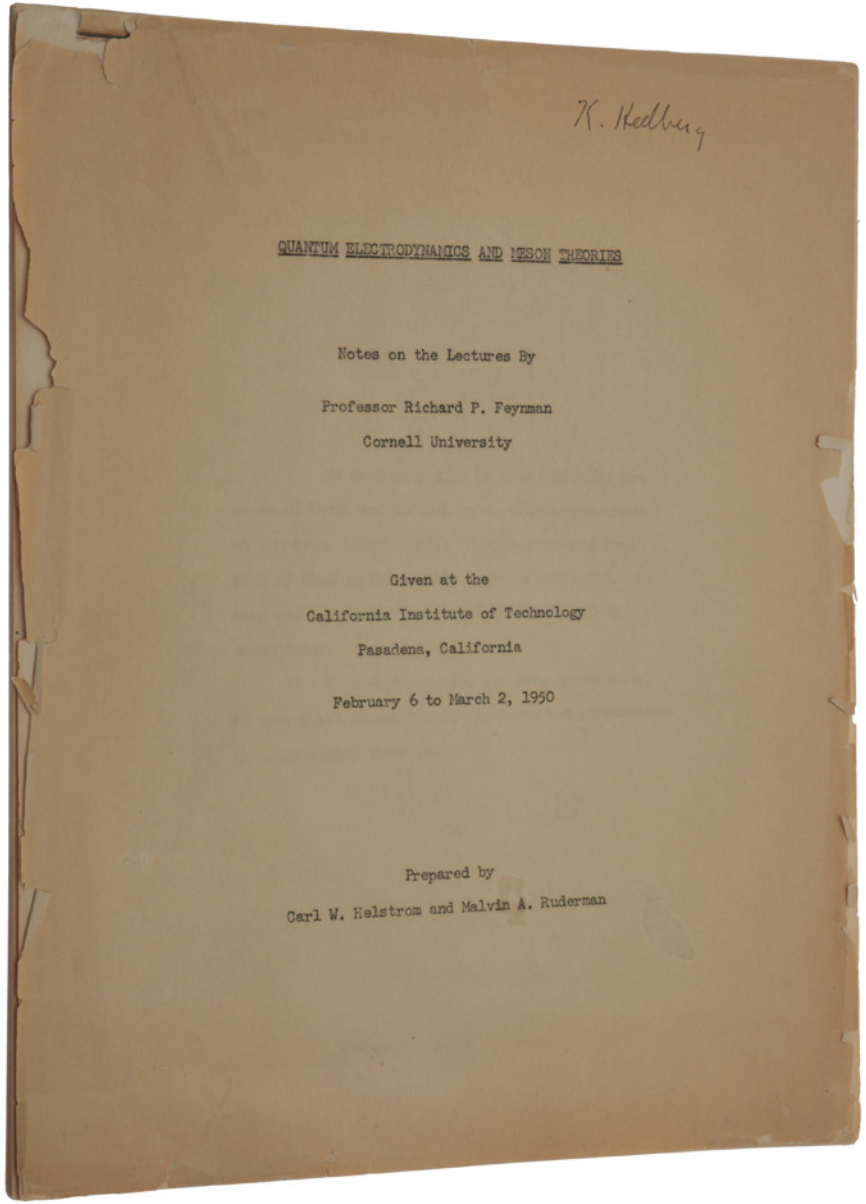


FEYNMAN'S UNPUBLISHED LECTURES ON MESON THEORY

FEYNMAN, Richard P. *Quantum Electrodynamics and Meson Theories. Notes on the Lectures by Professor Richard P. Feynman, Cornell University. Given at the California Institute of Technology, Pasadena, California, February 6 to March 2, 1950. Prepared by Carl W. Helstrom and Malvin A. Ruderman.* [Not published: California Institute of Technology, Pasadena, CA: , 1950].

$18,000

First and only edition, extremely rare, of the mimeographed notes of Feynman's lecture course on meson theory, delivered as a visiting lecturer at Caltech. Feynman became interested in meson theory while he was still perfecting his understanding of quantum electrodynamics, but his ideas in this area remain unpublished, even in his *Selected Papers* – these notes are thus a key historical record of Feynman's work on meson theory, the topic which most occupied theoretical physicists in the immediate post-war years.



K. Heelberg

QUANTUM ELECTRODYNAMICS AND MESON THEORIES

Notes on the Lectures By

Professor Richard P. Feynman

Cornell University

Given at the

California Institute of Technology

Pasadena, California

February 6 to March 2, 1950

Prepared by

Carl W. Helstrom and Malvin A. Ruderman

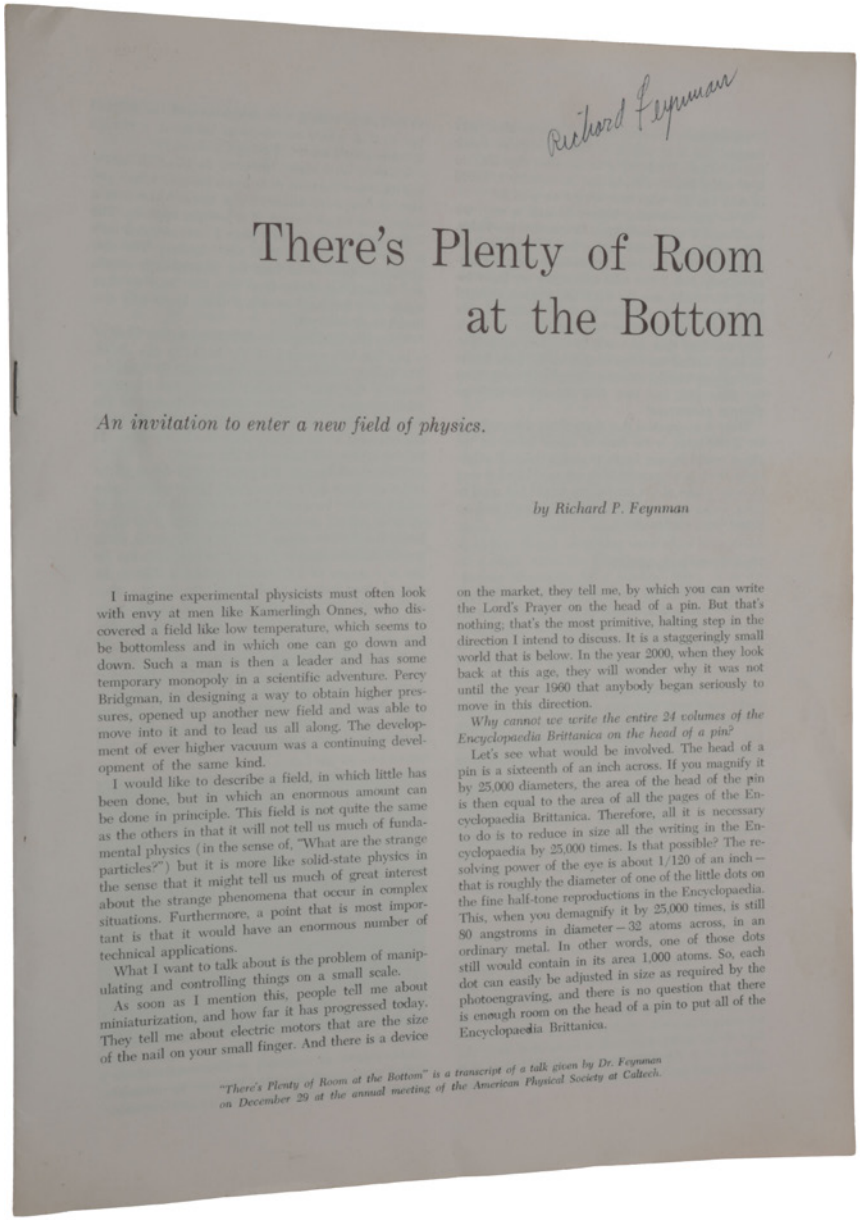
http://sophiararebooks.com/5205

THE BIRTH OF NANOTECHNOLOGY

FEYNMAN, Richard Phillips. *There's Plenty of Room at the Bottom. An invitation to enter a new field of physics. Offprint from: Engineering and Science Magazine, February 1960.* Pasadena, CA: California Institute of Technology, 1960.

$65,000

First edition, exceptionally rare offprint, **signed by Feynman**, of this visionary lecture which represents the birth of nanotechnology, the field of applied science involving manipulating matter on an atomic and molecular scale: 'What I want to talk about is the problem of manipulating and controlling things on a small scale.' "Feynman was the first to outline a world of technologies that would work and build at the ultimate, atomic scale" (Drexler, *Engines of Creation*). We have been unable to locate any other copy of this offprint, either in commerce or in institutional collections.



Richard Feynman

There's Plenty of Room at the Bottom

An invitation to enter a new field of physics.

by Richard P. Feynman

I imagine experimental physicists must often look with envy at men like Kamerlingh Onnes, who discovered a field like low temperature, which seems to be bottomless and in which one can go down and down. Such a man is then a leader and has some temporary monopoly in a scientific adventure. Percy Bridgman, in designing a way to obtain higher pressures, opened up another new field and was able to move into it and to lead us all along. The development of ever higher vacuum was a continuing development of the same kind.

I would like to describe a field, in which little has been done, but in which an enormous amount can be done in principle. This field is not quite the same as the others in that it will not tell us much of fundamental physics (in the sense of, "What are the strange particles?") but it is more like solid-state physics in the sense that it might tell us much of great interest about the strange phenomena that occur in complex situations. Furthermore, a point that is most important is that it would have an enormous number of technical applications.

What I want to talk about is the problem of manipulating and controlling things on a small scale.

As soon as I mention this, people tell me about miniaturization, and how far it has progressed today. They tell me about electric motors that are the size of the nail on your small finger. And there is a device on the market, they tell me, by which you can write the Lord's Prayer on the head of a pin. But that's nothing; that's the most primitive, halting step in the direction I intend to discuss. It is a staggeringly small world that is below. In the year 2000, when they look back at this age, they will wonder why it was not until the year 1960 that anybody began seriously to move in this direction.

Why cannot we write the entire 24 volumes of the Encyclopaedia Brittanica on the head of a pin?

Let's see what would be involved. The head of a pin is a sixteenth of an inch across. If you magnify it by 25,000 diameters, the area of the head of the pin is then equal to the area of all the pages of the Encyclopaedia Brittanica. Therefore, all it is necessary to do is to reduce in size all the writing in the Encyclopaedia by 25,000 times. Is that possible? The resolving power of the eye is about 1/120 of an inch—that is roughly the diameter of one of the little dots on the fine half-tone reproductions in the Encyclopaedia. This, when you demagnify it by 25,000 times, is still 80 angstroms in diameter—32 atoms across, in an ordinary metal. In other words, one of those dots still would contain in its area 1,000 atoms. So, each dot can easily be adjusted in size as required by the photoengraving, and there is no question that there is enough room on the head of a pin to put all of the Encyclopaedia Brittanica.

"There's Plenty of Room at the Bottom" is a transcript of a talk given by Dr. Feynman on December 29 at the annual meeting of the American Physical Society at Caltech.

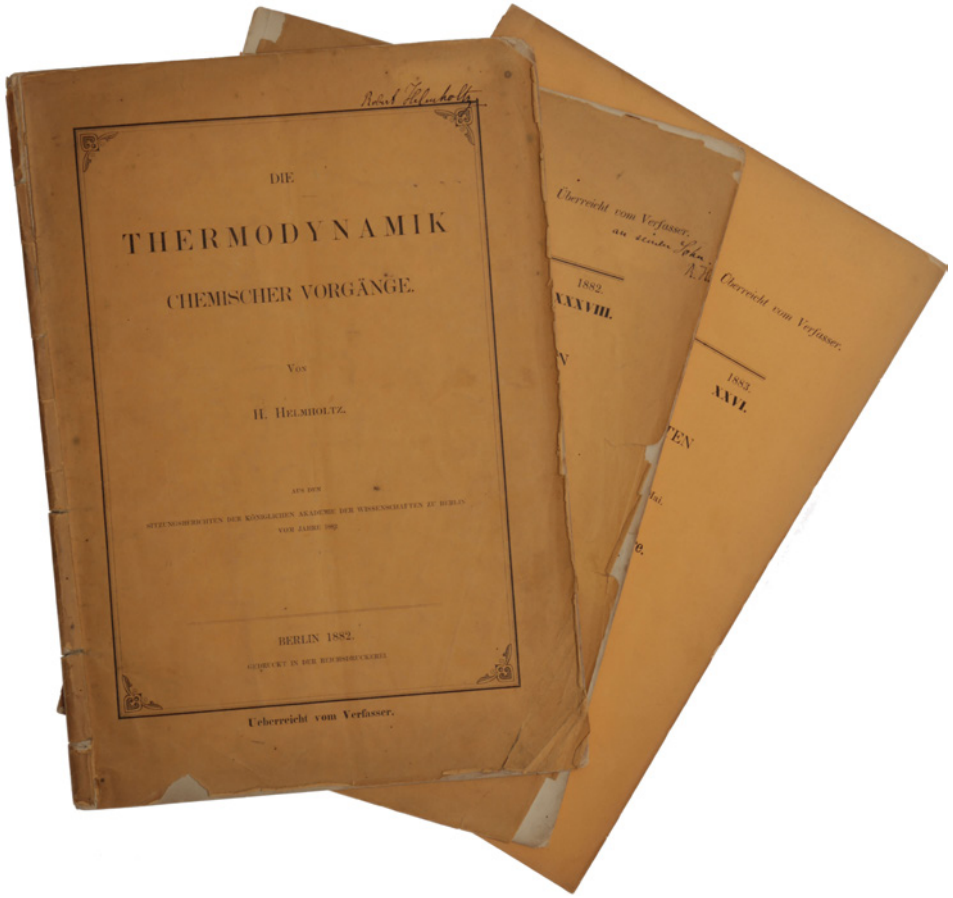
http://sophiararebooks.com/5184

A FOUNDING WORK OF CHEMICAL THERMODYNAMICS

HELMHOLTZ, Hermann. *Die Thermodynamik chemischer Vörgange. Offprint from: Sitzungsberichte der Königlichen Akademie der Wissenschaften zu Berlin, 1882. [With:] Zur Thermodynamik chemischer Vörgange. Zweiter Beitrag. Offprint from: ibid., 27 July 1882. [With:] Zur Thermodynamik chemischer Vörgange. Dritter Beitrag. Offprint from: ibid., 31 May, 1883.* Berlin: Akademie der Wissenschaften, 1882-1883.

$32,000

First edition, extremely rare author's presentation offprints, **inscribed by Helmholtz to his son**, of all three parts of one of the founding paper of chemical thermodynamics, along with Josiah Willard Gibbs's 1876 paper 'On the Equilibrium of Heterogeneous Substances.' In these papers, Helmholtz introduced the concept of 'free energy' and proved the 'Gibbs-Helmholtz equation' which he used to demonstrate that free energy – not heat production – was the driver of spontaneous change in isothermal chemical reactions, thereby overthrowing the previously accepted 'Thomsen-Berthelot principle.'



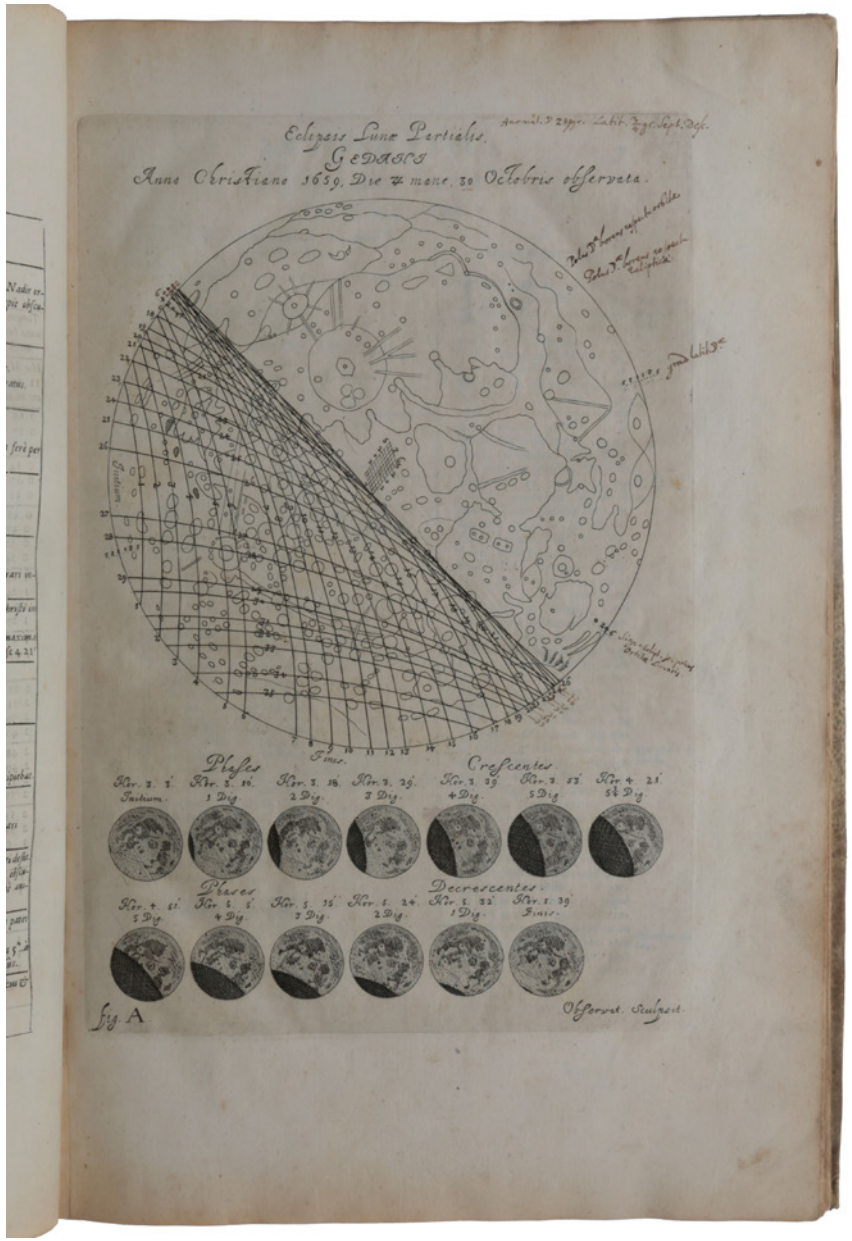
http://sophiararebooks.com/5192

PRESENTATION COPY INSCRIBED AND ANNOTATED BY HEVELIUS

HEVELIUS, Johannes [HORROCKS, Jeremiah]. *Mercurius in sole visus Gedani, anno christiano MDCLXI... cui annexa est Venus in sole pariter visa, anno 1639... Liverpoliae, a Jeremia Horroxio, nunc primum edita … quibus accedit ... Historiola, novae illius, ac mirae stellae in collo Ceti …* Danzig: Simon Reiniger for the author, 1662.

$200,000

First edition, very rare, presentation copy, inscribed by the author, and annotated by the author on 12 pages, including four longer annotations on the first engraving, that of a partial lunar eclipse. This work publishes Hevelius' observations of the transit of Mercury on 3 May 1661, followed by the first published description of the important observations by the short-lived English astronomer Jeremiah Horrocks (1618-1641) of the transit of Venus of 24 November 1639, with supplementary notes by Hevelius.



http://sophiararebooks.com/5175

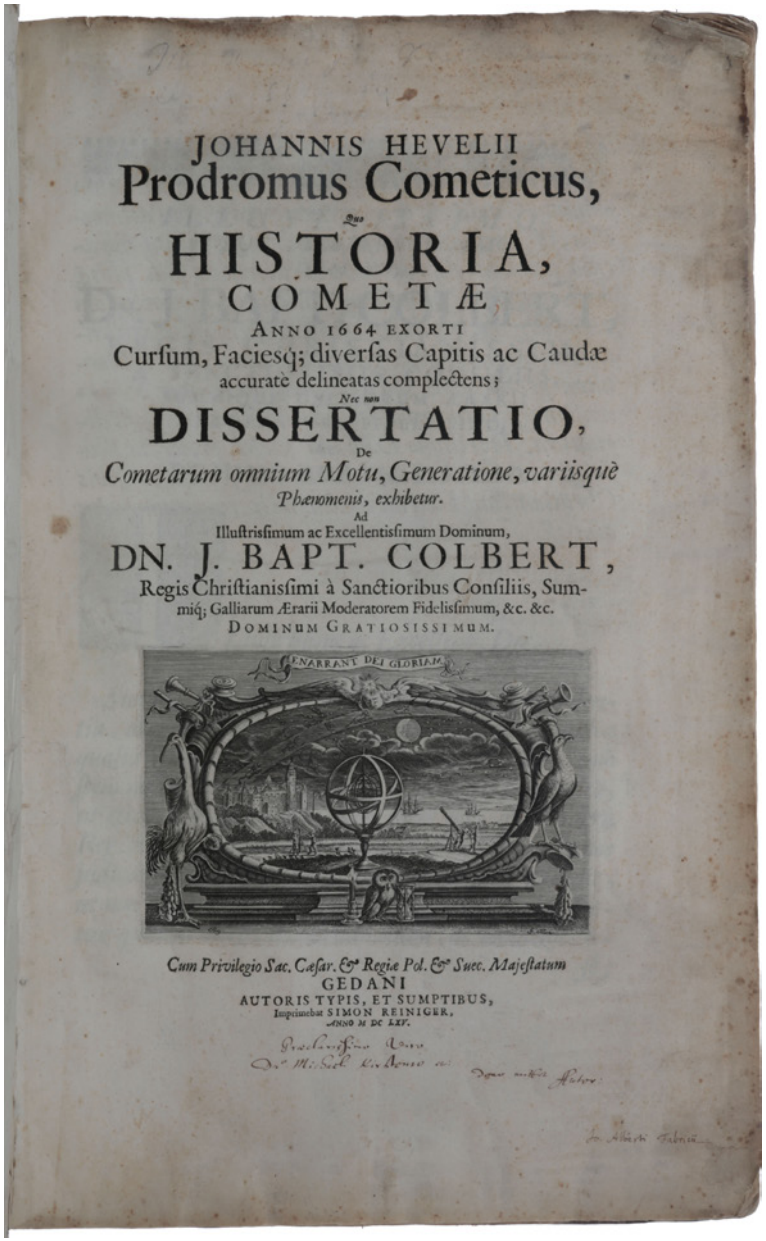
PRESENTATION COPY INSCRIBED AND ANNOTATED BY HEVELIUS

HEVELIUS, Johannes. *Prodromus cometicus: quo historia, cometæ anno 1664 exorti cursum,... [Bound with:] Descriptio cometae anno aereae Christi 1665 exorti... [Bound with:] KIRSTEN, Michael. Cometa, poëma. Ad ampliss. Virum Johannem Hevelium...* Danzig; Danzig; Hamburg: Simon Reiniger for the author; Simon Reiniger for the author; Zacharias Hertel, 1664; 1666; 1665.

$185,000

First editions, very rare, presentation copy, inscribed by the author on the title page and annotated by the author on 12 pages of the *Prodromus*, including an extensive note of 19 lines on C1v. These works record Hevelius' observations of the great comets of 1664 and 1665, and an outline of his theory of comets later developed in his *Cometographia* (1668). These publications led to a controversy with the French astronomer Adrien Auzout. While Hevelius considered comets to be ephemeral phenomena with elusive spiral trajectories, Auzout deemed them to be stable cosmic objects endowed with regular and predictable motions.

http://sophiararebooks.com/5176



JOHANNIS HEVELII
Prodromus Cometicus,
Seu
HISTORIA,
COMETÆ
ANNO 1664 EXORTI
Cursum, Faciesq; diversas Capitis ac Caudæ
accurate delineatas complectens;
Nec non
DISSERTATIO,
De
Cometarum omnium Motu, Generatione, variisquè
Phænomenis, exhibetur.
Ad
Illustrissimum ac Excellentissimum Dominum,
DN. J. BAPT. COLBERT,
Regis Christianissimi à Sanctioribus Consiliis, Summiq; Galliarum Ærarii Moderatorem Fidelissimum, &c. &c.
DOMINUM GRATIOSISSIMUM.

Cum Privilegio Sac. Cæsar. & Regiæ Pol. & Suec. Majestatum
GEDANI
AUTORIS TYPIS, ET SUMPTIBUS,
Impressibus SIMON REINIGER,
ANNO M DC LXV.

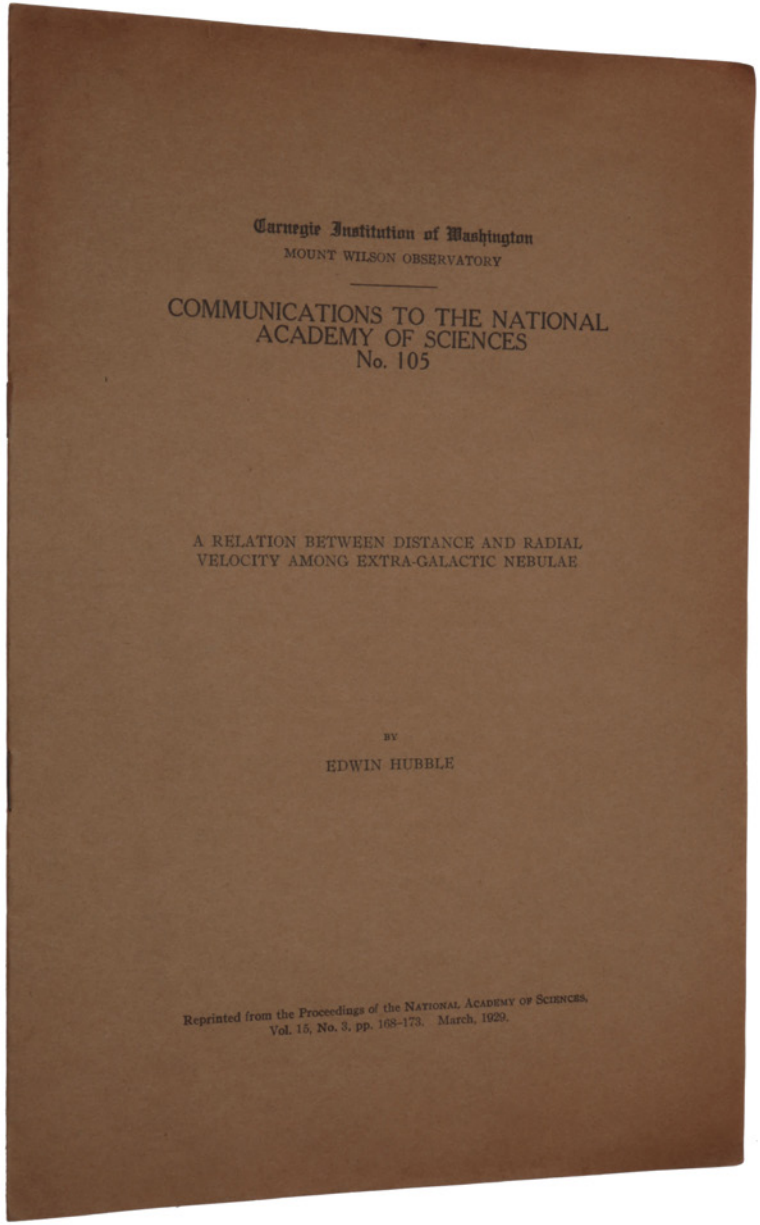
HUBBLE'S LAW, REDSHIFT AND THE EXPANSION OF THE UNIVERSE

HUBBLE, Edwin. *A Relation between Distance and Radial Velocity among Extra-Galactic Nebulae.* Washington: National Academy of Sciences, 1929.

$65,000

First edition, the very rare offprint, of Hubble's landmark paper, which "made as great a change in man's conception of the universe as the Copernican revolution 400 years before" (DSB). This paper "is generally regarded as marking the discovery of the expansion of the universe" (BEA). It established what would later become known as Hubble's Law: that galaxies recede from us in all directions and more distant ones recede more rapidly in proportion to their distance. "… the repercussions were immense. The galaxies were not randomly dashing through the cosmos, but instead their speeds were mathematically related to their distances, and when scientists see such a relationship they search for a deeper significance. In this case, the significance was nothing less than the realization that at some point in history all the galaxies in the universe had been compacted into the same small region. This was the first observational evidence to hint at what we now call the Big Bang" (Simon Singh).

http://sophiararebooks.com/5177



Carnegie Institution of Washington
MOUNT WILSON OBSERVATORY

COMMUNICATIONS TO THE NATIONAL ACADEMY OF SCIENCES
No. 105

A RELATION BETWEEN DISTANCE AND RADIAL VELOCITY AMONG EXTRA-GALACTIC NEBULAE

BY

EDWIN HUBBLE

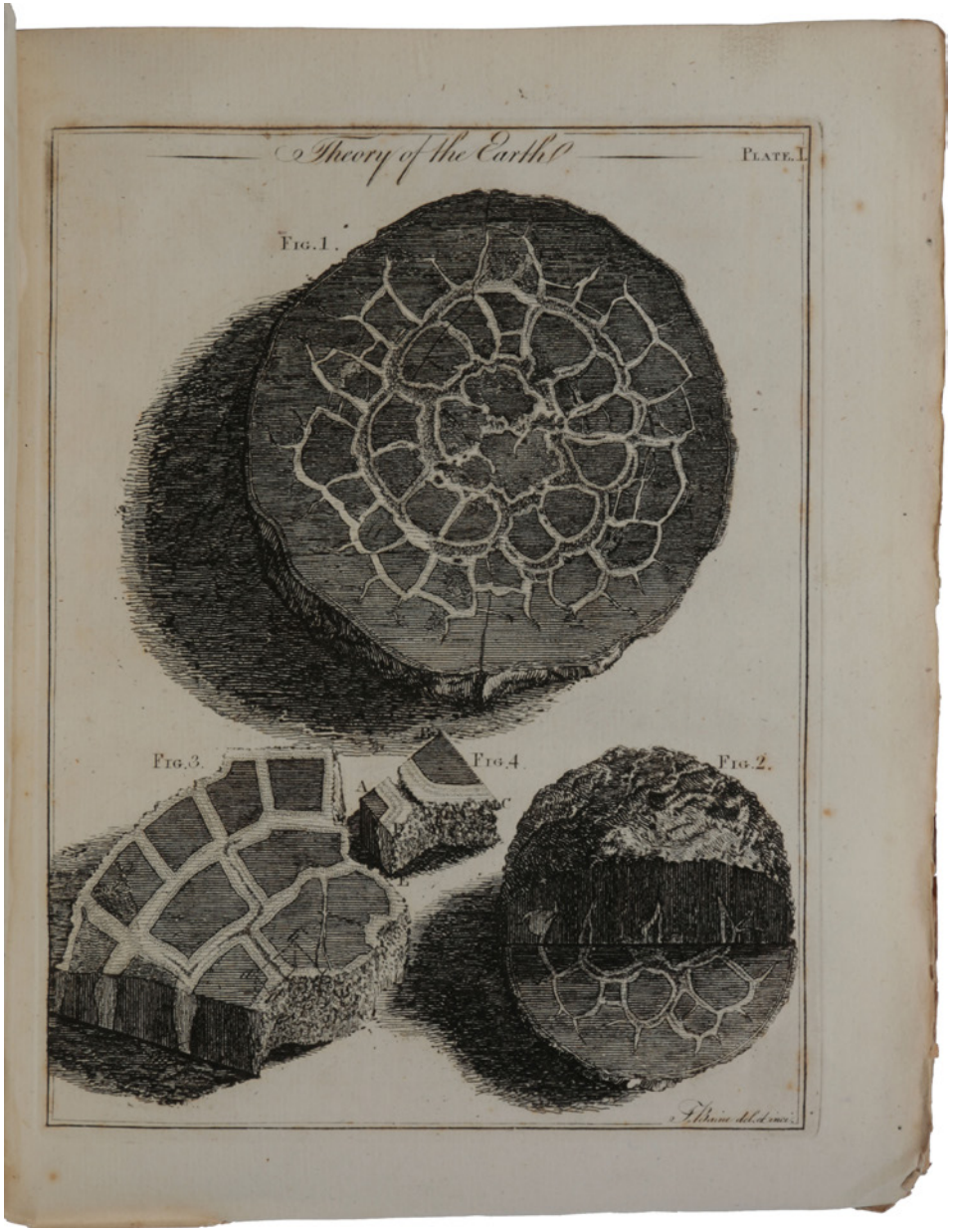
Reprinted from the Proceedings of the National Academy of Sciences, Vol. 15, No. 3, pp. 168-173. March, 1929.

PMM 247 - THE FOUNDATION OF MODERN GEOLOGY

HUTTON, James. *'Theory of the Earth; or an Investigation of the laws observable in the composition, dissolution, and restoration of land upon the globe… Read March 7 and April 4 1785,' in Transactions of the Royal Society of Edinburgh, 1788, Part II, pp. 209-304, with two engraved plates.* Edinburgh: Royal Society, 1778.

$12,500

First edition of this epoch-making work, the foundation of modern geology. "[Hutton's] fundamental conception, now accepted as a matter of course, but then entirely new, was the doctrine of uniformitarianism. The formation of the surface of the earth is one continuous process which can be studied entirely from terrestrial materials without cosmological or supernatural intervention . . . his central ideas of uniformitarianism and of the effect of small changes in nature leading eventually to gigantic transformations have had far-reaching consequences in their influence on Charles Lyell and Darwin" (*PMM*).



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RANKS NEXT TO THE 'ALMAGEST' AND 'DE REVOLUTIONIBUS' (CASPAR)

KEPLER, Johannes. *Epitome astronomiae Copernicanae...* Linz; Linz; Frankfurt: Johann Planck; Johann Planck; Georg Tampach, 1618; 1620; 1621.

$195,000

First edition, very rare first issue, and a superb copy, of the third of Kepler's great trilogy of astronomical treatises, following *Astronomia nova* (1609) and *Harmonice mundi* (1619), in which he introduced his three laws of planetary motion. The *Epitome* "ranks next to Ptolemy's *Almagest* and Copernicus' *De revolutionibus* … [It] is the first systematic complete presentation of astronomy to introduce the ideas of modern celestial mechanics founded by Kepler … Kepler had erected an entirely new structure on the foundation of the Copernican theory" (Caspar, p. 297).

http://sophiararebooks.com/5189

PMM 344 - ESTABLISHED A NEW ERA IN GEOLOGY

LYELL, Charles. *The Principles of Geology: Being an Attempt to Explain the Former Changes of the Earth's Surface, by Reference to Causes now in Operation. Three vols.* London: John Murray, 1830-1832-1833.

$28,500

First edition of this "classic by 'the father of modern geology'" (Grolier/Horblit), famous for "establishing a new era in geology" (DSB). "One of the key works in the nineteenth century encounters between science and Scripture, Charles Lyell's *Principles of Geology* (1830-33) sought to explain the geological state of the modern Earth by considering the long-term effects of observable natural phenomena. Written with clarity and a dazzling intellectual passion, it is both a seminal work of modern geology and a compelling precursor to Darwinism, speculating on radical changes in climate and geography across the ages, and exploring the evidence for the progressive development of life" (Secord, *Lyell, Principles of Geology*).

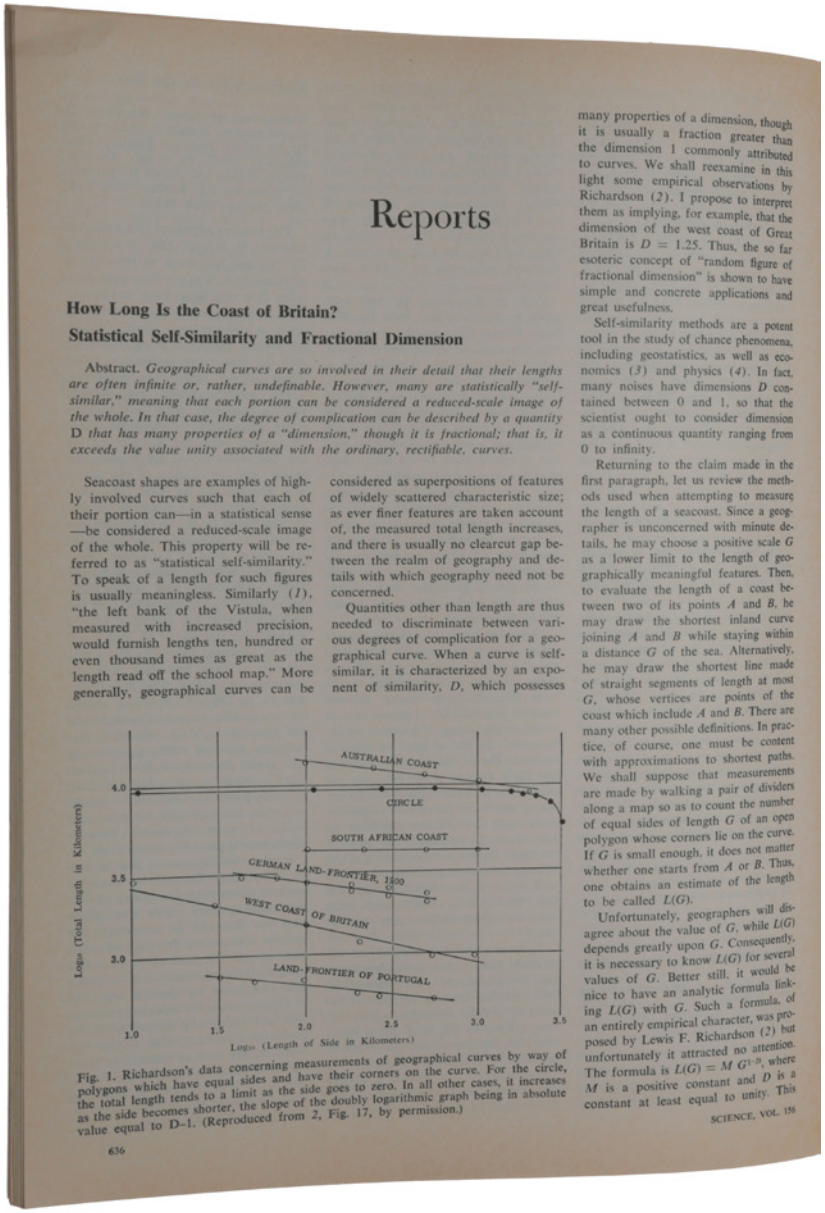
http://sophiararebooks.com/5181

THE FIRST PAPER ON FRACTALS

MANDELBROT, Benoit B. *'How Long is the Coast of Britain? Statistical Self-Similarity and Fractional Dimension,' pp. 636-638 in: Science, New Series, Vol. 56, No. 3775, May 5, 1967. [With:] RICHARDSON, Lewis Fry. 'The problem of contiguity: An appendix to Statistics of Deadly Quarrels,' pp. 139-187 in: General Systems: Yearbook of the Society for the Advancement of General Systems Theory. Ann Arbor, MI: The Society, 1961.* Washington, DC: American Association for the Advancement of Science, 1967.

$2,000

First edition, journal issue in original printed wrappers, of Mandelbrot's first paper on fractals (a term he coined in 1975). "Today Mandelbrot's paper on the coast of Britain is famous in the history of mathematics" (historyofscience.com). "Mandelbrot had come across the coastline question in an obscure posthumous article by an English scientist, Lewis F. Richardson, who groped with a surprising number of the issues that later became part of chaos [theory]" (Gleick, *Chaos*, p. 94). Mandelbrot and Richardson argued that the coastline should be regarded as having a fractional dimension between 1 and 2.



Reports

How Long Is the Coast of Britain?

Statistical Self-Similarity and Fractional Dimension

Abstract. *Geographical curves are so involved in their detail that their lengths are often infinite or, rather, undefinable. However, many are statistically "self-similar," meaning that each portion can be considered a reduced-scale image of the whole. In that case, the degree of complication can be described by a quantity* D *that has many properties of a "dimension," though it is fractional; that is, it exceeds the value unity associated with the ordinary, rectifiable, curves.*

Seacoast shapes are examples of highly involved curves such that each of their portion can—in a statistical sense—be considered a reduced-scale image of the whole. This property will be referred to as "statistical self-similarity." To speak of a length for such figures is usually meaningless. Similarly (*1*), "the left bank of the Vistula, when measured with increased precision, would furnish lengths ten, hundred or even thousand times as great as the length read off the school map." More generally, geographical curves can be considered as superpositions of features of widely scattered characteristic size; as ever finer features are taken account of, the measured total length increases, and there is usually no clearcut gap between the realm of geography and details with which geography need not be concerned.

Quantities other than length are thus needed to discriminate between various degrees of complication for a geographical curve. When a curve is self-similar, it is characterized by an exponent of similarity, *D*, which possesses many properties of a dimension, though it is usually a fraction greater than the dimension 1 commonly attributed to curves. We shall reexamine in this light some empirical observations by Richardson (*2*). I propose to interpret them as implying, for example, that the dimension of the west coast of Great Britain is $D = 1.25$. Thus, the so far esoteric concept of "random figure of fractional dimension" is shown to have simple and concrete applications and great usefulness.

Self-similarity methods are a potent tool in the study of chance phenomena, including geostatistics, as well as economics (*3*) and physics (*4*). In fact, many noises have dimensions *D* contained between 0 and 1, so that the scientist ought to consider dimension as a continuous quantity ranging from 0 to infinity.

Returning to the claim made in the first paragraph, let us review the methods used when attempting to measure the length of a seacoast. Since a geographer is unconcerned with minute details, he may choose a positive scale *G* as a lower limit to the length of geographically meaningful features. Then, to evaluate the length of a coast between two of its points *A* and *B*, he may draw the shortest inland curve joining *A* and *B* while staying within a distance *G* of the sea. Alternatively, he may draw the shortest line made of straight segments of length at most *G*, whose vertices are points of the coast which include *A* and *B*. There are many other possible definitions. In practice, of course, one must be content with approximations to shortest paths. We shall suppose that measurements are made by walking a pair of dividers along a map so as to count the number of equal sides of length *G* of an open polygon whose corners lie on the curve. If *G* is small enough, it does not matter whether one starts from *A* or *B*. Thus, one obtains an estimate of the length to be called $L(G)$.

Unfortunately, geographers will disagree about the value of *G*, while $L(G)$ depends greatly upon *G*. Consequently, it is necessary to know $L(G)$ for several values of *G*. Better still, it would be nice to have an analytic formula linking $L(G)$ with *G*. Such a formula, of an entirely empirical character, was proposed by Lewis F. Richardson (*2*) but unfortunately it attracted no attention. The formula is $L(G) = M\,G^{1-D}$, where *M* is a positive constant and *D* is a constant at least equal to unity. This

Fig. 1. Richardson's data concerning measurements of geographical curves by way of polygons which have equal sides and have their corners on the curve. For the circle, the total length tends to a limit as the side goes to zero. In all other cases, it increases as the side becomes shorter, the slope of the doubly logarithmic graph being in absolute value equal to D–1. (Reproduced from *2*, Fig. 17, by permission.)

636

SCIENCE, VOL. 156

http://sophiararebooks.com/5204

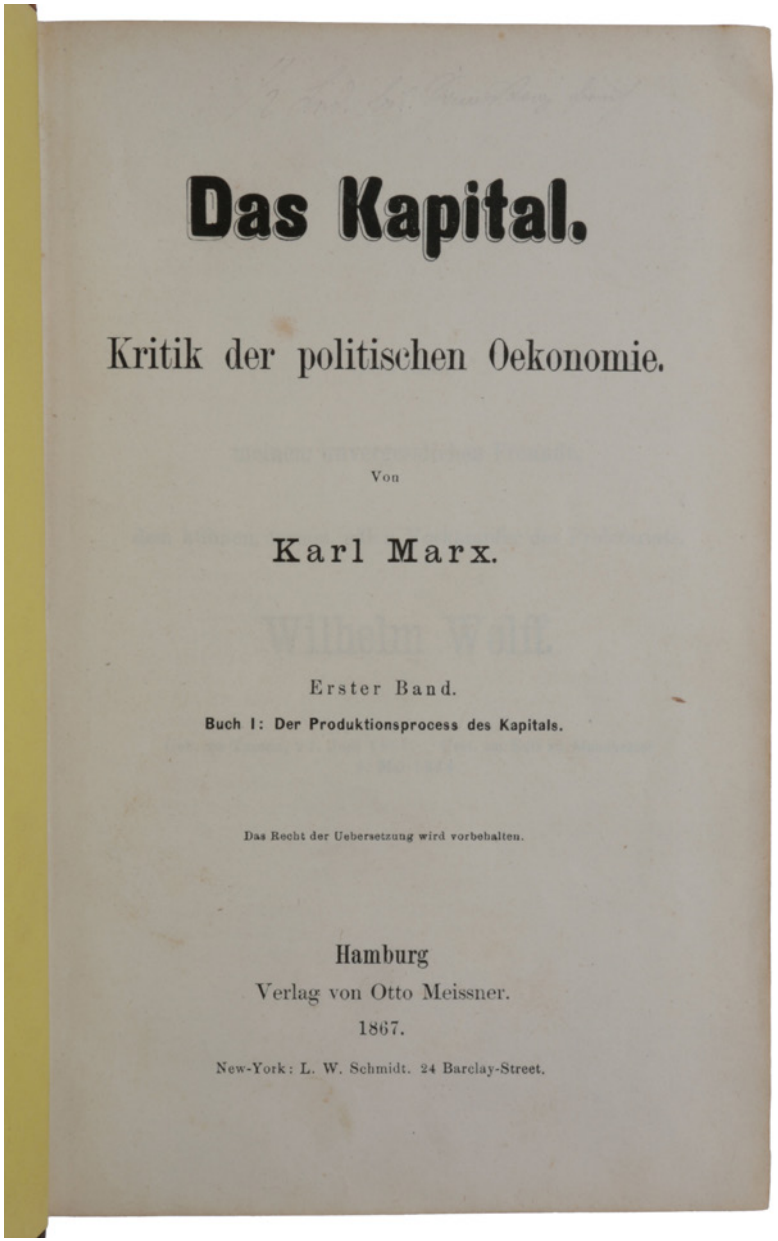
DAS KAPITAL – "THE NEW RELIGION" (PMM 359)

MARX, Karl. *Das Kapital. Kritik der politischen Oekonomie. Erster Band. Buch I: Der Produktionsprocess des Kapitals.* Hamburg: Otto Meissner, 1867.

$115,000

First edition, rare, of the first volume of *Das Kapital*, the only one to appear in Marx's lifetime; one of 1,000 copies printed. "Amongst the most influential pieces of writing in world history" (International Institute of Social History in Amsterdam). "The *Athenaeum* reviewer of the first English translation (1887) later wrote: 'Under the guise of a critical analysis of capital, Karl Marx's work is principally a polemic against capitalists and the capitalist mode of production, and it is this polemical tone which is its chief charm'. The historical-polemical passages, with their formidable documentation from British official sources, have remained memorable" (PMM).

http://sophiararebooks.com/5183



Das Kapital.

Kritik der politischen Oekonomie.

Von

Karl Marx.

Erster Band.

Buch I: Der Produktionsprocess des Kapitals.

Das Recht der Uebersetzung wird vorbehalten.

Hamburg
Verlag von Otto Meissner.
1867.

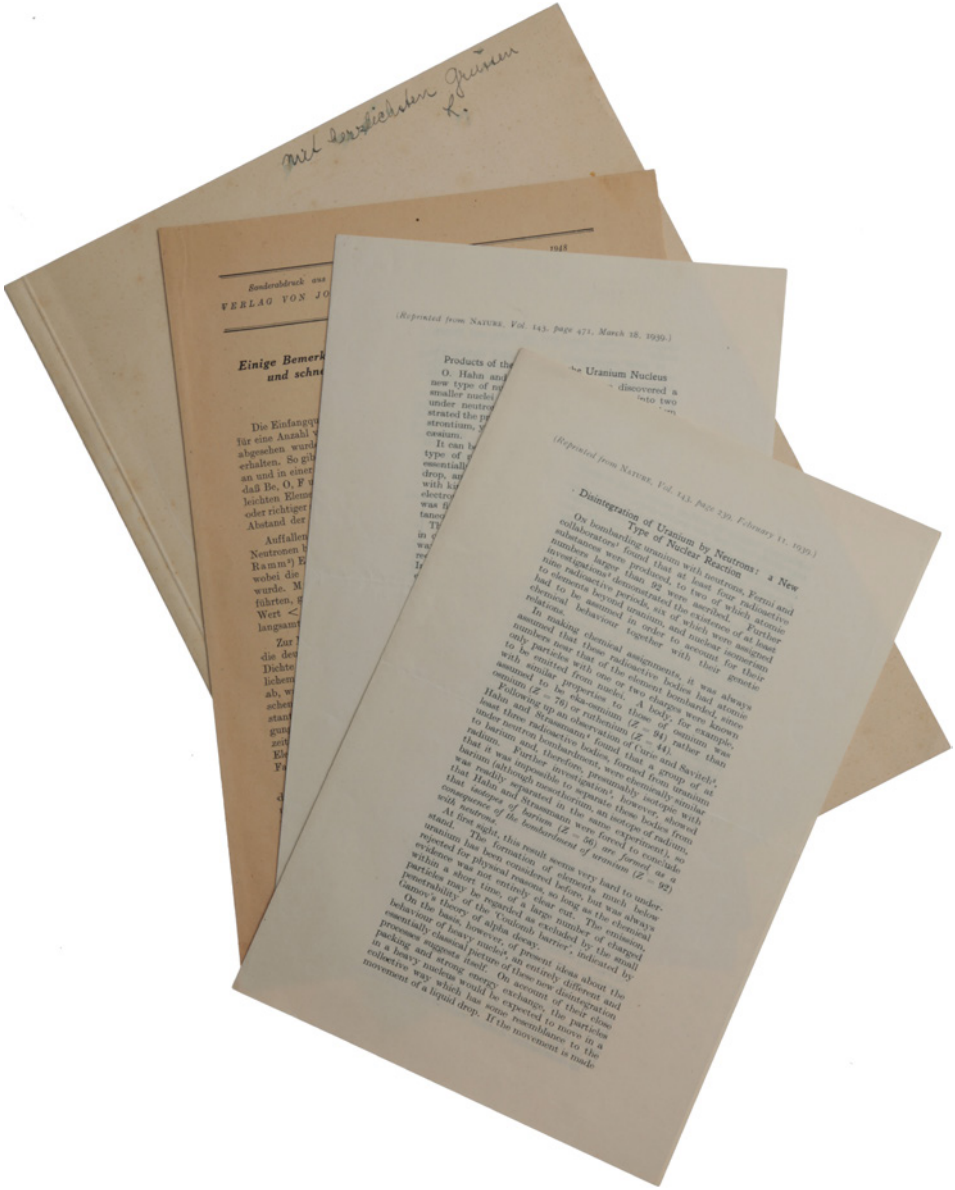
New-York: L. W. Schmidt. 24 Barclay-Street.

THE DISCOVERY OF NUCLEAR FISSION – PMM 422B

MEITNER, Lise & FRISCH, Otto. *Disintegration of uranium by neutrons: a new type of nuclear reaction. Offprint from Nature, Vol. 143, No. 3615, 11 February 1939 [PMM 422b]. [Offered with:] Products of the fission of the uranium nucleus. Offprint from Nature, Vol. 143, No. 3620, 18 March 1939.* [London: Macmillan, 1939].

$28,500

First edition, extremely rare offprints, of the discovery of nuclear fission, a process which had been observed by Otto Hahn and Fritz Strassmann the previous year but for which they were unable to provide an explanation. The two fission offprints are offered with two further offprints by Meitner, one of which is **inscribed by her**.



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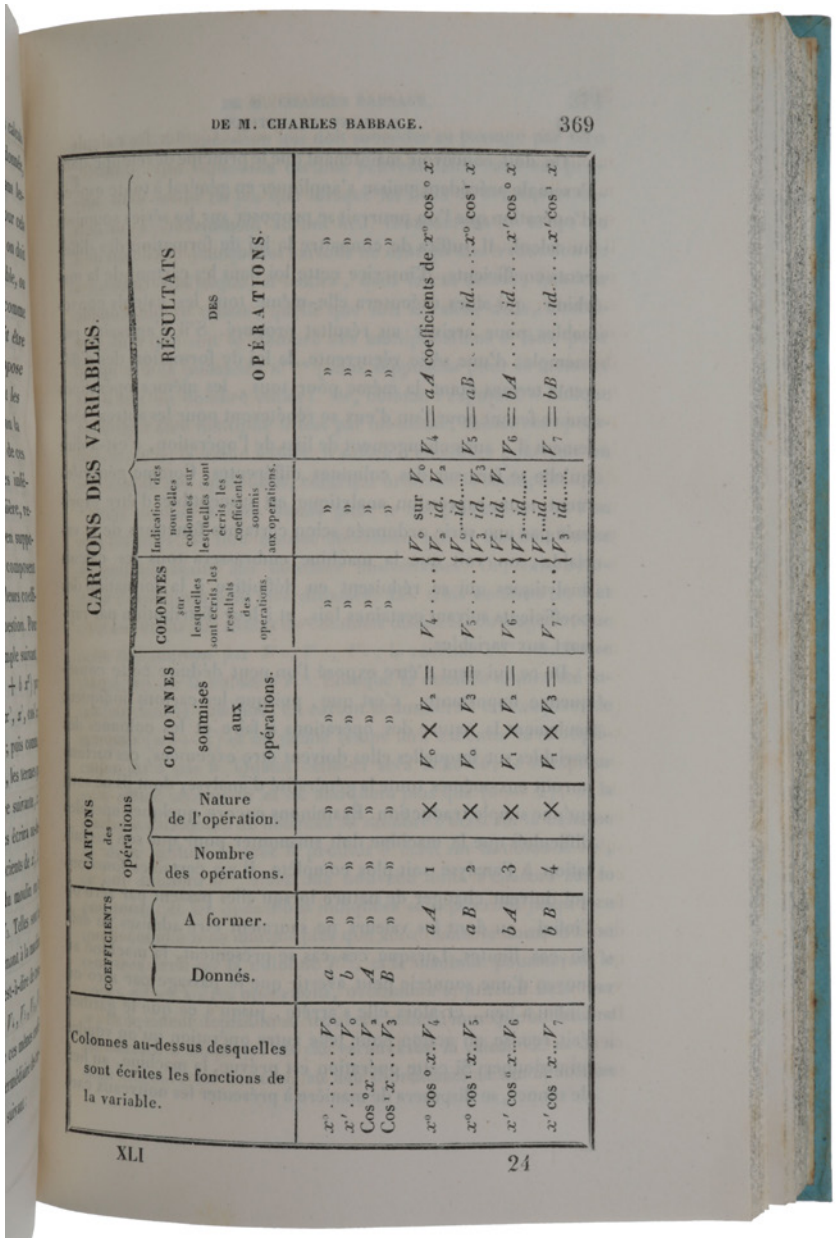
THE FIRST COMPUTER PROGRAMMES

MENABREA, Luigi Federico [BABBAGE, Charles]. *'Notions sur la machine analytique de M. Charles Babbage,' pp. 352-376 in: Bibliothèque Universelle de Genève. Nouvelle Série, Tome 41.* Paris: Anselin, 1842.

$32,500

First edition, journal issue, of Menabrea's account of the only public presentation that Babbage ever made concerning the design and operation of the Analytical Engine. "This was the first published account of Charles Babbage's Analytical Engine and the first account of its logical design, including the first examples of computer programs ever published" (historyofinformation.com).



DE M. CHARLES BABBAGE. 369

Colonnes au-dessus desquelles sont écrites les fonctions de la variable.	COEFFICIENTS		CARTONS des opérations		CARTONS DES VARIABLES.			
	Donnés.	A former.	Nombre des opérations.	Nature de l'opération.	COLONNES soumises aux opérations.	COLONNES sur lesquelles sont ecrits les resultats des operations.	Indication des nouvelles colonnes sur lesquelles sont ecrits les coefficients soumis aux operations.	RÉSULTATS DES OPÉRATIONS.
$x^0 \ldots\ldots V_0$	a	»	»	»	»	»	»	» »
$x' \ldots\ldots V_0$	b	»	»	»	»	»	»	» »
$\mathrm{Cos}\,^0 x \ldots V_2$	A	»	»	»	»	»	»	» »
$\mathrm{Cos}\,^1 x \ldots V_3$	B	»	»	»	»	»	»	» »
$x^0 \cos{}^0 x.\, V_4$		aA	1	×	$V_0 \times V_2 =$	$V_4 \ldots$	$\begin{cases} V_0 \text{ sur } V_0 \\ V_2 \text{ id. } V_2 \end{cases}$	$V_4 = aA$ coefficients de $x^0 \cos{}^0 x$
$x^0 \cos{}^1 x..V_5$		aB	2	×	$V_0 \times V_3 =$	$V_5 \ldots$	$\begin{cases} V_0 \ldots \text{id.} \ldots \\ V_3 \text{ id. } V_3 \end{cases}$	$V_5 = aB \ldots$ id. $\ldots x^0 \cos{}^1 x$
$x' \cos{}^0 x \ldots V_6$		bA	3	×	$V_1 \times V_2 =$	$V_6 \ldots$	$\begin{cases} V_1 \text{ id. } V_1 \\ V_2 \ldots \text{id.} \ldots \end{cases}$	$V_6 = bA \ldots$ id. $\ldots x' \cos{}^0 x$
$x' \cos{}^1 x \ldots V_7$		bB	4	×	$V_1 \times V_3 =$	$V_7 \ldots$	$\begin{cases} V_1 \ldots \text{id.} \ldots \\ V_3 \text{ id.} \ldots \end{cases}$	$V_7 = bB \ldots$ id. $\ldots x' \cos{}^1 x$

XLI 24

http://sophiararebooks.com/5187

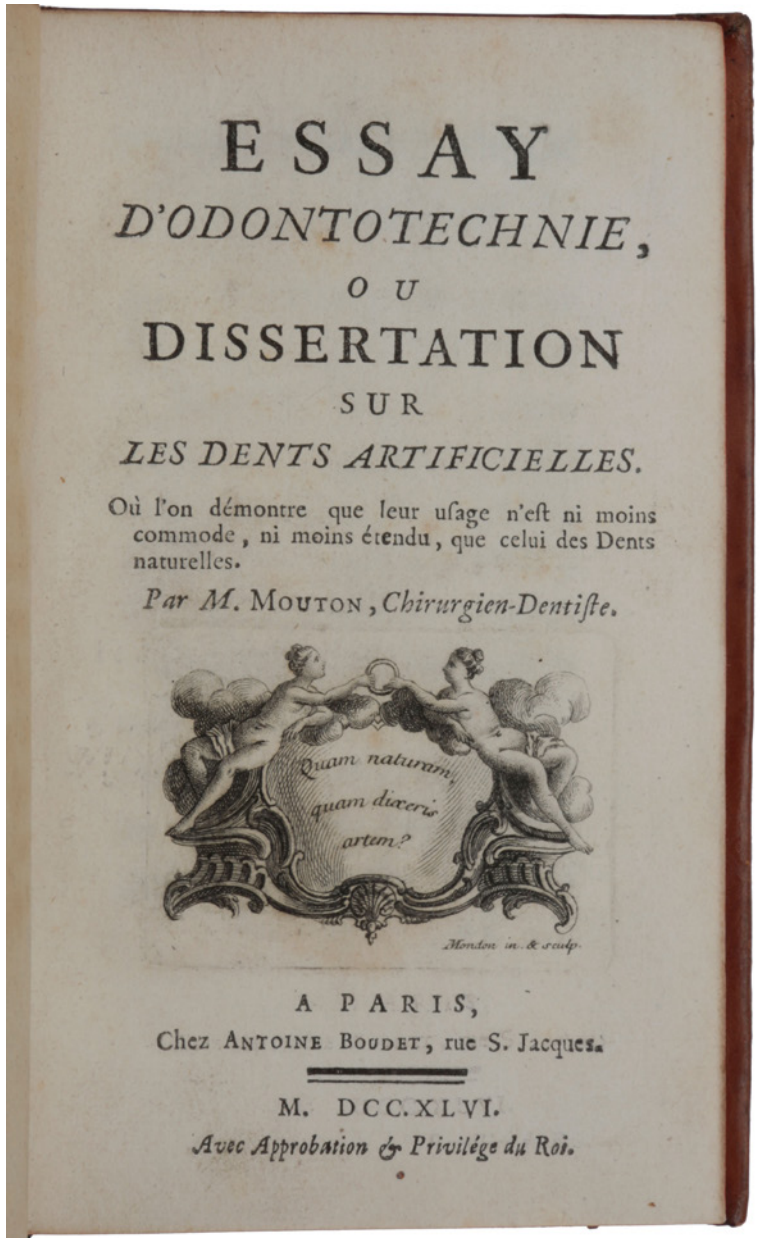
THE FIRST SPECIALIZED BOOK ON DENTAL PROSTHETICS

MOUTON, Claude. *Essay d'Odontotechnie, ou dissertation sur les dents artificielles. Ou l'on démontre que leur usage n'est ni moins commode, ni moins étendu, que celui des Dents naturelles.* Paris: Antoine Boudet, 1746.

$6,500

First edition, rare on the market, of "the first specialized book on dental prosthetics" (G & M), and perhaps the first contribution to what would later be called "cosmetic dentistry." Mouton introduced the use of gold crowns, which he enamelled to give them the same appearance as natural teeth. He was the first to speak of artificial teeth fixed to the natural teeth adjoining them by means of springs or clasps. He was also the first to describe successful transplants, procedures which gave him great renown not only in France, but also in England.

http://sophiararebooks.com/5166



ESSAY
D'ODONTOTECHNIE,
OU
DISSERTATION
SUR
LES DENTS ARTIFICIELLES.

Où l'on démontre que leur usage n'est ni moins commode, ni moins étendu, que celui des Dents naturelles.

Par M. MOUTON, Chirurgien-Dentiste.

Quam naturam, quam diveris artem?

Mouton in. & sculp.

A PARIS,
Chez ANTOINE BOUDET, rue S. Jacques.

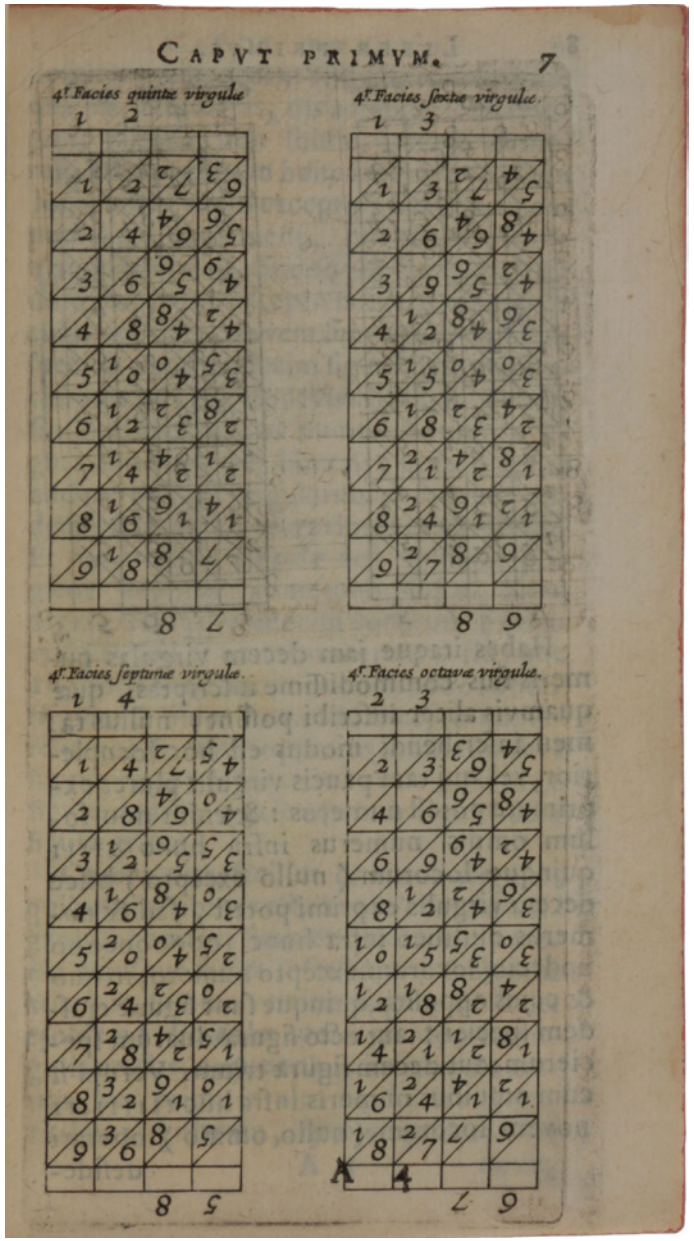
M. DCC.XLVI.
Avec Approbation & Privilége du Roi.

NAPIER'S BONES

NAPIER, John. *Rabdologiae seu numerationis per virgulas libni duo.* Edinburgh: Andrew Hart, 1617.

$75,000

First edition, very rare, of one of the earliest mechanical calculating devices. Napier, the inventor of logarithms, also devised a number of practical devices for simplifying the multiplication and division of large numbers, the most famous being Napier's 'rods' or 'bones'. The present work also contains a number of other mechanical aids to calculation, in one of which he makes one of the earliest uses of the decimal point in arithmetical calculations.



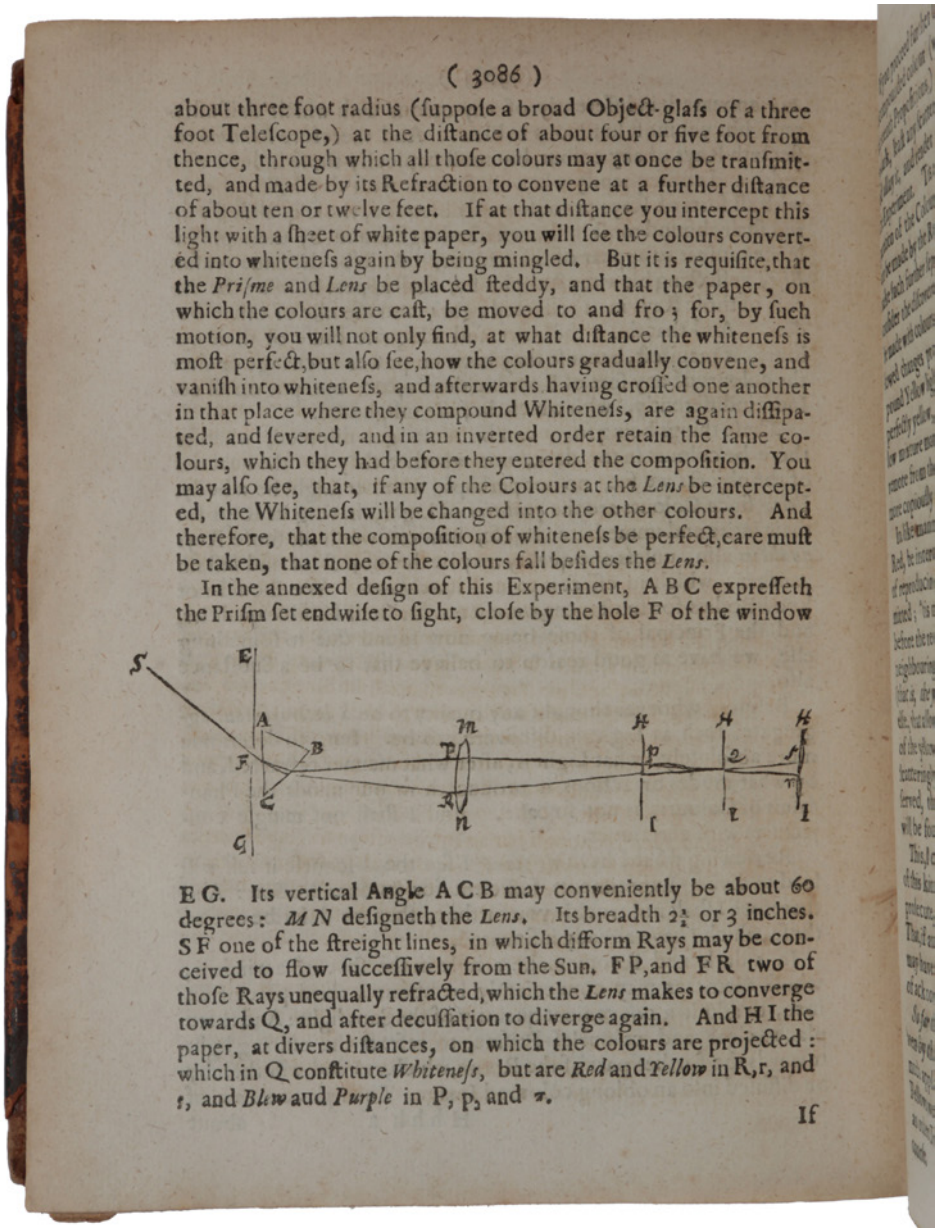
NEWTON'S FIRST PUBLISHED PAPER – HIS THEORY OF COLOURS

[NEWTON, Sir Isaac.] *'A Letter of Mr. Isaac Newton ... containing his New Theory about Light and Colors: Where Light is declared to be not Similar or Homogeneal, but consisting of difform rays, some of which are more refrangible than others: And Colors are affirm'd to be not Qualifications of Light, deriv'd from Refractions of natural Bodies, ...* London: John Martyn, [1671/1672].

$45,000

First printing of Newton's seminal discoveries on the nature of light. This is Newton's first published paper, and arguably the most important paper in the history of optics. "If he had published nothing else, it would be sufficient of itself to guarantee him a place among the immortals of modern science" (Christianson, *In the Presence of the Creator*, p. 152). "… before the end of 1669 [Newton] had worked out the details of his discovery of the decomposition of a ray of white light into rays of different colours by means of a prism. The complete explanation of the theory of the rainbow followed from this discovery … The chief new results were embodied in a paper communicated to the Royal Society in February 1672, and subsequently published in the *Philosophical Transactions*" (*ibid.*).

http://sophiararebooks.com/5191



(3086)

about three foot radius (ſuppoſe a broad Object-glaſs of a three foot Teleſcope,) at the diſtance of about four or five foot from thence, through which all thoſe colours may at once be tranſmitted, and made by its Refraction to convene at a further diſtance of about ten or twelve feet. If at that diſtance you intercept this light with a ſheet of white paper, you will ſee the colours converted into whiteneſs again by being mingled. But it is requiſite, that the *Priſme* and *Lens* be placed ſteddy, and that the paper, on which the colours are caſt, be moved to and fro; for, by ſuch motion, you will not only find, at what diſtance the whiteneſs is moſt perfect, but alſo ſee, how the colours gradually convene, and vaniſh into whiteneſs, and afterwards having croſſed one another in that place where they compound Whiteneſs, are again diſſipated, and ſevered, and in an inverted order retain the ſame colours, which they had before they entered the compoſition. You may alſo ſee, that, if any of the Colours at the *Lens* be intercepted, the Whiteneſs will be changed into the other colours. And therefore, that the compoſition of whiteneſs be perfect, care muſt be taken, that none of the colours fall beſides the *Lens*.

In the annexed deſign of this Experiment, A B C expreſſeth the Priſm ſet endwiſe to ſight, cloſe by the hole F of the window

E G. Its vertical Angle A C B may conveniently be about 60 degrees: *M N* deſigneth the *Lens*. Its breadth $2\frac{1}{2}$ or 3 inches. S F one of the ſtreight lines, in which difform Rays may be conceived to flow ſucceſſively from the Sun. F P, and F R two of thoſe Rays unequally refracted, which the *Lens* makes to converge towards Q, and after decuſſation to diverge again. And H I the paper, at divers diſtances, on which the colours are projected: which in Q conſtitute *Whiteneſs*, but are *Red* and *Yellow* in R, r, and *ρ*, and *Blew* and *Purple* in P, p, and *π*.

If

PMM 336 - THE REFUTATION OF SPONTANEOUS GENERATION

PASTEUR, Louis. *Mémoire sur les corpuscules organisés qui existent dans l'atmosphère. Examen de la doctrine des générations spontanées. Offprint from: Annales de chimie et de physique, 3rd series, vol. 64.* Paris: Mallet-Bachelier, 1862.

$42,000

First edition, very rare offprint, **inscribed by Pasteur**. "The longest and most important of Pasteur's papers on spontaneous generation, describing the series of classic experiments with bent-necked and sealed flasks by which he proved conclusively that fermentation and putrefaction are not the products of spontaneous generation, but result from contamination by airborne micro-organisms. Pasteur's experiments also mark the beginning of microbiology" (Norman).

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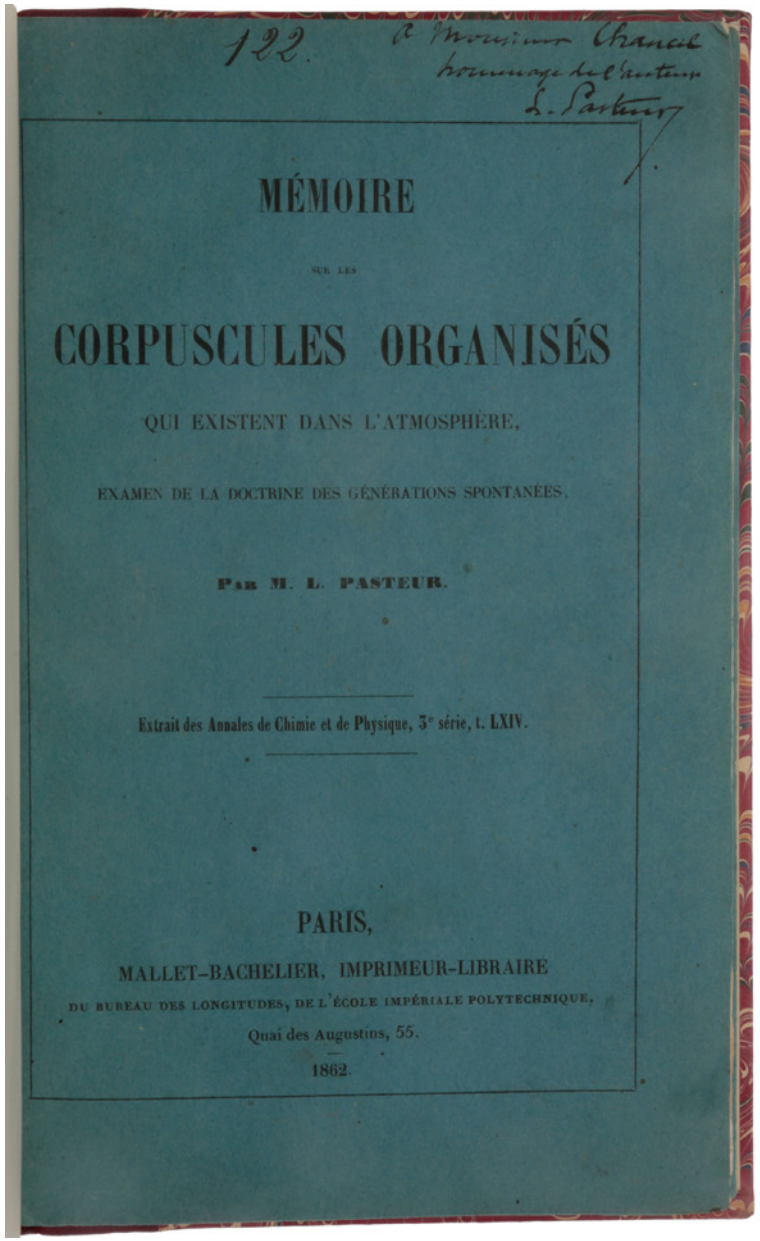


122. A Monsieur Chauveau hommage de l'auteur L. Pasteur

MÉMOIRE

SUR LES

CORPUSCULES ORGANISÉS

QUI EXISTENT DANS L'ATMOSPHÈRE,

EXAMEN DE LA DOCTRINE DES GÉNÉRATIONS SPONTANÉES,

PAR M. L. PASTEUR.

Extrait des Annales de Chimie et de Physique, 3e série, t. LXIV.

PARIS,

MALLET-BACHELIER, IMPRIMEUR-LIBRAIRE

DU BUREAU DES LONGITUDES, DE L'ÉCOLE IMPÉRIALE POLYTECHNIQUE,

Quai des Augustins, 55.

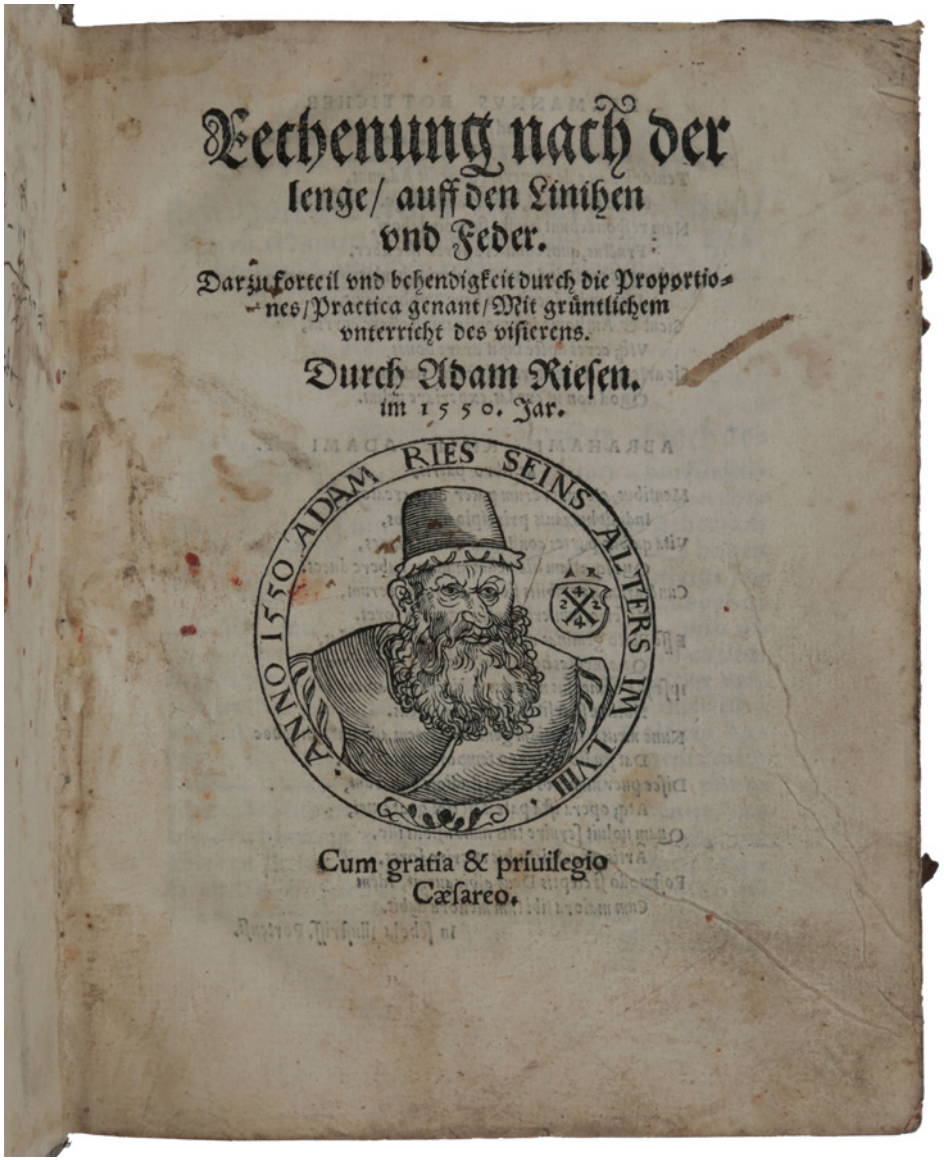
1862.

THE MOST IMPORTANT 16TH CENTURY GERMAN ARITHMETIC

RIESE (or RIES], Adam. *Rechnung nach der lenge, auff den Linihen und Feder. Darzu forteil und behendigkeit durch die Proportiones Practica genant. Mit grüntlichem unterricht des visierens.* Leipzig: Jakob Bärwald, 1550.

$25,000

First edition, rare, of Riese's last, and most comprehensive, arithmetic text. "Riese (1492-1559), while not the first *Rechenmeister* to publish an arithmetic book in Germany, was by far the most famous and influential. His works went through at least one hundred editions and were used in schools for over a century. They were the main force behind the replacement of the old methods using the table abacus (*auff der Linien*) by the new use of the pen (*auff Federn*)" (Tomash & Williams).



Rechenung nach der lenge/ auff den Linihen vnd Feder.

Darzu forteil vnd behendigkeit durch die Proportiones/Practica genant/Mit grüntlichem vnterricht des visierens.

Durch Adam Riesen.

im 1550. Jar.

ANNO 1550 ADAM RIES SEINS ALTERS IM LVIII

Cum gratia & priuilegio Cæsareo.

http://sophiararebooks.com/5199

EXTREMELY RARE LARGE AND THICK PAPER COPY

SCHEINER, Christoph. *Rosa ursina sive Sol ex admirando facularum & macularum suarum phoenomeno varius: necnon circa centrum suum et axem fixum ab occasu in ortum annua, circaq[ue] alium axem mobilem ab ortu in occasum conuersione quasi menstrua, super polos proprios, libris quatuor mobilis ostensus...* Bracciano: Andreas Phaeus, 1626-1630.

$145,000

First edition, extremely rare large and thick paper copy, of the most lavishly illustrated astronomical work published in the first half of the seventeenth century, with many full-page illustrations of Scheiner's observations of the sun and of the optical instruments he had designed for the purpose. Scheiner was one of the first to observe sunspots, and this work is the definitive account of his observations. "Scheiner's drawings in the *Rosa Ursina* are of almost modern quality, and there was little improvement in solar imaging until 1905" (Britannica).

http://sophiararebooks.com/5198

THE NATURE AND PREVENTION OF PEURPERAL FEVER

[SEMMELWEIS, Ignaz]. HEBRA, Ferdinand von, editor. *'Höchst wichtige Erfahrungen über die Ätiologie der in Gebäranstalten epidemischen Puerperalfiebern,' pp. 242-4 in: Zeitschrift der k.k. Gesellschaft der Aerzte zu Wien, vol. IV. 'Fortzetzung der Erfahrungen über die Ätiologie …,' pp. 64-5 in: ibid., vol. V.* Vienna: Kaulfuss Witwe, Prandel & Comp., 1847 [- 1848].

$28,500

First edition of the first announcement of Semmelweis's epoch-making discovery of the source and means of preventing puerperal fever, one of the greatest achievements in the history of medicine. This announcement already contains the essence of the findings and recommendations of which Semmelweis published a detailed account 14 years later in his famous *Die Aetiologie, der Begriff und die Prophylaxis des Kindbettfiebers*. "It could be said that he was the father of preventive medicine and, some have argued, of asepsis in obstetrics and gynecology as well as surgery. But the most far-reaching significance of his work was its influence on the development of the 'Germ Theory of Disease' and the ushering in of an entirely new way of thinking about diseases as having necessary causes" (Kadar *et al.*).

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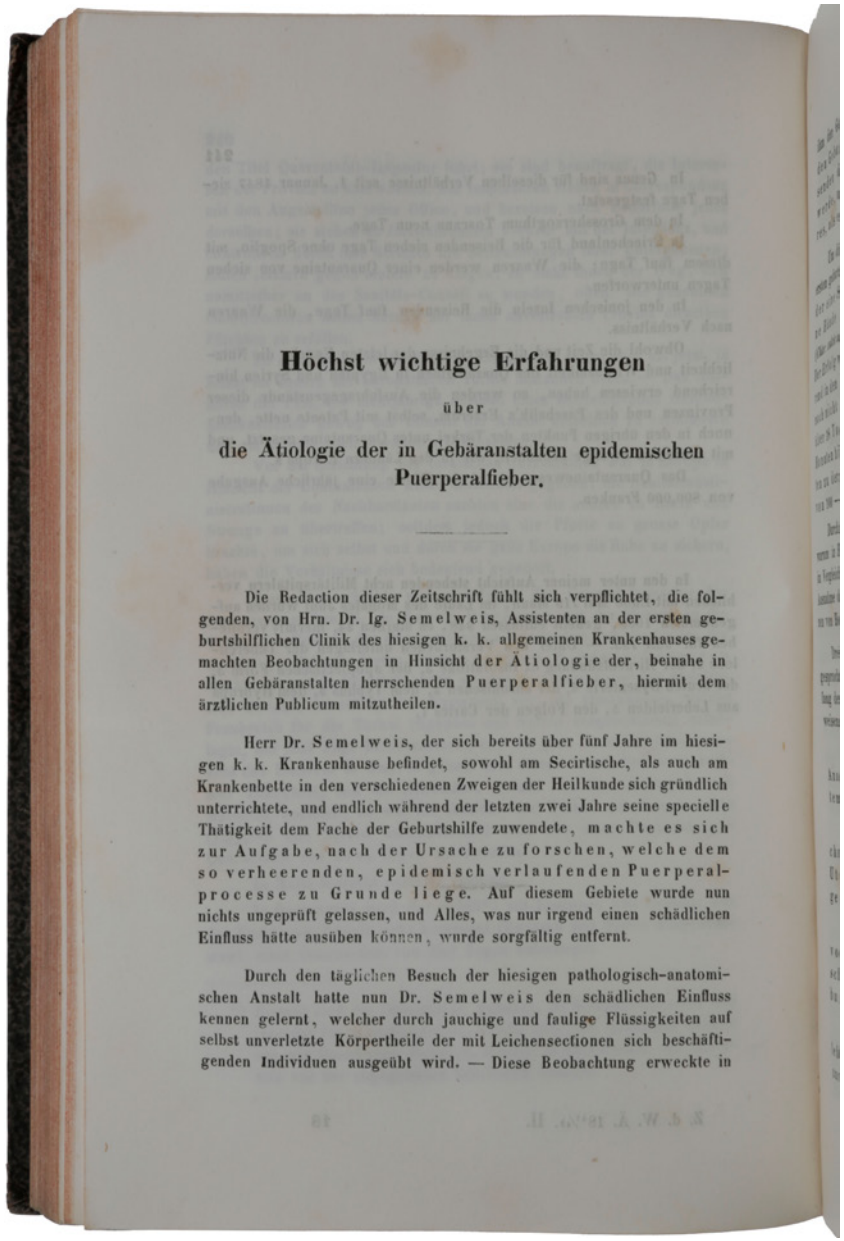

Höchst wichtige Erfahrungen

über

die Ätiologie der in Gebäranstalten epidemischen Puerperalfieber.

Die Redaction dieser Zeitschrift fühlt sich verpflichtet, die folgenden, von Hrn. Dr. Ig. Semelweis, Assistenten an der ersten geburtshilflichen Clinik des hiesigen k. k. allgemeinen Krankenhauses gemachten Beobachtungen in Hinsicht der Ätiologie der, beinahe in allen Gebäranstalten herrschenden Puerperalfieber, hiermit dem ärztlichen Publicum mitzutheilen.

Herr Dr. Semelweis, der sich bereits über fünf Jahre im hiesigen k. k. Krankenhause befindet, sowohl am Secirtische, als auch am Krankenbette in den verschiedenen Zweigen der Heilkunde sich gründlich unterrichtete, und endlich während der letzten zwei Jahre seine specielle Thätigkeit dem Fache der Geburtshilfe zuwendete, machte es sich zur Aufgabe, nach der Ursache zu forschen, welche dem so verheerenden, epidemisch verlaufenden Puerperalprocesse zu Grunde liege. Auf diesem Gebiete wurde nun nichts ungeprüft gelassen, und Alles, was nur irgend einen schädlichen Einfluss hätte ausüben können, wurde sorgfältig entfernt.

Durch den täglichen Besuch der hiesigen pathologisch-anatomischen Anstalt hatte nun Dr. Semelweis den schädlichen Einfluss kennen gelernt, welcher durch jauchige und faulige Flüssigkeiten auf selbst unverletzte Körpertheile der mit Leichensectionen sich beschäftigenden Individuen ausgeübt wird. — Diese Beobachtung erweckte in

TURING AND THE SECRET OF LIFE – CLAUDE SHANNON'S COPY

TURING, Alan Mathison. *The chemical basis of morphogenesis. Offprint from: Philosophical Transactions of the Royal Society of London, Series B, Vol. 237, No. 641, 14 August, 1952.* London: Cambridge University Press for the Royal Society, [1952].

$30,000

First edition, **Claude Shannon's copy** of the extremely rare offprint, of Turing's last major published work, which was "in every respect ahead of its time" (Copeland, *The Essential Turing*, p. 510). Turing here provides the first mathematical theory of embryology. "Although still very controversial, Turing's theory for morphogenesis provided a paradigm shift in our way of thinking" (Maini, in *Alan Turing: his work and impact*, p. 684). This is a remarkable association copy linking two of the greatest pioneers of the digital age.

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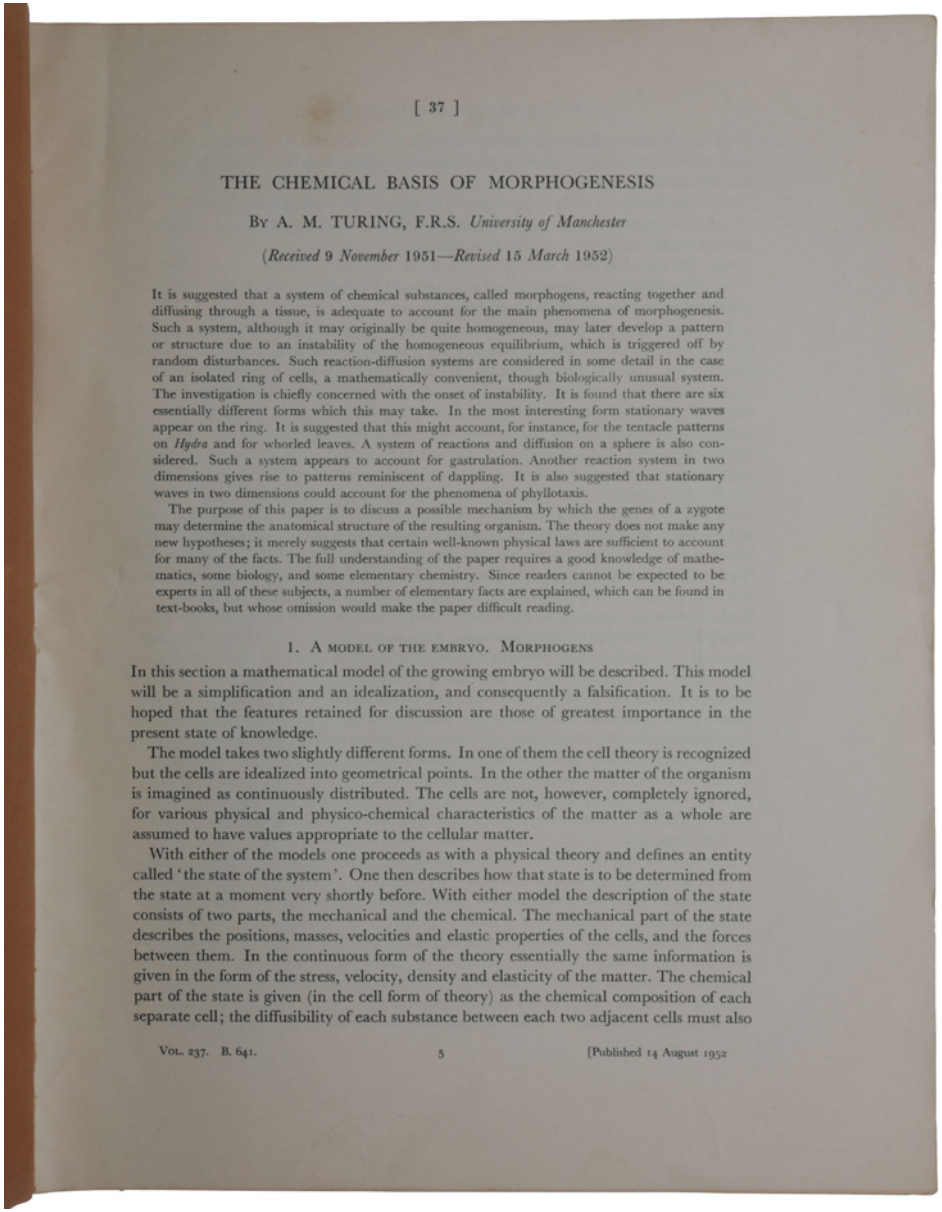

[37]

THE CHEMICAL BASIS OF MORPHOGENESIS

By A. M. TURING, F.R.S. *University of Manchester*

(*Received* 9 *November* 1951—*Revised* 15 *March* 1952)

It is suggested that a system of chemical substances, called morphogens, reacting together and diffusing through a tissue, is adequate to account for the main phenomena of morphogenesis. Such a system, although it may originally be quite homogeneous, may later develop a pattern or structure due to an instability of the homogeneous equilibrium, which is triggered off by random disturbances. Such reaction-diffusion systems are considered in some detail in the case of an isolated ring of cells, a mathematically convenient, though biologically unusual system. The investigation is chiefly concerned with the onset of instability. It is found that there are six essentially different forms which this may take. In the most interesting form stationary waves appear on the ring. It is suggested that this might account, for instance, for the tentacle patterns on *Hydra* and for whorled leaves. A system of reactions and diffusion on a sphere is also considered. Such a system appears to account for gastrulation. Another reaction system in two dimensions gives rise to patterns reminiscent of dappling. It is also suggested that stationary waves in two dimensions could account for the phenomena of phyllotaxis.

The purpose of this paper is to discuss a possible mechanism by which the genes of a zygote may determine the anatomical structure of the resulting organism. The theory does not make any new hypotheses; it merely suggests that certain well-known physical laws are sufficient to account for many of the facts. The full understanding of the paper requires a good knowledge of mathematics, some biology, and some elementary chemistry. Since readers cannot be expected to be experts in all of these subjects, a number of elementary facts are explained, which can be found in text-books, but whose omission would make the paper difficult reading.

1. A model of the embryo. Morphogens

In this section a mathematical model of the growing embryo will be described. This model will be a simplification and an idealization, and consequently a falsification. It is to be hoped that the features retained for discussion are those of greatest importance in the present state of knowledge.

The model takes two slightly different forms. In one of them the cell theory is recognized but the cells are idealized into geometrical points. In the other the matter of the organism is imagined as continuously distributed. The cells are not, however, completely ignored, for various physical and physico-chemical characteristics of the matter as a whole are assumed to have values appropriate to the cellular matter.

With either of the models one proceeds as with a physical theory and defines an entity called 'the state of the system'. One then describes how that state is to be determined from the state at a moment very shortly before. With either model the description of the state consists of two parts, the mechanical and the chemical. The mechanical part of the state describes the positions, masses, velocities and elastic properties of the cells, and the forces between them. In the continuous form of the theory essentially the same information is given in the form of the stress, velocity, density and elasticity of the matter. The chemical part of the state is given (in the cell form of theory) as the chemical composition of each separate cell; the diffusibility of each substance between each two adjacent cells must also

Vol. 237. B. 641. 5 [Published 14 August 1952

THE CLASSIC TEXT ON GAME THEORY

VON NEUMANN, John & Oskar MORGENSTERN. *Theory of Games and Economic Behavior.* Princeton: Princeton University Press, 1944.

$12,500

First edition, and a fine copy with the very rare dust jacket, of "the classic work upon which modern-day game theory is based … In it, John von Neumann and Oskar Morgenstern conceived a ground-breaking mathematical theory of economic and social organization, based on a theory of games of strategy. Not only would this revolutionize economics, but the entirely new field of scientific inquiry it yielded – game theory – has since been widely used to analyze a host of real-world phenomena from arms races to optimal policy choices of presidential candidates, from vaccination policy to major league baseball salary negotiations" (from the introduction to the 60th anniversary commemorative edition).

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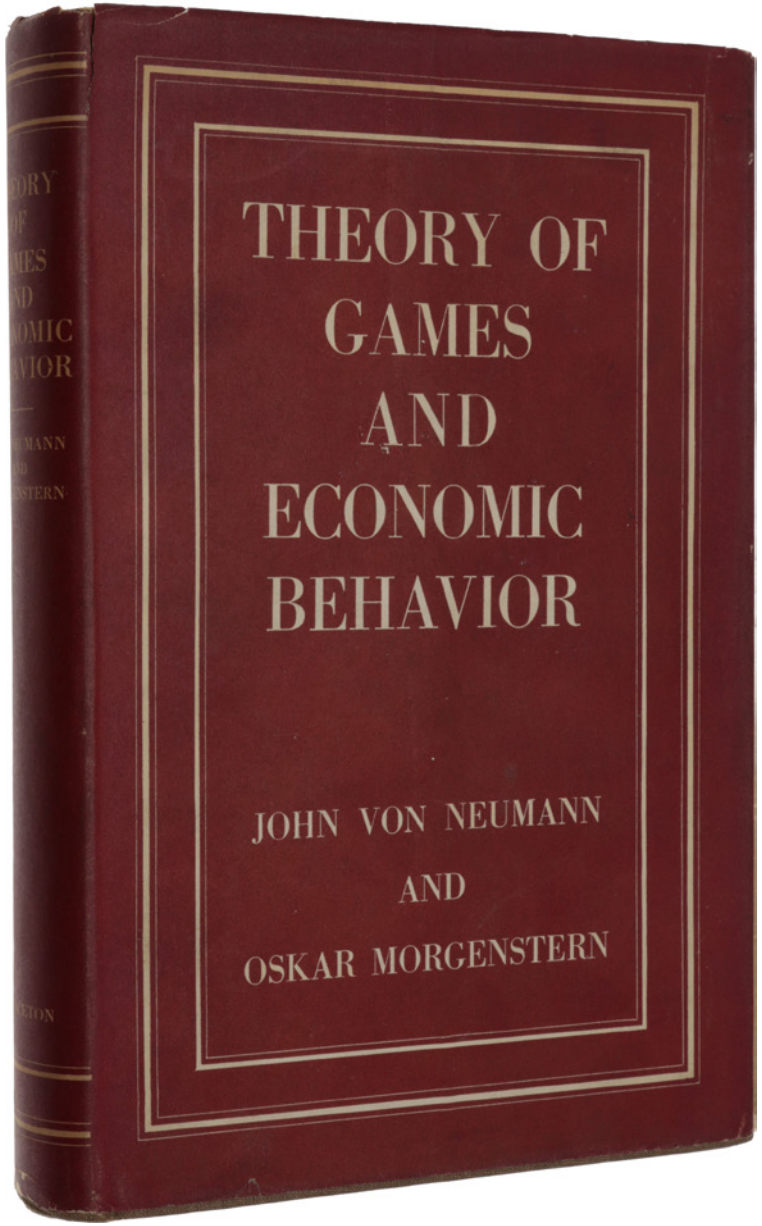

THE INVENTION OF SEQUENTIAL ANALYSIS - THE ORIGINAL RESTRICTED REPORTS

WALD, Abraham & FREEMAN, H. A. *Sequential Analysis of Statistical Data: Theory; [with:] Sequential Tests of Statistical Significance; [with:] Sequential Analysis of Statistical Data: Applications.* Washington: National Defense Research Committee, 1943-1944.

$18,500

First edition, very rare, of Wald's seminal invention of 'Sequential analysis', the "notion that in some sense it is economical to observe and analyze data sequentially, rather than to observe and analyze a single sample of predetermined fixed size" (DSB). It is here offered in the original 'restricted' reports; it was published four years later in his well-known book *Sequential Analysis*. "It was Wald, in 1943, who first formulated mathematically and solved quite generally the problem of sequential tests of statistical hypotheses. He introduced the particular method of the sequential probability ratio test and, with Wolfowitz (1948), showed its optimal properties" (*ibid.*).

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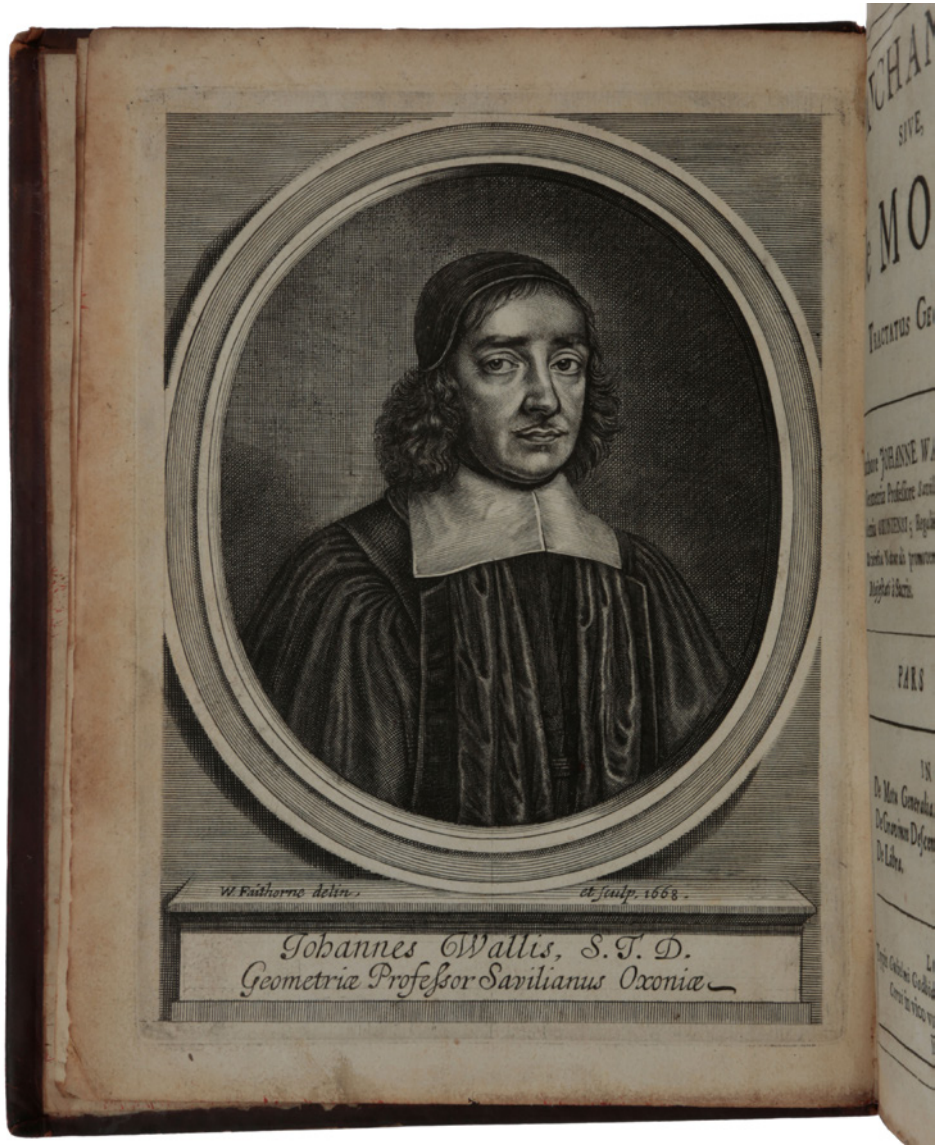
"A MAJOR ADVANCE IN THE MATHEMATIZATION OF MECHANICS" (DSB)

WALLIS, John. *Mechanica: sive de motu, tractatus geometricus. Pars prima. In qua, De motu generalia. De gravium descensu, & motuum declivitate. De libra (Pars secunda. In qua, De centro gravitates. Ejusque calculo; Pars tertia...* London: William Godbid for Moses Pitt, [1669-] 1671.

$32,500

First edition, very rare when complete with the portrait and all three parts, of this classic treatise on mechanics by Newton's most important English precursor. It treats both statics (the balance, the lever, centres of gravity, elasticity, and hydrostatics) and dynamics (including the motion of bodies under gravity, and the first comprehensive treatment of the collision of both hard and elastic bodies). "On these investigations, according to Professor Mach, Sir Isaac Newton based his researches contained in the *Principia*" (Sotheran). "It represents a major advance in the mathematization of mechanics" (DSB).



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ONE OF THE MOST IMPORTANT SCIENTIFIC DISCOVERIES OF THE 20TH CENTURY - SIGNED BY CRICK & WATSON

WATSON, J. D. & CRICK, F. H. C. *'Molecular Structure of Nucleic Acids: A Structure for Deoxyribose Nucleic Acid,' pp. 737-738; WILKINS, M. H. F., STOKES, A. R. & WILSON, H. R. 'Molecular Structure of Deoxypentose Nucleic Acids,' pp. 738-740; FRANKLIN, R. E. & GOSLING, R. G. 'Molecular Configuration in Sodium Thymonucleate,' pp. 740-741. Three papers in: Nature, Vol. 171, No. 4356, April 25, 1953.* London: Macmillan, 1953.

$60,000

First edition, complete journal issue, **signed by both Crick and Watson**, of one of the most important scientific papers of the twentieth century. This is the only complete example we have seen of this seminal article in the form in which it first appeared and signed by both authors. The paper "records the discovery of the molecular structure of deoxyribonucleic acid (DNA), the main component of chromosomes and the material that transfers genetic characteristics in all life forms. Publication of this paper initiated the science of molecular biology" (*One Hundred Books Famous in Medicine*).

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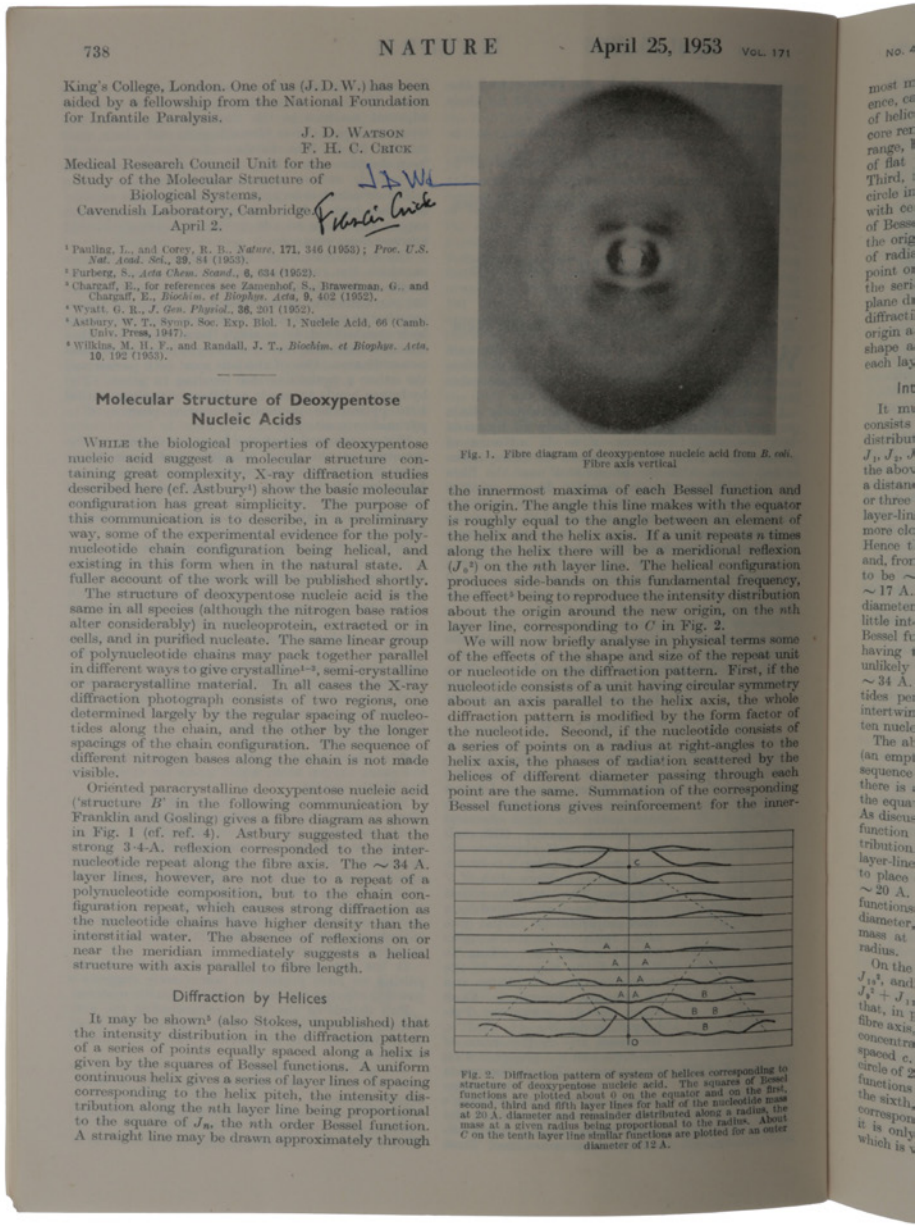

738 NATURE April 25, 1953 VOL. 171

King's College, London. One of us (J. D. W.) has been aided by a fellowship from the National Foundation for Infantile Paralysis.

J. D. WATSON
F. H. C. CRICK

Medical Research Council Unit for the Study of the Molecular Structure of Biological Systems, Cavendish Laboratory, Cambridge. April 2.

[1] Pauling, L., and Corey, R. B., *Nature*, 171, 346 (1953); *Proc. U.S. Nat. Acad. Sci.*, 39, 84 (1953).
[2] Furberg, S., *Acta Chem. Scand.*, 6, 634 (1952).
[3] Chargaff, E., for references see Zamenhof, S., Brawerman, G., and Chargaff, E., *Biochim. et Biophys. Acta*, 9, 402 (1952).
[4] Wyatt, G. R., *J. Gen. Physiol.*, 36, 201 (1952).
[5] Astbury, W. T., Symp. Soc. Exp. Biol. 1, Nucleic Acid, 66 (Camb. Univ. Press, 1947).
[6] Wilkins, M. H. F., and Randall, J. T., *Biochim. et Biophys. Acta*, 10, 192 (1953).

Molecular Structure of Deoxypentose Nucleic Acids

WHILE the biological properties of deoxypentose nucleic acid suggest a molecular structure containing great complexity, X-ray diffraction studies described here (cf. Astbury[1]) show the basic molecular configuration has great simplicity. The purpose of this communication is to describe, in a preliminary way, some of the experimental evidence for the polynucleotide chain configuration being helical, and existing in this form when in the natural state. A fuller account of the work will be published shortly.

The structure of deoxypentose nucleic acid is the same in all species (although the nitrogen base ratios alter considerably) in nucleoprotein, extracted or in cells, and in purified nucleate. The same linear group of polynucleotide chains may pack together parallel in different ways to give crystalline[1-3], semi-crystalline or paracrystalline material. In all cases the X-ray diffraction photograph consists of two regions, one determined largely by the regular spacing of nucleotides along the chain, and the other by the longer spacings of the chain configuration. The sequence of different nitrogen bases along the chain is not made visible.

Oriented paracrystalline deoxypentose nucleic acid ('structure *B*' in the following communication by Franklin and Gosling) gives a fibre diagram as shown in Fig. 1 (cf. ref. 4). Astbury suggested that the strong 3·4-A. reflexion corresponded to the inter-nucleotide repeat along the fibre axis. The ~34 A. layer lines, however, are not due to a repeat of a polynucleotide composition, but to the chain configuration repeat, which causes strong diffraction as the nucleotide chains have higher density than the interstitial water. The absence of reflexions on or near the meridian immediately suggests a helical structure with axis parallel to fibre length.

Diffraction by Helices

It may be shown[5] (also Stokes, unpublished) that the intensity distribution in the diffraction pattern of a series of points equally spaced along a helix is given by the squares of Bessel functions. A uniform continuous helix gives a series of layer lines of spacing corresponding to the helix pitch, the intensity distribution along the *n*th layer line being proportional to the square of J_n, the *n*th order Bessel function. A straight line may be drawn approximately through

Fig. 1. Fibre diagram of deoxypentose nucleic acid from *B. coli*. Fibre axis vertical

the innermost maxima of each Bessel function and the origin. The angle this line makes with the equator is roughly equal to the angle between an element of the helix and the helix axis. If a unit repeats *n* times along the helix there will be a meridional reflexion (J_n^2) on the *n*th layer line. The helical configuration produces side-bands on this fundamental frequency, the effect[5] being to reproduce the intensity distribution about the origin around the new origin, on the *n*th layer line, corresponding to *C* in Fig. 2.

We will now briefly analyse in physical terms some of the effects of the shape and size of the repeat unit or nucleotide on the diffraction pattern. First, if the nucleotide consists of a unit having circular symmetry about an axis parallel to the helix axis, the whole diffraction pattern is modified by the form factor of the nucleotide. Second, if the nucleotide consists of a series of points on a radius at right-angles to the helix axis, the phases of radiation scattered by the helices of different diameter passing through each point are the same. Summation of the corresponding Bessel functions gives reinforcement for the inner-

Fig. 2. Diffraction pattern of system of helices corresponding to structure of deoxypentose nucleic acid. The squares of Bessel functions are plotted about O on the equator and on the first, second, third and fifth layer lines for half of the nucleotide mass at 20 A. diameter and remainder distributed along a radius, the mass at a given radius being proportional to the radius. About *C* on the tenth layer line similar functions are plotted for an outer diameter of 12 A.

THE 'YELLOW PERIL'

WIENER, Norbert. *The Extrapolation, Interpretation and Smoothing of Stationary Time Series with Engineering Applications. DIC Contract 6037, A Research Pursued on Behalf of the National Defense Research Council.* [Washington, DC: National Defense Research Council], 1942.

$28,500

Extremely rare first edition of this classic in modern communication theory. "It has been the opinion of many that Wiener will be remembered for his Extrapolation long after Cybernetics is forgotten. Indeed few computer-science students would know today what cybernetics is all about, while every communication student knows what Wiener's filter is. The work was circulated as a classified memorandum in 1942, as it was connected with sensitive war-time efforts to improve radar communication. This book became the basis for modern communication theory, by a scientist considered one of the founders of the field of artificial intelligence. Combining ideas from statistics and time-series analysis, Wiener used Gauss's method of shaping the characteristic of a detector to allow for the maximal recognition of signals in the presence of noise. This method came to be known as the 'Wiener filter'.

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