

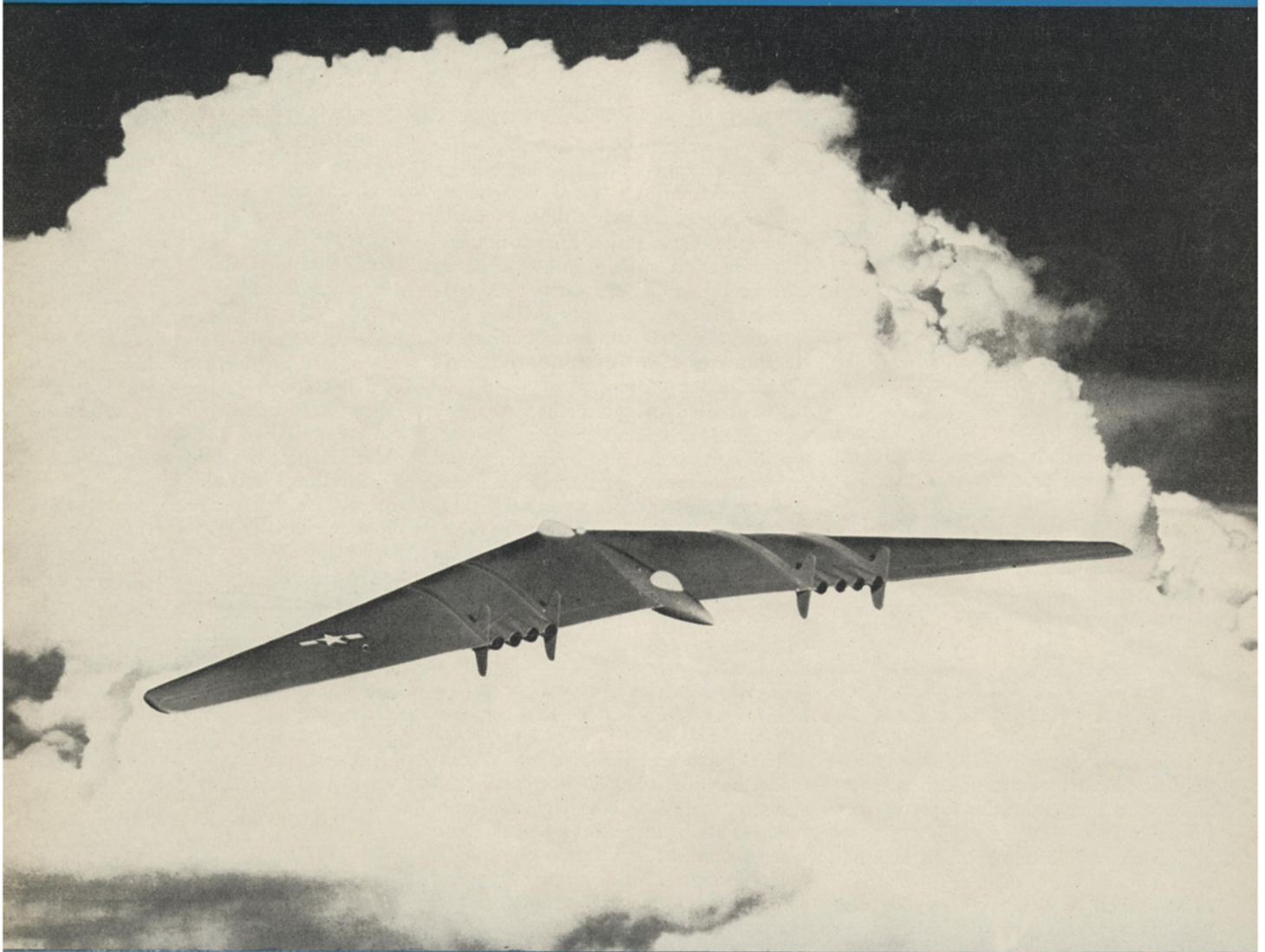
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Flying-Wing

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By H. T. PLEDGE

Librarian, Science Museum of London

FROM THE TABLE OF CONTENTS

SCIENCE AND PRE-SCIENCE—From Ancient Greece to the second Renaissance. Pre-science: isolation; lack of specialism; symbolism; mysticism. State of certain sciences 1450-1500: perspective and anatomy; mechanics; mines and chemical crafts; lack of physics.

BIOLOGY BEFORE THE MICROSCOPE—Mode of exposition adopted in the book. Weakness of botany without technical terms; teleology and science. Commentators, artists and doctors; naturalistic and diagrammatic plates; Vesalius; the Paduan line. Weakness of physiology without the idea of the physical; Harvey and the pump-idea. Lack of microscopes the limiting factor here and in early embryology.

ASTRONOMY BEFORE THE TELESCOPE—Experiment and observation. Earth and sun rival centres before the modern period. Technical advances and the great explorations; mapping; the Iberian contribution. Copernicus, Brahe, Kepler; the German contribution. Stirrings of the idea of the physical.

MATHEMATICS BEFORE THE CALCULUS—Some Greek points of view; rigour, music, and mysticism. Pure mathematics: Symbolism and suggestiveness; equations; Italian contribution. Computation: "calculating machines" preceded paper computation, which brings in a second dimension. Single-radix numeration; decimals; logarithms. Navigational astronomy as the stimulus.

THE 17TH CENTURY—War and order. Learned societies. Bacon and Descartes; philosophy and science; from the circle to the straight line as the "natural" path.

MECHANICS, ASTRONOMY, OPTICS, especially in the 17th Century—Stevinus, hydrostatics; Galileo, dynamics. Twofold importance of *glass*: telescopes and the end of Ptolemy, and barometers, defining the concept of a gas and of the physical. Thence, choice of mass as fundamental. Conservation principles in science. Gravitation, action at a distance. Light. Minimum principles in science. Waves and projectiles. 18th-century instruments. The idea of compensation: achromatic lenses and compensated chronometer.

MATHEMATICS (1600-1800)—Geometry restarts: from perspective to projective geometry; from mapping and equations to coordinates. Infinity; gradients and areas and infinite series. 18th century; analytical mechanics; minimal theories again; doubts of the calculus; the "insoluble" problems—quintics and elliptic integrals; the ambition of formulation.

MICROSCOPY, CLASSIFICATION, GEOLOGY—The descriptive and observational sciences. "Classical" microscopy, embryology, spontaneous generation, preformationism. Classifying, naming, comparing; relation to physiology; spirit formal and static; Linnaeus, Cuvier. Geology separates from cosmology; parts played by volcanoes, mines, etc., in its history; Guettard and Desmarests; Werner; Hutton; Cuvier.

THE 18TH CENTURY—Formalism and systematism; examples from medicine; reaction to revolution, political, agricultural, industrial. Premature applied science. Germany's greatness still ahead.

EXPERIMENTAL SCIENCE I—Interdependence of experimental physics, chemistry, and physiology. Heat and gases as key ideas; their confusion (17th century) and separation (18th). Vitalism and mechanism. Heat: thermometers, calorimetry, material theory. Chemistry: notes on technique. From principles (phlogiston) to substance (after Lavoisier) and weights. Oxygen monism. Gases again; atoms and Dalton. Application to physiology; respiration.

EXPERIMENTAL SCIENCE II—Qualitative electricity and magnetism. Physiology (Haller, Galvani) gives the sensitive detector needed for the discovery of currents; electrolysis. Dualism in chemistry; Berzelius and professionalism; atomic weights; analysis systematised. Organic chemistry; isomers, radicals, types; anarchy of the fifties. Physiology; the tradition of great teachers; the cycles, especially of nitrogen; digestion; nerves and senses, Helmholtz.

MATHEMATICAL PHYSICS—Certain ideas which always fascinate: vortices, crystals, waves; the second (c. 1800) leads to the triumph of the third in optics, but the first will be needed to complete the picture. Quantitative electricity and magnetism, ignoring dielectrics; historical importance of thermoelectricity; mathematicians and picture-thinkers. Kinetic theory, energy (contribution of physiology), thermodynamics, statistics. Radiant energy. Electromagnetic theory; vortices enter from hydrodynamics and unite electricity and optics.

THE 19TH CENTURY—The world-wide spread of white man. The revolution opens the flood gates of French genius; the Romantic Epoch enchains Germany at first. Industrialism and the struggle for existence; mechanical models, statistics, continuity in English thought. Emergence of Germany.

EVOLUTION AND THE MICROSCOPE—Achromatic microscopes, giving cell theory. Naturphilosophie, morphology, embryology. The stage set for evolution. Buffon, Lamarck, the burst of hereditary aptitude in England. Influence of islands. Discussion of Darwinism. Distribution; the oceans; formalistic remnants expelled. Systematics: influences of conservatism, economics, and discoveries in physiology. The (non-Greek?) tradition as to infection. Jenner, Pasteur, Lister; staining and the microtome; the biochemical point of view.

19TH-CENTURY MATHEMATICS I AND II—Its philosophical character: rigour, generalised quantity and space. Gauss and theory of numbers. Continuity, function, complex variable. From quintics to algebraic numbers, many-unit quantities, generalised algebras; also to groups, transformations and invariants; thus to geometry: non-Euclidean and n-dimensional; projective geometry; Klein, Poincare; differential equations and mechanics; sets of points; towards general topology. Philosophy of mathematics.

(Continued on following page)

"A THOROUGH-GOING HISTORY OF SCIENCE"



"The author takes the subject and the reader in his stride on a journey which must be ranked as a very able performance, indeed. The illustrations are excellent, the bibliography is unusually helpfully arranged, and the indices are full and satisfactory."

—*M. F. Ashley Montagu, The New York Times*

"H. T. Pledge, of the Science Museum, London, has given a remarkably complete account of mathematics, physics, chemistry, and biology in his period, based on careful scholarship, and he has included some original features. He has not overlooked the question of the social relation of science, which is now converting the history of science from a minor into a major subject. A standard book in all libraries, and in particular it will be a perfect science prize for educational institutions."

—*The Manchester Guardian*

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MAINLY ORGANIC CHEMISTRY—Experimental science again. End of the anarchy of the fifties in chemistry; groups of elements, homologous series; Avogadro's hypothesis; periodic law. Organic: crystals again, stereoisomerism; biochemistry and chemical industry; aromatics; typical constitutions. Notes on apparatus, especially chemical.

SURFACES AND IONS—Physical chemistry: balanced actions and thermodynamics. Electrochemistry; Raoult, osmosis; ionic dissociation theory, gas analogy. Colloids and surface chemistry. Catalysts and enzymes: surfaces again.

CYTOLOGY AND GENETICS—Cell division and union with the aid of new microtechnique; Weissmann. Ancient experiments in breeding; the part played by religious houses; pre-Mendel and Mendel; the gene; heredity and environment; the gene-complex; relation to evolution.

GROWTH AND UNITY OF THE INDIVIDUAL I—Embryology; cytological and evolutionary; experimental; technique of tissue culture; "rate genes." Nerves; neurons, integrative action; adrenaline and acetylcholine, importance of ultra-sensitive instruments; electrochemical models for nerve and muscle.

GROWTH AND UNITY OF THE INDIVIDUAL II—Internal secretion; dependence of our knowledge on antiseptic and other operative advances; the integration of the individual; plant hormones. Deficiency diseases; metabolic thermodynamics; vitamins. Some biochemical points: vitamins, pigments, respiration, and photosynthesis.

ECOLOGY—Pigments continued (vision); comparative biochemistry; the interrelations of life, that is, ecology. Its chief ideas and economic relations; soil science; parasitism, fluctuations, their mathematics and relations to evolution.

MODERN EXPERIMENTAL PHYSICS—Vacuum pumps and tubes; electrons; radioactivity; the planetary atom; atomic number; isotopes; projectile physics and new ultimate particles.

QUANTUM THEORY—Statistical and radiational theories and their erroneous result. Interferometers; line spectra, and no explanation. Quanta; Bohr; correspondence principle; matrices and wave-mechanics; probability and uncertainty; the relativistic equation.

RELATIVITY AND COSMOLOGY—The interferometer and special relativity. General relativity; efforts to geometrize electromagnetism. Astrophysics: Laplace's hypothesis and the alternatives; the spectroscope and spectral classifications; the galaxy; stellar evolution. Cosmological consequences of general relativity; Einstein and de Sitter; Milne and Eddington.

REAL MATERIALS I AND II—Subjects of Chapters XIV and XV revived by fresh elements from physics: crystals (once more) and X-rays; from valency to lattice and (with quanta) to the architecture of the solid state. Surfaces again; oriented films. Fibres and proteins; "templates." From ideal to real materials; real gases and electrolytes; reaction kinetics, activation, chains, reactions at surfaces; real liquids, vortices, boundary layers, in relation to the weather, ships and aeroplanes; real solids, geophysics.

CONCLUDING DISCUSSION • BIBLIOGRAPHICAL NOTE • SUBJECT INDEX • NAME INDEX.

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