

TEXT-BOOK OF OPHTHALMOLOGY

BY

SIR W. STEWART DUKE-ELDER

K.C.V.O., M.A., D.Sc.(St. And.), Ph.D.(Lond.), M.D., Ch.B., F.R.C.S.

*Surgeon Oculist to H.M. The King;
Hon. Consulting Surgeon to the British Army;
Ophthalmic Surgeon to St. George's Hospital;
Honorary Research Associate, University College, London;
Lecturer in Ophthalmology, St. George's Hospital Medical
School, University of London, etc.*

VOL. I

**THE DEVELOPMENT, FORM AND FUNCTION
OF THE VISUAL APPARATUS**

**WITH 1022 ILLUSTRATIONS, INCLUDING
7 COLOURED PLATES**

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AND ADDITIONS**

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PREFACE TO THE NEW IMPRESSION

THIS impression does not in any way pretend to be a new edition ; but the circumstance that a reprinting was rendered necessary has been taken advantage of to correct some errors in the first edition and also to make some additions. The opportunity has also been taken to bring up to date certain sections wherein fundamental advances in knowledge have rendered the original text misleading, such as, for example, in the sections dealing with ocular pigment and the neurogenic origin of pigmented tumours, the biochemistry of the eye, the nature of the intra-ocular fluids, the physico-chemistry of the vitreous body, the chemical and electrical reactions in the retina, and so on.

STEWART DUKE-ELDER.

PUBLISHER'S NOTE

This reprint was produced in the absence of the Author, owing to military service, to whom it was not possible to refer or submit any proofs.

ERRATA

Page 208 Caption to Fig. 276: 1. Zonule of Zinn to read 1. Annulus of Zinn.
7. Corrugator Supercilii to read 4. Corrugator Supercilli.

Page 275, line 12 The word "pila" to read "pial."

Page 282 Caption to Fig. 346: Nucleus of Nerve (from IV Cunningham's etc.
to read Nucleus of Nerve IV (from Cunningham's etc.

PREFACE

ON more than one occasion it has seemed to me anomalous that no reference Text-book of Ophthalmology should exist in our literature, and it is in order to make such a work available that I have written this book. Moreover, the present time appears to me to be opportune to review the position, for ophthalmology seems to be passing from one stage into another. In past years the centre of interest of what may be called modern ophthalmology lay first in the harvest garnered by the ophthalmoscope, then in the intensive pursuit of minute pathology, and finally, turning from the pathology of the dead to that of the living, in the wealth of clinical facts made available by improved methods of examination which culminated in the slit-lamp. While it is absurd to suggest that these methods of inquiry have exhausted their resources, it must be admitted that there seems little prospect of further revolutionary advances by their aid: the ophthalmoscope has shown us most of its secrets, the microscope has pictured most of the mysteries to which histology can reach, and with the slit-lamp we have gained the highest magnifications which can usefully be employed clinically. No one can believe that scientific investigation is becoming exhausted; it is much truer to say that it has hardly yet entered into its kingdom, and the years which are to come will undoubtedly be immeasurably more fruitful than those which are past. A change of method is required. Hitherto we have been busied with the structural ruins which disease has left behind it; to-day the tendency is growing to probe more deeply and examine the more subtle nature of the initial defect, to pass from the study of structures composed of cells to the study of cells composed of atoms and molecules, to look beyond anatomy and pathology to biophysics and biochemistry. It is certainly true that the processes of life with all their intricacy and plasticity will never be adequately elucidated by the meagre physico-chemistry at our disposal; but it seems equally certain that along this path is to be found the most favourable avenue of approaching the innumerable problems which confront us with any hope of a pragmatic solution.

This first volume is entirely devoted to the fundamental sciences upon which alone a thorough understanding of clinical ophthalmology can rest,

and upon which any advances in the treatment of disease must be based. I have dealt with these subjects in some detail—more than is perhaps usual—partly because of their own intrinsic interest, partly because of their extreme importance to the clinician, and partly from the hope that, inasmuch as all aspects of our knowledge of the development, form and function of the visual apparatus have not recently been gathered together, this volume of the text-book may prove useful not only to the clinical ophthalmologist but also to those who are interested in the study of the special senses from the purely scientific point of view.

W. S. DUKE-ELDER.

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ACKNOWLEDGMENTS

IN writing a text-book of this kind, the essential aim of which is to present a survey of authoritative opinion on our subject, one is, of course, indebted in almost every line to the work of other writers. I have attempted to acknowledge this as fully as I could in the text and in the appended bibliographies. The use of illustrations brings an indebtedness of a more technical nature. A very large number of these are copied from other sources, and in each case the authorship is indicated. I will take this opportunity of thanking them collectively. Singling out the two into whose debt I have run most deeply, I would especially thank Professor Salzmann for his anatomical figures, and Miss I. C. Mann for her embryological figures. I am also indebted to the following publishers for their permission to reproduce a large number of illustrations, most of which have been modified :

- Franz Deuticke, Wien, for Figs. 47, 48, 54, 56, 72, 74-6, 78-80, 84-6, 109-11, 141-2, 148, 155, 187, 191 from Salzmann's *Anatomie u. Histologie d. mensch. Augapfels*.
 Julius Springer, Berlin, for Figs. 8, 9, 11, 12, 13, 14, 16, 19, 42-5, 113, 116-18, 120, 122, 128-30, 134-8, 168-79, 189-90, 196-7, 431-4, 503, 551, 553, 555, 561, 569, 587-8 from the *Graefe-Saemisch Handbuch*.
 The Ophthalmological Society of the United Kingdom for Figs. 188, 201-2, 204-13, 215-17, 402, 406-7, 409-11.
 The Optical Society for Figs. 181-4, 893, 897, 898, 903.
 The Controller of H.M. Stationery Office for Figs. 902, 1017, 1019.
 The Oxford Medical Publications for Figs. 222-3, 229, 252, 256, 259, 261, 277, 305, 321-3, 342 from Whitnall's *Anatomy of the Human Orbit*; and Figs. 264, 345-7, 359 from Cunningham's *Text-book of Anatomy*.
 William Heinemann (Medical Books) Ltd. for Figs. 245, 251, 253, 298-301 from Bland-Sutton's *Selected Lectures and Essays*.
 J. and A. Churchill for Figs. 324, 325, 326, 348-357.
 The Cambridge University Press for Figs. 442 and 454 from Bateson's *Mendel's Principles of Heredity*; and 627-8 from Jeans' *Mysterious Universe*.
 Oliver and Boyd for Figs. 437-41 from Hogben's *Pigmentary Effector System*.
 The British Journal of Ophthalmology for Figs. 98, 570-1, 573-6, and from I. C. Mann's *Development of the Human Eye*, Figs. 378-9, 393, 405, 408, 423-4, 429-30, 435.
 The Journal of the Optical Society of America for Figs. 557-9.
 The Archives of Ophthalmology for Figs. 856, 977, 979.
 The Journal of General Physiology for Figs. 915, 929, 944-5, 951.
 The Journal of Physiology for Figs. 957-8.
 Psychological Monographs for Figs. 912, 916-18, 920-1.
 Pflügers Archiv für d. gesamte Physiologie for Figs. 931, 947, 952-4, 1018.
 Zeitschrift für Psychologie und Physiologie des Sinnesorgane for Figs. 868, 892, 926.
 Zeitschrift für Augenheilkunde for Figs. 199, 200.
 Zeitschrift für Sinnesphysiologie for Figs. 948-9.
 Zeitschrift für Biologie for Fig. 946.

By availing myself of the help of my senior colleague, Mr. R. R. James, in reading the proofs of this volume, I have increased an already deep indebtedness to the kindest and ablest of critics.

Finally, my publishers, Henry Kimpton, and especially their representative, Mr. Deed, have invariably extended towards me a courteous consideration which has relieved me of many anxieties and has in numberless ways made my share in the production of this book a pleasure.

W. S. DUKE-ELDER.

TABLE OF ABBREVIATIONS

IN order to save space in the references to the literature the titles of text-books and journals are abbreviated more than is customary. The following are the abbreviations used in some of the commoner journals quoted, and in those which may give rise to difficulty. In the bibliographies the Roman numeral indicates the volume, the Arabic numeral the page, which is followed by the date. When necessary the number of an edition is indicated by capital Roman italics, and the number of a part or Hefte by an Arabic numeral in brackets.

<i>A. d'anat. mic.</i>	Archives d'anatomie microscopique, Paris.
<i>A. f. Anat. Phys.</i>	[Meckel's (1826-32); J. Müller's (1834-58); Reichert and du Bois Reymond's (1859-76)] Archiv für Anatomie und Physiologie (1877—). Leipzig.
The Abteilung (Anat. or Phys.) not indicated is bracketed.	
<i>A. f. Aug.</i>	(Knapp und Schweiggers) Archiv für Augenheilkunde. Wiesbaden.
<i>A. f. Aug. Ohrenh.</i>	Archiv für Augen- und Ohrenheilkunde. Karlsruhe, Wiesbaden. (After 1878 continued as <i>A. f. Aug.</i>)
<i>A. de biol.</i>	Archives de biologie. Paris.
<i>A. Derm. Syph.</i>	Archives of Dermatology and Syphilis. Chicago.
<i>A. f. Derm. Syph.</i>	Archiv für Dermatologie und Syphilis. Wien, Leipzig.
<i>A. f. Entw.</i>	Arch. für Entwicklungsmechanik des Organismen. Leipzig.
<i>A. f. exp. Path.</i>	Archiv für experimentelle Pathologie und Pharmakologie. Leipzig.
<i>A. farmacol. speriment.</i>	Archivio di farmacologia sperimentale e scienze affini. Roma.
<i>A. di fisiol.</i>	Archivio di fisiologia. Firenze.
<i>A. f. Gynäk.</i>	Archiv für Gynäkologie. Berlin.
<i>A. Int. Med.</i>	Archives of Internal Medicine. Chicago.
<i>A. It. Biol.</i>	Archives italiennes de biologie. Pise.
<i>A. It. Otol. Rinol.</i>	Archivio italiano di otologia, rinologia e laringologia. Torino, Palermo.
<i>A. f. Kinderh.</i>	Archiv. für Kinderheilkunde. Stuttgart.
<i>A. f. Lary. Rhin.</i>	Archiv für Laryngologie und Rhinologie. Berlin.
<i>A. f. mik. Anat.</i>	(Schultzes) Archiv für mikroskopische Anatomie. Bonn.
<i>A. néer. Phys.</i>	Archives néerlandaises de physiologie de l'homme et des animaux. 's-Gravenhage.
<i>A. Neur. Psych.</i>	Archives of Neurology and Psychiatry. Chicago.
<i>A. d'O.</i>	Archives d'Ophtalmologie. Paris.
<i>A. f. O.</i>	(Albrecht v. Graefes) Archiv für Ophthalmologie. Leipzig, Berlin.
<i>A. of O.</i>	(Knapp's) Archives of Ophthalmology, 1868-1929, New York; 1929—Chicago.
(Originally, Arch. of Ophthalmology and Otology.)	
<i>A. de Oft. (B.-A.)</i>	Archivos de oftalmologia de Buenos Aires. Buenos
<i>A. de Oft. (H.-A.)</i>	Archivos de oftalmologia, hispano-americanos. Madrid.
<i>A. f. Ohr.-Heilk.</i>	Archiv für Ohren-, Nasen- und Kehlkopf- heilkunde. Leipzig.
<i>A. di Ott.</i>	Archivio di Ottalmologia. Napoli.
<i>A. path. Anat.</i>	(Virchows) Archiv für pathologische Anatomie und Physiologie und für klinische Medizin. Berlin.
<i>A. Phil. Psy. and Sc. Meth.</i>	Archives of Philosophy, Psychology and Scientific Methods. New York.
<i>A. de Phys.</i>	Archives de physiologie normal et pathologique. (1868-99.) Paris. See <i>J. de Phys.</i>
<i>A. d. Phys.</i>	Deutsches Archiv für die Physiologie. Halle. (1796-1823.) (Continued as <i>A. f. Anat. Phys.</i>)

<i>A. f. phys. Heilk.</i>	Archiv für physiologische Heilkunde. Stuttgart, Wien. (Continued as Archiv der Heilkunde, Leipzig.)
<i>A. g. Phys.</i>	(Pfluegers) Archiv für die gesamte Physiologie des Menschen und der Tiere. Bonn.
<i>A. physiq. biol.</i>	Archives de physique biologique. Paris.
<i>A. f. Protist.</i>	Archiv für Protistenkunde. Jena.
<i>A. g. Psy.</i>	Archiv für die gesamte Psychologie. Leipzig.
<i>A. f. Psych.</i>	Archiv für Psychiatrie und Nervenkrankheiten. Berlin.
<i>A. f. Rass. Ges. Biol.</i>	Archiv für Rassen- und Gesellschaftsbiologie einschl. Rassen- und Gesellschaftshygiene. Leipzig, Berlin.
<i>A. di scienze biol.</i>	Archivo di scienze biologiche. Napoli.
<i>A. per le Sc. med.</i>	Archivio per le scienze mediche. Torino.
<i>A. vgl. O.</i>	Archiv für vergleichende Ophthalmologie. Leipzig.
<i>A. wis. pr. Tierh.</i>	Archiv. für wissenschaftliche und praktische Tierheilkunde. Berlin.
<i>Ac., Academy, Académie.</i>	
<i>Acta med. Scand.</i>	Acta medica Scandinavica. Stockholm.
<i>Acta O.</i>	Acta Ophthalmologica. Copenhagen.
<i>Acta Otolary.</i>	Acta Oto-laryngologica. Stockholm.
<i>Ak., Akademie.</i>	
<i>Am. J. Anat.</i>	American Journal of Anatomy. Baltimore.
<i>Am. J. Med. Sc.</i>	American Journal of the Medical Sciences. Philadelphia.
<i>Am. J. O.</i>	American Journal of Ophthalmology. St. Louis.
<i>Am. J. Phys.</i>	American Journal of Physiology. Boston.
<i>Am. J. Phys. Opt.</i>	American Journal of Physiological Optics, American Optical Co.
<i>Am. J. Physic. Anthro.</i>	American Journal of Physical Anthropology. Washington.
<i>Am. J. Sc.</i>	American Journal of Science and Arts. After 1820 continued as the American Journal of Science. New Haven.
<i>An. Inst. Past.</i>	Annales de l'Institut Pasteur. Paris.
<i>An. méd.</i>	Annales de médecine. Paris.
<i>An. of O.</i>	Annals of Ophthalmology. St. Louis.
<i>An. d'Oc.</i>	Annales d'Oculistique. (Originally Annales d'oculistique et de gynécologie, 1838-1839.) Paris
<i>An. de Oft.</i>	Anales de oftalmología. Mexico.
<i>An. di Ott.</i>	Annali di Ottalmologia e Clinica Oculistica. Roma.
<i>An. d. Physik</i>	(Gilbert's, 1799-1824; Poggendorff's, 1824-77; Wiedeman's, 1877-99) Annalen der Physik und Chemie. Continued as Annalen der Physik. Leipzig.
<i>Anat. Anz.</i>	Anatomischer Anzeiger. Jena.
<i>Anat. Hefte.</i>	Anatomische Hefte. Beiträge und Referate zur Anatomie und Entwicklungsgeschichte. Wiesbaden. (Continued as <i>Z. g. Anat.</i> , Abt. 3.)
<i>Anat. Rec.</i>	Anatomical Record. Philadelphia.
<i>Année O.</i>	Année ophtalmologique. Paris.
<i>Année psy.</i>	L'Année psychologique. Paris.
<i>Anthropologie</i>	L'Anthropologie. Paris.
<i>Arb., Arbeit.</i>	
<i>Astrophys. J.</i>	Astrophysical Journal. Chicago and New York.
<i>At., Atti, as—At. R. Ac. Lincei</i>	Atti della R. Accademia dei Lincei. Rendiconti.
<i>Athen.</i>	Athenæum. London.
<i>B. J. Exp. Path.</i>	British Journal of Experimental Pathology. London.
<i>B. J. O.</i>	British Journal of Ophthalmology. London.
<i>B. J. Surg.</i>	British Journal of Surgery. Bristol.
<i>B. Med. J.</i>	British Medical Journal. London.
<i>Beil., Beilageheft.</i>	
<i>Beit., Beiträge, as—Beit. path. Anat.,</i>	Beiträge zur pathologischen Anatomie und zur allgemeine Pathologie. Jena.
<i>Beit. z. Aug., (Deutschmanns)</i>	Beiträge zur Augenheilkunde. Hamburg, Leipzig.
<i>Ber., Bericht.</i>	
<i>Ber. k. W.</i>	Berliner klinische Wochenschrift. Berlin.
<i>Bib. Anat.</i>	Bibliographie anatomique. Paris, Nancy.
<i>Bib. britan.</i>	Bibliothèque britannique (1733-47). La Haye. Continued as Journal britannique (1750-7); then as Bibliothèque britannique (1796-1815), and Bibliothèque universelle (1816—). Genève.

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<i>Bioch. e terap. sperim.</i>	Biochimica e terapia sperimentale. Milano.
<i>Bioch. J.</i>	Biochemical Journal. 1906-1913. Liverpool. 1913— Cambridge.
<i>Bioch. Z.</i>	Biochemische Zeitschrift. Berlin.
<i>Biol. Zb.</i>	Biologisches Zentralblatt. Leipzig.
<i>Biomet.</i>	Biometrika. Cambridge.
<i>Boll. di Oc.</i>	Bollettino di oculistica. Firenze.
<i>Brain</i>	Brain: a Journal of Neurology. London.
<i>Brat. Lek. Lis.</i>	Bratislavské lekárske listy. Bratislava.
<i>Bull. Ac. méd.</i>	Bulletin de l'Académie de médecine. Paris.
<i>Bull. Bur. Stand.</i>	Bulletin of the Bureau of Standards. Washington.
<i>Bull. méd.</i>	Bulletin médical. Paris.
<i>Bull. Nat. Res. Coun.</i>	Bulletin of the National Research Council. Washington.
<i>Bull. d'Oc.</i>	Bulletin d'oculistique. Toulouse.
<i>Bull. S. méd. Hôp.</i>	Bulletins et mémoires de la Société médicale des hôpitaux de Paris. Paris.
<i>Bull. S. O. Paris</i>	Bulletin de la Société d'ophtalmologie de Paris. Paris.
<i>Bull. S. franç. d'O.</i>	Bulletins et mémoires de la Société française d'ophtalmologie. Paris.
<i>C. R. Ac. Sc.</i>	Comptes rendus hebdomadaires des séances de l'Académie des sciences. Paris.
<i>C. R. S. Biol.</i>	Comptes rendus hebdomadaires des séances et mémoires de la Société de biologie. Paris.
<i>Cas. Lek. Cesk.</i>	Časopis Lékařův Českých. v. Praze.
<i>Cellule</i>	Cellule. Liège.
<i>Cl. oc.</i>	Clinica oculistica. Palermo.
<i>Cong., Congress.</i>	
<i>Contrib. Embry.</i>	Contributions to Embryology. (Publications of Carnegie Institution.) Washington.
<i>Cron. O.</i>	La Crónica oftalmológica. Cádiz.
<i>D. A. k. Med.</i>	Deutsche Archiv für klinische Medizin. Leipzig.
<i>D. med. W.</i>	Deutsche medizinische Wochenschrift. Leipzig.
<i>D. tier. W.</i>	Deutsche tierärztliche Wochenschrift. Hannover.
<i>D. Z. f. Nervh.</i>	Deutsche Zeitschrift für Nervenheilkunde. Leipzig.
<i>Diss.</i>	Inaug. Dissertation.
<i>E., Ergebnisse, as—E. alg. Path.,</i>	Ergebnisse der allgemeinen Pathologie und pathologischen Anatomie des Menschen und der Tiere. Wiesbaden, München.
<i>E. de Phys.,</i>	Ergebnisse der Physiologie. Wiesbaden.
<i>Ed. Med. J.</i>	Edinburgh Medical Journal. Edinburgh.
<i>Elect. World</i>	Electrical World and Electrical Engineer. New York.
<i>Elektrotech.</i>	Elektrotechniker. Wien.
<i>Elettrotec.</i>	Elettrotecnica. Milano.
<i>Enceph.</i>	Encéphale. Journal de psychiatrie. Paris.
<i>Erg.,</i>	Ergänzungsbände.
<i>Eug. Lab. Mem.</i>	Eugenics Laboratory Memoirs. Francis Galton Laboratory, London.
<i>Fest.,</i>	Festschrift.
<i>Fol. Neur.</i>	Folia neuro-biologica. Leipzig.
<i>G.,</i>	Gesellschaft (see <i>Heidel. G.</i>).
<i>Gaz. d'O.</i>	Gazette d'ophtalmologie. Paris.
<i>Gen. tij. Ned.</i>	Geneeskundig tijdschrift voor Nederlandsch-Indië. Batavia.
<i>Gior. Ac. Med. Torino</i>	Giornale della R. Accademia di medicina di Torino. Torino.
<i>Gior. d'O. It.</i>	Giornale d'oftalmologia italiana. Torino.
<i>G-S. Hb.</i>	Graefe-Saemisch Handbuch der gesamten Augenheilkunde. Leipzig, Berlin.
<i>Hb.,</i>	Handbook, Handbuch: as— <i>Hb. norm. path. Phys.</i> Handbuch der normalen und patho- logischen Physiologie mit Berücksichtigung der experimentellen Pharmakologie. Berlin.
<i>Hb. path. Anat.</i>	Handbuch der speciellen pathologischen Anatomie und Histologie. Berlin.
<i>Heart</i>	Heart. London.
<i>Heidel. G.</i>	Bericht über die—Zusammenkunft der deutschen ophthalmo- logischen Gesellschaft in Heidelberg. München.
<i>Hosp. tid.</i>	Hospitalstidende. Copenhagen.
<i>Hygiea.</i>	Hygiea. Stockholm.

<i>Illum. Eng.</i>	•	•	Illuminating Engineer (London).
<i>Illum. Eng. N.Y.</i>	•	•	Illuminating Engineer (New York).
<i>Inst.</i> , Institute.			
<i>Inter. M. f. Anat. Phys.</i>	•	•	Internationale Monatsschrift für Anatomie und Physiologie. Leipzig.
<i>J. Am. Chem. S.</i>	•	•	Journal of the American Chemical Society. Easton, Pa.
<i>J. Am. Med. As.</i>	•	•	Journal of the American Medical Association. Chicago.
<i>J. Anat.</i>	•	•	Journal of Anatomy (and Physiology). London.
<i>J. d'Anat. Phys.</i>	•	•	Journal d'anatomie et de la physiologie normales et pathologiques de l'homme et des animaux. Paris.
<i>Jb.</i> , Jahresbericht.			
<i>J. Bact.</i>	•	•	Journal of Bacteriology. Baltimore.
<i>J. Biol. Chem.</i>	•	•	Journal of Biological Chemistry. Baltimore.
<i>J. Chem. S.</i>	•	•	Journal of the Chemical Society. London.
<i>J. Chir. Aug.</i>	•	•	Journal der Chirurgie und Augen-Heilkunde. Berlin.
<i>J. Comp. Neur.</i>	•	•	Journal of Comparative Neurology (and Psychology). Philadelphia.
<i>J. Exp. Med.</i>	•	•	Journal of Experimental Medicine. New York.
<i>J. Exp. Zoo.</i>	•	•	Journal of Experimental Zoology. Philadelphia.
<i>J. Frank. Inst.</i>	•	•	Journal of the Franklin Institute. Philadelphia.
<i>J. Gen. Phys.</i>	•	•	Journal of General Physiology. Baltimore.
<i>J. Genet.</i>	•	•	Journal of Genetics. Cambridge.
<i>J. Hered.</i>	•	•	Journal of Heredity. Washington.
<i>J. Inf. Dis.</i>	•	•	Journal of Infectious Diseases. Chicago.
<i>J. Med. Res.</i>	•	•	Journal of Medical Research. Boston.
	(Originally	J. of the Boston Soc. of Medical Sciences.)	
<i>J. Morph.</i>	•	•	Journal of Morphology. Boston.
<i>J. Nerv. Ment. Dis.</i>	•	•	Journal of Nervous and Mental Diseases. New York.
<i>J. Neur. Psychopath.</i>	•	•	Journal of Neurology and Psychopathology. London.
<i>J. O. Ot. Lary.</i>	•	•	Journal of Ophthalmology, Otology and Laryngology. New York.
<i>J. Path.</i>	•	•	Journal of Pathology and Bacteriology. Edinburgh.
<i>J. Pharm.</i>	•	•	Journal of Pharmacology and Experimental Therapeutics. Baltimore.
<i>J. Phys.</i>	•	•	Journal of Physiology. London and Cambridge.
<i>J. de Phys.</i>	•	•	(Brown-Sequard's) Journal de la physiologie de l'homme et des animaux (1858-68). Continued as <i>A. de Phys.</i> , (1868-99); and then Journal de physiologie et de pathologie générale (1899-). Paris.
<i>J. Physic. Chem.</i>	•	•	Journal of Physical Chemistry. Ithaca, New York.
<i>J. f. Psy. Neur.</i>	•	•	Journal für Psychologie und Neurologie. Leipzig.
<i>J. R. Mic. S.</i>	•	•	Journal of the Royal Microscopical Society. London.
<i>K. M. Aug.</i>	•	•	(Zehenders) Klinische Monatsblätter für Augenheilkunde. Stuttgart.
<i>K. W.</i>	•	•	Klinische Wochenschrift. Berlin.
<i>Kl.</i> , Klasse.			
<i>Kolloidz.</i>	•	•	Kolloidzeitschrift. Dresden.
<i>La. cl. O.</i>	•	•	La clinique ophtalmologique. Paris.
<i>Lancet</i>	•	•	The Lancet. London.
<i>Lb.</i> , Lehrbuch			
<i>Let. O.</i>	•	•	Lettura oftalmologica. Pistoia.
<i>Lij. V es</i>	•	•	Liječnički Vijesnik. u Zagrebu.
<i>M. f. Ohr. Lar.-Rh.</i>	•	•	Monatsschrift für Ohrenheilkunde u. Laryngo-Rhinologie. Berlin, Wien.
<i>Med. K.</i>	•	•	Medizinische Klinik. Wien.
<i>Med. Res. Council Rep.</i>	•	•	Medical Research Council. Special Report Series. H.M. Stationery Office, London.
<i>Mind</i>	•	•	Mind. London.
<i>Mit.</i> , Mitteilung.			
<i>Mon. Psych. Neur.</i>	•	•	Monatsschrift für Psychiatrie und Neurologie. Berlin.
<i>Mon. Zoo. It.</i>	•	•	Monitore zoologico italiano. Firenze.
<i>Monist</i>	•	•	Monist. A quarterly magazine devoted to the philosophy of science. Chicago.
<i>Munch. med. W.</i>	•	•	Münchener medizinische Wochenschrift. München.

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<i>N. Y. J. Med.</i>		New York State Journal of Medicine. New York.
<i>Nature</i>		Nature. London.
<i>Naturw. W.</i>		Naturwissenschaftliche Wochenschrift. Jena.
<i>Ned. Lancet</i>		Nederlandsch Lancet. Utrecht.
<i>Ned. tij. Gen.</i>		Nederlandsch tijdschrift voor geneeskunde. Amsterdam.
<i>Neur. Zb.</i>		Zentralblatt für die gesamte Neurologie und Psychiatrie. Berlin.
<i>Nord. Med. Ark.</i>		Nordiskt medicinskt Arkiv. Stockholm. [Continued as <i>Acta med.</i> (or <i>chir.</i>) <i>Skand.</i>]
<i>Nord. O. Tid.</i>		Nordisk ophthalmologisk Tidsskrift. Copenhagen.
<i>Nors. Mag. Laeg.</i>		Norsk Magazin for Lægevidenskaben. Kristiania.
<i>O. Kl.</i>		Die ophthalmologische Klinik. Stuttgart.
<i>O. Rec.</i>		The Ophthalmic Record. Chicago.
<i>O. Rev.</i>		The Ophthalmic Review. London.
<i>Ophthalmologica</i>		Ophthalmologica. Torino.
<i>Ophthalmologist</i>		The Ophthalmologist. Chicago.
<i>Ophthalmology</i>		Ophthalmology. Milwaukee, Seattle.
<i>Ophthalmoscope</i>		The Ophthalmoscope. London.
<i>P. Am. Ac. Arts. Sc.</i>		Proceedings of the American Academy of Arts and Science. Boston.
<i>P. Am. Phil. S.</i>		Proceedings of the American Philosophical Society. Philadelphia.
<i>P. Nat. Ac.</i>		Proceedings of the National Academy of Sciences. Washington.
<i>P. R. S.</i>		Proceedings of the Royal Society (Series A and B). London.
<i>P. R. S. Med.</i>		Proceedings of the Royal Society of Medicine. London.
<i>P. S. Exp. Biol. Med.</i>		Proceedings of the Society for Experimental Biology and Medicine. New York.
<i>Phil. Mag.</i>		The Philosophical Magazine (1798-1832). London.
Continued as the London and Edinburgh Philosophical Magazine and Journal of Science (1832-40); and then as the London, Edinburgh and Dublin Philosophical Magazine and Journal of Science.		
<i>Phil. T.</i>		Philosophical Transactions of the Royal Society. London.
<i>Phys., Physiology.</i>	<i>Physic., Physical.</i>	
<i>Phys. Rev.</i>		Physiological Reviews. Baltimore.
<i>Physic. Rev.</i>		Physical Review. Ithaca, New York; Lancaster, Pa.
<i>Presse méd.</i>		Presse médicale. Paris.
<i>Psy., Psychology.</i>	<i>Psych., Psychiatry.</i>	
<i>Psy. Bull.</i>		Psychological Bulletin. Lancaster, Pa.
<i>Psy. Monog.</i>		Psychological Monographs. Lancaster, Pa.
<i>Psy. Rev.</i>		The Psychological Review. Lancaster, Pa.
<i>Psy. Stud.</i>		(Wundt's) Psychologische Studien. Leipzig.
<i>Q. J. Exp. Phys.</i>		Quarterly Journal of Experimental Physiology. London.
<i>Q. J. Med.</i>		Quarterly Journal of Medicine. Oxford.
<i>Q. J. Mic. Sc.</i>		Quarterly Journal of Microscopical Science. London.
<i>R. L. O. H. Rep.</i>		Royal London Ophthalmic Hospital Reports. London.
<i>Rec. d'O.</i>		Recueil d'ophtalmologie. Paris.
<i>Rep. B. As.</i>		Report of the British Association for the Advancement of Science. London.
<i>Rev. cub. O.</i>		Revista cubana de oftalmologia. Habana.
<i>Rev. gén. d'hist.</i>		Revue générale d'histologie. Paris.
<i>Rev. gén. d'O.</i>		Revue générale d'ophtalmologie. Genève.
<i>Rev. méd. Suisse</i>		Revue médicale de la Suisse romande. Genève.
<i>Rev. d'O.</i>		Revue d'ophtalmologie. Marseille.
<i>Rev. oto.-neur.-oc.</i>		Revue d'oto-neuro-oculistique. Paris.
<i>Rif. Med.</i>		Riforma medica. Napoli.
<i>Riv. oto-neur.-oft.</i>		Rivista oto-neuro-oftalmologica. Roma.
<i>Russ. O. Z.</i>		Russkij oftalmologičeskij žurnal.
<i>S., Society.</i>	<i>Sc., Science.</i>	<i>Sch., School.</i>
<i>Schw. A. Neur.</i>		Schweizerische medizinische Wochenschrift. Basel.
<i>Semana Méd.</i>		Semana Médica. Buenos Aires.
<i>Sitz., Sitzungsberichte; as—Sitz. Ak. Wiss. Wien, Sitzungsberichte der Kais. Akademie der Wissenschaften in Wien.</i>		

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<i>Sitz. Preus. Ak. Wiss.</i> , Sitzungsberichte der Kgl. Preussischen Akademie der Wissenschaften zu Berlin.	
<i>Sk. A. Phys.</i>	Skandinavisches Archiv für Physiologie. Leipzig.
<i>Sperm.</i>	Sperimentale. Archivio di biologia normale e patologica. Firenze.
<i>Sv. Läk. Förh.</i>	Svenska Läkaresällskapets Förhandlingar. Stockholm.
<i>T. Am. O. S.</i>	Transactions of the American Ophthalmological Society. New York.
<i>T. Ill. Eng. S.</i>	Transactions of the Illuminating Engineering Society. New York.
<i>T. O. S.</i>	Transactions of the Ophthalmological Society of the United Kingdom. London.
<i>T. Opt. S.</i>	Transactions of the Optical Society. London.
<i>Trab.</i> , Trabajos, as <i>Trab. Lab. biol. Mad.</i> , Trabajos del Laboratorio de investigaciones biológicas de la Universidad de Madrid.	
<i>Unters.</i> , Untersuchungen.	
<i>Ups. Läk. Förh.</i>	Uppsala Läkaresällskapets Förhandlingar. Uppsala.
<i>vgl.</i> , vergleichende.	
<i>Wien. k. W.</i>	Wiener klinische Wochenschrift. Wien.
<i>Wien. med. W.</i>	Wiener medizinische Wochenschrift. Wien.
<i>Yb.</i> , Yearbook.	
<i>Z. allg. Phys.</i>	Zeitschrift für allgemeine Physiologie. Jena.
<i>Z. anorg. Chem.</i>	Zeitschrift für anorganische und allgemeine Chemie. Hamburg und Leipzig.
<i>Z. g. Anat.</i>	Zeitschrift für die gesamte Anatomie. Abt. 1 (<i>Z. Anat. Entw.</i>) Zeitschrift für Anatomie und Entwicklungsgeschichte. Berlin.
<i>Z. f. Aug.</i>	Zeitschrift für Augenheilkunde. Berlin.
<i>Z. f. Biol.</i>	Zeitschrift für Biologie. München und Berlin.
<i>Z. Elektrochem.</i>	Zeitschrift für Elektrochemie und angewandte physikalische Chemie. Halle.
<i>Z. f. Ethnol.</i>	Zeitschrift für Ethnologie. Berlin.
<i>Z. exp. Med.</i>	Zeitschrift für die gesamte experimentelle Medizin. Berlin.
<i>Z. f. Hyg.</i>	Zeitschrift für Hygiene und Infektionskrankheiten. Leipzig.
<i>Z. f. Immun.</i>	Zeitschrift für Immunitätsforschung und experimentelle Therapie. Jena.
<i>Z. ind. Abs. u. Vererb.</i>	Zeitschrift für induktive Abstammungs- und Vererbungslehre. Berlin.
<i>Z. f. Infekt.</i>	Zeitschrift für Infektionskrankheiten, parasitäre Krankheiten und Hygiene der Haustiere. Berlin.
<i>Z. Instrum.</i>	Zeitschrift für Instrumentenkunde. Berlin.
<i>Z. f. k. Med.</i>	Zeitschrift für klinische Medizin. Berlin.
<i>Z. f. Lary.</i>	Zeitschrift für Laryngologie, Rhinologie, und ihre Grenzgebiete. Würzburg.
<i>Z. f. Morph.</i>	Zeitschrift für Morphologie und Anthropologie. Stuttgart.
<i>Z. f. Naturw.</i>	Zeitschrift für Naturwissenschaften. Leipzig.
<i>Z. g. Neur. Psych.</i>	Zeitschrift für die gesamte Neurologie und Psychiatrie. Berlin.
<i>Z. f. O.</i>	(von Ammons) Zeitschrift für die Ophthalmologie. Dresden, Heidelberg, Leipzig.
<i>Z. f. Ohrenh.</i>	Zeitschrift für Ohrenheilkunde. München.
<i>Z. f. O. Opt.</i>	Zeitschrift für ophthalmologische Optik m. Einschluss der Instrumentenkunde. Berlin.
<i>Z. f. phys. Chem.</i>	(Hoppe-Seylers) Zeitschrift für physiologische Chemie. Strassburg.
<i>Z. f. physik. Chem.</i>	Zeitschrift für physikalische Chemie, Stöchiometrie und Verwandtschaftslehre. Leipzig.
<i>Z. Psy. Phys. Sinnes.</i>	Zeitschrift für Psychologie und Physiologie des Sinnesorgane. Leipzig. After 1906 the two parts are referred to as <i>Z. f. Psy.</i> , and <i>Z. f. Sinnesphys.</i>
<i>Z. f. rat. Med.</i>	(Henle and Pfeufers) Zeitschrift für rationelle Medizin. Zürich, Heidelberg, and Leipzig

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<i>Z. f. Sinnesphys.</i>	.	.	See <i>Z. Psy. Phys. Sinnes.</i>
<i>Z. tech. Physik</i>	.	.	Zeitschrift für technische Physik. Leipzig.
<i>Z. vgl. Aug.</i>	.	.	Zeitschrift für vergleichende Augenheilkunde. Leipzig.
<i>Z. wiss. Zoo.</i>	.	.	Zeitschrift für wissenschaftliche Zoologie. Leipzig.
<i>Zb. alg. Path.</i>	.	.	Zentralblatt für die allgemeine Pathologie und pathologische Anatomie. Jena.
<i>Zb. g. O.</i>	.	.	Zentralblatt für die gesamte Ophthalmologie und ihre Grenzgebiete. Berlin.
<i>Zb. pr. Aug.</i>	.	.	(Hirschberg's) Zentralblatt für praktische Augenheilkunde. Leipzig.
<i>Ztg.</i> , Zeitung.			

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