Inspection of the pupil and its reactions is an essential part of the standard neurological examination, and every neurologist learns to recognize abnormalities of clinical significance: miosis or mydriasis, anisocoria, a diminished or sluggish response to light, the relative afferent pupil defect, redilatation lag and light–near dissociation. Most of these pupillary abnormalities have been recognized since the 19th century, some even before that, but our understanding of the mechanisms involved is more recent. It derives mainly from the painstaking research carried out on both animals and man by two German emigre scientists, Otto Lowenstein and Irene Loewenfeld. They established a pupil laboratory in New York in 1940, moving 8 years later to the Columbia-Presbyterian Medical Center. From this laboratory they published a large number of papers in journals of great prestige, attracting medical and other scientists from far and wide, and their influence today is such that almost all current pupil research derives from their work.

We learn in the opening section of this book, that when Otto Lowenstein died in 1965, they had already started the enormous task of assembling all their accumulated material, both basic and clinical, into book form. Irene Loewenfeld was left to continue this project alone, a task made all the more difficult because by training she was a physiologist, not a clinician, and she admits that she lacked the necessary clinical experience which she saw as necessary for the job in hand. But after years of intensive labour, the book emerged. It is a fitting monument to Lowenstein himself and to the work they did together.
The book is enormous. Volume 1 contains the written material set out in five parts: ‘Anatomy and physiology’, ‘Special fields’, ‘Methodology’, ‘Pupillary pathology: symptomatology’ and ‘Pupillary pathology: pupillary signs in various diseases’. This volume contains 1590 pages of text with a 52 page index, making it very heavy indeed and rather too cumbersome for convenience (at the next reprint we recommend Volume 1 is divided in half between parts two and three). Volume 2 is a more manageable size (just 633 pages). It contains an extensive bibliography (over 15 000 references, mostly annotated with the author’s comments) together with some attractive photographs of many of the prominent scientists involved, and an index (sensibly repeated to allow the reader to keep text and index open at the same time).

Volume 1 starts with a comprehensive review of the basic anatomy and physiology of the pupil. The reader is led through a fairly logical sequence of 11 chapters beginning with a description of iris anatomy, followed by chapters on the responses of the pupil to light, dark, near, eye movements and central processes. Each subject is introduced with a didactic summary sufficiently self-contained to be read in isolation. This is followed by a meticulous review of the literature, often summarized and categorized in tables extending over several pages, well illustrated with real data both from the author’s own work and from others. The history of each subject is painstakingly traced, with her personal assessment of the value of the various research contributions that have been made over the years up until the late 1980s. Her approach provides useful insight into the origins of many of our current concepts about the pupil, and in general she has achieved a happy balance between historical detail and ‘take-home message’. There is reasonable, although not perfect, correspondence between text references from Volume 1 and the publications cited in the Bibliography in Volume 2.

The first two chapters in the section called ‘Special fields in pupillary physiology’ deal with research applications of the pupil, which are interesting but have little or no relevance to clinical medicine. The first chapter describes the application of control theory to the pupil using engineering principles. Written by Lawrence Stark, it summarizes three decades of work (mostly done in his own laboratory) studying oscillations, noise, transfer function and non-linearities in the pupillary system. The language will be unfamiliar to most clinicians, but it offers a refreshing approach to the study of neurological systems and has since been applied in many other areas of the nervous system. The second chapter dips into more populist territory, describing how pupil measurements have been used in experimental psychology. Loewenfeld understandably disparages some of this work as ‘inane twaddle’, particularly those attempts to correlate changes in pupil size with a person’s interests or attitudes, but undoubtedly the pupil has afforded psychologists a sensitive technology for the objective study of conditioning and cognitive processes.

There are two areas in particular which we thought justify expansion. First, there is no account of the mathematical algorithms which have been developed over the last 20 years to model the pupil light reflex, enabling computer software to automate the process of measuring various parameters of the reflex response. Secondly, in contrast to the light reflex, little consideration is given to eliciting and evaluating the near response with any degree of precision. As a whole, this section of the book is authoritative and immensely enjoyable to browse through. It is unlikely to be of more than passing interest to the clinician, but should be on the obligatory reading list for any scientist when first joining a pupil research laboratory.

Part 4 is ‘Pupillary pathology: symptomatology’. The title of this section is curious, given that most pupil abnormalities are asymptomatic. The text in fact deals with all the main ‘types’ of pupil abnormality: afferent defects, midbrain syndromes, pre-ganglionic parasympathetic block, tonic pupils and Horner’s syndrome. Throughout this section, Loewenfeld is uncompromising in her insistence on the correct use of terminology; not all midbrain pupils are Argyll.
Robertson, and a tonic pupil is not always due to Adie’s syndrome. The result is a rigorous and incisive analysis of an often-muddled literature. Her accounts of the Argyll Robertson pupil and of Adie’s syndrome are particularly outstanding, shedding much-needed light on these often misunderstood entities.

The section starts with a short chapter on iris damage; most of this material is very familiar to ophthalmologists and better covered in ophthalmic textbooks, but it serves its purpose in reminding the reader to look for local causes of a pupil abnormality before ascribing a neurological mechanism. The next chapter deals with afferent defects, starting logically with a discussion of whether the visual afferent and the pupil afferent signals are conveyed by separate fibres, then describing the pupil abnormalities associated with prechiasmal, chiasmal, optic tract and supra-geniculate lesions. The debate about the influence of striate visual cortex on the pupil–light reflex is briefly introduced, although more detailed analysis would have been welcome in this controversial area. There follow four chapters on the pupil changes associated with lesions in the midbrain. The scholarly essay on Argyll Robertson pupil has already been mentioned, and the other chapters reinforce the point that any pattern of light and near responsiveness in the face of normal vision is possible, depending on the site of the lesion.

The next three chapters are concerned with pre- and post-ganglionic lesions of the parasympathetic supply to the iris sphincter muscle. These include an important discussion of the interpretation of a large, unreactive pupil, including pharmacological and other tests that can be used to investigate the differential diagnoses. The tonic pupil has long been of particular interest to Loewenfeld, and she dispels many myths as well as uncovering a few gems in her historical review. There is not enough discussion of the many other neurological conditions associated with tonic pupils, but her description of Adie’s syndrome itself is masterly. Horner’s syndrome is a common and important sign in clinical neurology, and a lengthy chapter is devoted to its detection, evaluation and interpretation. The final chapters deal with rare and miscellaneous abnormalities, the mechanisms for which are often poorly understood, including a charming account of iridology.

‘Pupillary pathology: pupillary signs in various diseases’ is the final section, covering over 300 pages. It is devoted to descriptions of diseases with which pupil abnormality is associated. There is a chapter on syphilis, impeccable and fascinating for its history, and a subsequent one that deals with encephalitis, meningitis, zoster, sarcoid, toxin-producing bacterial infections and also regional infections of sinuses, the orbit and the ear. There follow chapters on metabolic conditions including thyroid disorder and diabetes, on degenerative disorders, multiple sclerosis, dysautonomias, peripheral neuropathies, tumours, trauma, vascular disturbances and psychiatric illness. There is a final chapter on terminal events, including an interesting description of pupil changes during Cheyne–Stokes respiration. In all these chapters, the author describes very clearly many of the abnormalities that have been reported, and quotes at some length from the enormous literature on these subjects. Many of the conditions which she describes are rare except in highly specialized referral centres, and an outline description of these is perhaps adequate for most purposes. By contrast, however, we find her exposition of the changes in diabetes somewhat perfunctory, considering its prevalence in many parts of the world. In general, the evidence quoted is anecdotal, and the clinician may be disappointed that no attempt has been made to estimate the prevalence of pupil abnormalities in particular conditions, or the diagnostic value of ascertaining the presence or absence of pupil signs. Throughout this section we found it necessary to supplement the information by referring back to the previous section where there is more detailed discussion of mechanisms underlying pupil phenomenology.

As a comprehensive historical document this book will never be surpassed. It is a pleasure to dip into and an inspiration to the next generation of clinicians and scientists curious about the pupil. As such it should be on the library shelf of everyone involved in pupil research. However, it is not a book for the practising clinical neurologist, except as a reference text to be consulted when faced with an inexplicable pupil anomaly.

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