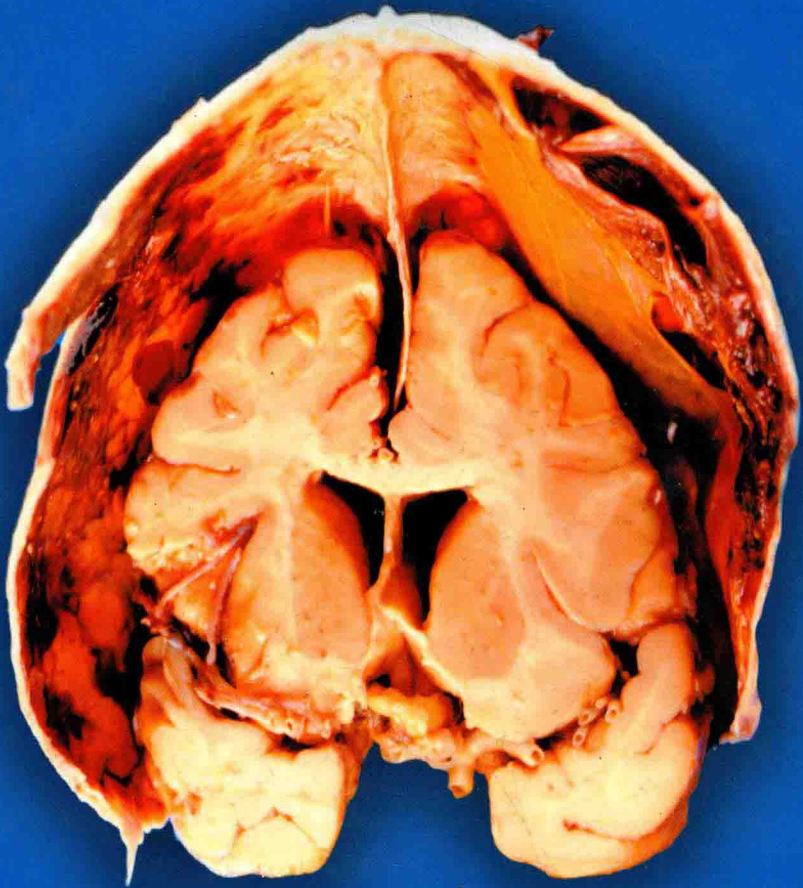


FORENSIC NEUROPATHOLOGY

S E C O N D E D I T I O N



JAN E. LEESTMA, M.D., M.M.



CRC Press
Taylor & Francis Group

FORENSIC NEUROPATHOLOGY

SECOND EDITION

JAN E. LEESTMA, M.D., M.M.



CRC Press

Taylor & Francis Group

Boca Raton London New York

CRC Press is an imprint of the
Taylor & Francis Group, an **informa** business

CRC Press
Taylor & Francis Group
6000 Broken Sound Parkway NW, Suite 300
Boca Raton, FL 33487-2742

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CRC Press is an imprint of Taylor & Francis Group, an Informa business

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Printed in the United States of America on acid-free paper
10 9 8 7 6 5 4 3 2 1

International Standard Book Number-13: 978-0-8493-9167-5 (Hardcover)

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Library of Congress Cataloging-in-Publication Data

Forensic neuropathology / [edited by] Jan E. Leestma. -- 2nd ed.

p. ; cm.

"A CRC title."

Includes bibliographical references and index.

ISBN 978-0-8493-9167-5 (hardcover : alk. paper)

1. Forensic neurology. I. Leestma, Jan E.

[DNLN: 1. Forensic Pathology--methods. 2. Central Nervous System--pathology. 3. Craniocerebral Trauma--pathology. 4. Spinal Cord Injuries. W 700 F715025 2008]

RA1147.L44 2008

614'.1--dc22

2008022908

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<http://www.taylorandfrancis.com>

and the CRC Press Web site at
<http://www.crcpress.com>

Foreword

More than half a century ago a medical examiner office was created for Dade County (Miami, Florida), where no such facility had existed before. The first chief medical examiner was Dr. Stanley H. Durlacher, 13 years my senior. I was his assistant. I lacked the experience of Dr. Durlacher and considered him my mentor for the future.

After 1 year in office, Dr. Durlacher experienced a fatal rupture of an aneurysm of the Circle of Willis while attending the Chicago meeting of the American Academy of Forensic Sciences. I was placed in charge and had to develop forensic experience gained from personal scene investigations while working closely with well-experienced police homicide investigators, my autopsies, and courtroom cross-examinations. Illustrated forensic pathology texts were useful for initial learning but lacked detail and variations demonstrated by our case material.

Neurological problems, natural and violent in origin, were common in my forensic pathology practice. Not clearly diagnosed coma cases were accepted from hospitals because computed tomography (CT) and magnetic resonance imaging (MRI) were for the future. Ruptured aneurysms of cerebral arteries were frequent. Each case was carefully evaluated in terms of circumstances correlated with pathological findings—a constant learning experience.

Histological judgment of post-event healing time based upon literature and texts failed to help us consistently judge time estimates. References were inadequate. For example, timing of skin bruises based upon published articles failed to correlate with what we had determined as correct based upon careful investigation of circumstances. Two publications appeared that taught me lessons.

In 1957 Robertson published an article on the aging of skin contusions in the *Journal of Forensic Medicine* from South Africa. An illustration of a 5-day-old bruise appeared as fresh as a 5-minute bruise. Why? Not appreciated by his predecessors, or by those since who failed to heed what he observed, was the fact that neutrophilic response was not a response to blood but was in response to escape of intracellular content from damaged tissue cells, an inconsistent component of skin bruises.

Another example concerned evidence of neuronal hypoxia prior to death. Richard Lindenberg, former Luftwaffe neuropathologist and scientist brought to the United States following World War II who served many years as a forensic neuropathologist at the Baltimore Medical Examiner's Office, produced a military publication demonstrating that structural neuronal changes of hypoxia were dependent upon the duration of the agonal period. The more rapid the death, the more changes were apparent that reflect the fact that sudden death occurs while life's functions, including enzyme activities, are operating to the fullest. Sudden death favored more enzymatic autolysis. Over time many misconceptions of medical belief have come to my attention in the forensic pathology and toxicology literature.

Now is the time to address misconceptions in forensic neuropathology. The new edition of *Forensic Neuropathology* does so by including contributions from different disciplines. Kirk Thibault, PhD, a biomechanical engineer with extensive experience in application of physical laws to the study of physical trauma, adds to our understanding of craniocerebral injuries. Proper application of biomechanical principles is crucial to expert witness testimony. Conversely, improper distortion of physical laws needs recognition when such appears in literature or the court.

A pathologist is not expected to be a qualified biomechanical engineer but must accept the fact that injurious forces follow laws of physics. The pathologist must be aware of non-medical contributions made to our understanding of trauma. Ignorant is the pathologist who denigrates the application of biomechanical disciplines to the judging of craniocerebral trauma but accepts erroneous concepts outside the laws of physics. I have encountered forensic pathologists who have stated that only a medical doctor is entitled to express opinions of cause and effect of trauma—an illogical *ad hominem* argument.

Forensic in the title of the book clearly implies courts of law. Physicians must realize that the ultimate judges of their professionalism and opinions are not physicians but lawyers in courts of law and, through them, the public that supports legislatures. Legislators set the parameters of medical practice.

Elaine Whitfield Sharp, JD, an attorney with experience with legal issues of injury, clarifies for the reader the present legal principles that define expert witness testimony. The legal system in which we operate has developed a framework to judge the worth of expert opinion. However, that method involves the adversary system in which attorneys argue for their side of cause and effect. A forensic pathologist must understand the system and be prepared to present logical and correct justifications of opinions.

A major impetus for this creation of a totally new approach to forensic neuropathology is recent concepts associated with expansion of diagnostic criteria used by many physicians to include intent aspects of craniocerebral findings “nonaccidental” or “abusive head trauma.” Dr. Leestma has approached this subject in a logical fashion. His comments, augmented by those of Dr. Thibault and Ms. Sharp, develop this book into a new and refreshing approach to the interpretation of neuropathology. I regret it was not available to me more than half a century ago.

Joseph H. Davis, MD

Preface

Forensic pathology and neuropathology have much in common. Both fields are well recognized within the medical and legal professions; both are subspecialties recognized by the American Board of Pathology, which offers certification in them; and both fields demand similar attributes in their practitioners. These include the basic skills of the anatomic pathologist and morbid anatomist; a broad scientific, medical, and pathological knowledge; a firm background in the basic physical and medical sciences; highly developed analytical skills; and a constant desire to confront the unusual and the unknown and to search for answers to innumerable questions that arise every day in the course of their practices. Both fields make use of all other disciplines of medicine, the physical and life sciences, and yet, traditionally, comparatively few practitioners of either discipline have developed a close working relationship with practitioners of the other in order to share their expertise and further their efforts toward a common goal. In part this has been due to physical separation, with comparatively few forensic pathology units being associated, administratively or physically, with hospitals or medical schools; however, this is changing.

Over the past 30+ years, as both forensic pathology and neuropathology have grown in sophistication, the two specialties have had increasing interaction, and now many forensic pathologists also have neuropathology training and often board certification in neuropathology.

A particularly seminal interaction was begun by the late Dr. Russell S. Fisher, former chief medical examiner for the state of Maryland and former member of the American Board of Pathology. Dr. Fisher, in the mid-1950s, established the first formal laboratory of neuropathology associated with a medical examiner's office in the United States and retained the full-time services of an experienced neuropathologist, Dr. Richard Lindenberg, to serve in that laboratory. Dr. Lindenberg and his faithful collaborator to the end of his life, Ms. Ella Freytag, tirelessly offered the full range of neuropathological expertise to the Maryland State Medical Examiner's Office and influenced several generations of trainees in forensic pathology, general pathology, neuropathology, neurology, and neurosurgery through their popular evening show-and-tell sessions that were held regularly for several years in the unforgettable old City Morgue on the now-refurbished Baltimore waterfront and later in the modern medical examiner's building near the University of Maryland Medical Center. These exciting sessions drew visitors from all along the East Coast of the United States. They came to view an unparalleled array of fascinating case material, available virtually nowhere else. Those who attended these sessions and who were stimulated by Dr. Lindenberg have formed an ever-expanding cadre of individuals who have developed the interactions between forensic pathology and neuropathology wherever they have gone and influenced still other generations of pathologists and other specialists as to the richness of the case material to be found in the forensic neuropathological material.

Like any other field of science or medicine, change occurs constantly. While the autopsy rate in hospitals has declined, and with it expertise in autopsy pathology, the case load has increased for the forensic pathology services all across America. Natural and public

disasters have focused attention upon forensic pathologists and demonstrated how important this discipline is to the public welfare. DNA trace analysis technologies have changed the landscape of forensic pathology and the legal system, and many once-sacred forensic tools have been shown to be unreliable. The increasing sophistication of the legal community has increased demand for many areas of highly specialized knowledge and expertise, including neuropathology. Within forensic pathology and neuropathology, the discipline of injury biomechanics has evolved as a vital area of science to both, yet most recent forensic pathology texts make little mention or little use of the wealth of injury biomechanics information and its applications to forensics.

In the short period before the publication of this edition of *Forensic Neuropathology*, one measure of the increasing attention being paid to the forensic aspects of neuropathology has been the appearance of several new books dealing with forensic neuropathology. These include: Dolinak and Matshes, *Medicolegal Neuropathology: A Color Atlas* (CRC Press); Oehmichen et al., *Forensic Neuropathology and Neurology* (Springer); Whitwell, *Forensic Neuropathology* (Hodder Arnold); and Itabashi et al., *Forensic Neuropathology: A Practical Review of the Fundamentals* (Academic Press). Each brings a different perspective to the discipline. It is hoped that this new edition of *Forensic Neuropathology* will complement the growing literature and prove as helpful to forensic pathologists as the first edition proved to be. One would be remiss by not mentioning the original text with the name *Forensic Neuropathology*, by Cyril Courville (Callaghan & Co., Mundelein, Illinois, 1964), which is now a collector's item. In a sense this book and the numerous articles Dr. Courville published over his career pointed the way for what has become a discipline in itself—forensic neuropathology.

In this second edition of *Forensic Neuropathology*, much of original content has been nearly totally or substantially rewritten in response to the incredible increase in knowledge and scientific progress in the past 20 years. A number of changes are noteworthy. The evolution of new perspectives and rules regarding expert testimony and evidence admissibility, occasioned by the landmark *Daubert* and related Supreme Court rulings on expert testimony, called for a discussion of the relevance of these decisions on how forensic pathologists, neuropathologists, and other potential experts can and must interact with the legal system. The standards for veracity and reliability of expert testimony are not the same as they were and are still evolving as courts incorporate them into their day-to-day practice. The medical profession, not necessarily driven by the legal environment but on its own, has called for so-called evidence-based medicine to underscore clinical decision making and medical education. All of these movements call for what should be and should have been the gold standard—solid science and evidence to back up the way we do things and what we purport to say we know against the basic framework of logic.

In this edition, some new approaches to various subdisciplines have been undertaken. Owing to the dramatic increase in attention in the public mind as well as in the professions and legal community for the problem of child abuse and child protection, additional coverage of special issues in pediatric neuropathology is given. The chapter on child abuse has been significantly revised to reflect major advances in knowledge and science particularly surrounding the so-called shaken baby syndrome and its scientific bases or lack thereof. Similarly, the chapter dealing with physical injury, apart from gunshot and missile injuries, has been completely revised, incorporating significant elements of the principles of injury biomechanics. This discipline has grown remarkably in the past 20 years and deserves to become one more of the basic sciences that have to underpin the practice of

forensic pathology and neuropathology in the same way that the disciplines depend upon anatomy, physiology, biochemistry, genetics, and the clinical sciences to understand how disease works. This means, of course, that one cannot forget basic physics and mathematics as irrelevant, and one must acquire or retain one more body of knowledge in order to do one's job, which never gets easier.

This new edition, like most new medical books, uses an all-color format for the figures. Some of the previous figures were replaced with better-quality color photographs, while many are reproduced here from the original Kodachromes. Again, modern technology has offered new opportunities not only for the authors but also for the readers.

Readers of the first edition of *Forensic Neuropathology* will note that the publisher of this edition is the Taylor & Francis Group (CRC Press) rather than Raven Press, which no longer exists and has been incorporated into the Lippincott, Williams & Wilkins publishing group. Taylor & Francis has published and continues to publish important high-quality books in the forensic sciences. It is hoped that this book will complement an already strong bibliography for them. The professionalism of the staff of Taylor & Francis is appreciated by the authors.

Jan E. Leestma, MD, MM

Acknowledgments

The authors thank the following individuals and organizations for their contributions, direct and indirect, and for making this second edition of *Forensic Neuropathology* possible. In the original edition many individuals made important contributions. Their contributions are again acknowledged, even though many have retired or died. Collectively, thanks go to the pathologists at the Cook County Medical Examiner's Office during the years 1977–1986; the Department of Pathology of the District of Columbia General Hospital, Washington, D.C., 1969–1971; and the many excellent pathologists at the Armed Forces Institute of Pathology, Washington, D.C., with whom the lead author worked during the years 1968–1971 and who provided the opportunity to examine a wealth of forensic neuropathological material and the case material for many figures that are used in this book. Without their eager assistance, this and the first edition of this book would not have been possible.

Specifically deserving of mention are the late Dr. Robert J. Stein, Dr. J. Douglas Balentine, Dr. Richard Lindenberger, and Dr. Kenneth M. Earle. From the Cook County Medical Examiner's Office, I acknowledge the assistance of Dr. Edmund Donoghue and Drs. Mitra Kalelkar, Shaku Teas, Eupil Choi, Ty-Lyong An, Michael Chambliss, Yuksel Konakci, Barry Lifschultz, H. Wayne Carver, Lee F. Beamer, Joann M. Richmond, and Carol Haller. Other pathologists who have contributed in intellectual or material ways to the new edition include Drs. Joseph H. Davis (who wrote the foreword), John Plunkett, Janice Ophoven, Patrick Lantz, Mark Shuman, Jennian Geddes, Helen Whitwell, Waney Squier, Andreas Buettner, Edward N. Willey, Darinka Mileusnic-Polchan, David Wolfe, John Galaznik, and Willam C. Schoene, and the forensic pathologists at the Institute for Forensic Sciences, San Juan, Puerto Rico. The late professor Werner Goldsmith, of the University of California at Berkeley (biomechanics), deserves special personal gratitude for his wisdom and kind patience even when he was desperately ill. Other biomechanicians whose advice, counsel, and contributions deserve mention are Faris Bandak, Larry Thibault, and Chris Van Ee.

As often happens when one collects and shares case materials with colleagues, microscopic slides and photographs often lose identifications of origin. It is inevitable that some photographs will appear in this book, as they did in the last one, that do not have an attribution, simply because it has been lost or strayed. In some cases the origin of previously published figures was discovered and attribution is now given. If a reader should happen to recognize one of his or her cases without attribution, we hope that this oversight will be understood and that satisfaction might be gained for having shared a good example of a process for the benefit of a larger audience, perhaps advancing someone else's learning. For all such anonymous individuals, I thank you for your kindness in sharing your case material with me and our readers.

Jan E. Leestma, MD, MM

The Author

Jan E. Leestma, MD, MM, is the lead author of this second edition of *Forensic Neuropathology*. He received the MD degree from the University of Michigan School of Medicine in 1964 and a Master of Management (MM) degree from the J. L. Kellogg Graduate School of Management of Northwestern University, Evanston, Illinois in 1986. He completed residency training in anatomic and neuropathology at the University of Colorado Medical Center, Denver, and a neuropathology fellowship at the Albert Einstein College of Medicine, Bronx, New York. He is certified in both anatomic and neuropathology by the American Board of Pathology (1970). He served in the U.S. Air Force Medical Corps at the Armed Forces Institute of Pathology, Washington, D.C. (1968–1971), and was honorably discharged with the rank of major, USAF MC. Dr. Leestma was an assistant and associate professor of pathology and neurology at Northwestern University School of Medicine (1971–1986) and served as chief of neuropathology at both Northwestern Memorial Hospital and the Children's Memorial Hospitals, Chicago. He was professor of pathology and neurology and dean of students for the Division of the Biological Sciences and the Pritzker School of Medicine at the University of Chicago, Chicago (1986–1987). He was an assistant medical examiner and neuropathology consultant to the Office of the Medical Examiner, Cook County, Illinois (1977–1987). Dr. Leestma was a guest researcher at the Karolinska Institutet, Huddinge University Hospital, Pathology Institute, Stockholm, Sweden (1981–1982). He was associate medical director and chief of neuropathology at the Chicago Institute of Neurosurgery and Neuroresearch in Chicago (1987–2003). He has had a private consulting practice in forensic neuropathology since the early 1970s that continues to the present time, and he has given expert testimony in more than 30 states, Canada, and the United Kingdom. Dr. Leestma is the author of more than 100 professional publications, including numerous book chapters in texts. He was the author of *Forensic Neuropathology*, 1st Edition, Raven Press, New York, 1988. He is a member of the American Association of Neuropathologists and of the American Academy of Forensic Sciences.

Contributors

Joseph H. Davis, MD, is a graduate of Long Island College of Medicine (1949). He served an internship and residency in pathology at the University of California School of Medicine, the University of Washington in Seattle, and the Public Health Service Hospital in New Orleans, serving also with the Public Health Service in the Department of Indian Affairs. He served on the faculty and was a coroner's pathologist at Louisiana State University and Charity Hospital in New Orleans. He is certified by the American Board of Pathology in anatomic pathology and forensic pathology. Dr. Davis became an assistant medical examiner and, later, chief medical examiner for Miami-Dade County, Florida, serving there from 1956 until his first retirement in 1996 but resuming temporary duties there again until he retired for good in 2000. He was also professor of legal medicine and professor of pathology at the University of Miami School of Medicine. In his long and distinguished career he has served in numerous consultative positions and has been the recipient of numerous honors and awards. He has served as president of the National Association of Medical Examiners as well as president of the American Academy of Forensic Sciences. Dr. Davis is the author of a long list of professional publications in the forensic sciences and forensic pathology, including several book chapters.

Joel B. Kirkpatrick, MD, is a graduate of Washington University School of Medicine, St. Louis, Missouri (1962). His residency training in anatomic and neuropathology was done at Washington University and Barnes Hospital in St. Louis (1962–1967). He is certified by the American Board of Pathology in both anatomic and neuropathology. He is the author of numerous publications in neuropathology and experimental neurology. Dr. Kirkpatrick held academic positions at the University of Texas and Southwestern in Dallas, Texas, and was a consultant to the Institute of Forensic Sciences (Dr. Charles Petty), also in Dallas. He was a professor of pathology at Baylor College of Medicine and the Methodist Hospital in Houston, Texas until his retirement in 1999. He currently has an appointment as visiting assistant professor of neurology, University of Texas Southwestern Medical School, Dallas.

Elaine Whitfield Sharp, JD, is an attorney who has focused her private practice on forensic issues and scientific evidence for more than a decade. Ms. Sharp began practicing law in 1987, when she worked on criminal appeals for both defense and prosecution agencies, after which she was sworn in as an assistant attorney general for the State of Michigan and served in the Transportation Division, the Special Litigation Division, and the Corrections Division. Ms. Sharp opened her private practice in Michigan in late 1989. Ms. Sharp was admitted to practice in Massachusetts in 1993. Ms. Sharp has handled several high-profile criminal cases in the past decade; she was the architect with the experts of the forensic defense in *Commonwealth of Massachusetts v. Louise Woodward*, and in 2000 she represented the family members of Albert DeSalvo in their bid to clear his name as the

Boston Strangler and family members of Mary Sullivan, the last victim of the so-called strangler, who joined forces with them because they did not believe DeSalvo was her killer. Ms. Sharp also handles a variety of civil cases involving allegations of federal constitutional violations. As a graduate of the Wyoming-based Gerry Spence Trial Lawyers College (TLC), Ms. Sharp has written about science and the law for the TLC's journal, *The Warrior*. She was selected by her TLC peers as Warrior of the Year in 2004 for the northeastern region for her *pro bono* services in assisting other lawyers with forensic questions. Ms. Sharp has presented at the American Bar Association on several cold cases and has spoken to defense organizations and the American Academy of Forensic Sciences on scientific issues in the law. Ms. Sharp has appeared in numerous states to assist counsel in cases involving forensic issues and has consulted with lawyers in every state on such issues, frequently authoring briefs for *Daubert* or *Frye* hearings in criminal and civil cases. Ms. Sharp earned her bachelor's degree in journalism and political science from the University of Michigan at Ann Arbor in 1980, after which she wrote a variety of news articles and investigative features for numerous state and national newspapers and was a contributor to Michigan Public Radio. Ms. Sharp earned her law degree from the University of Detroit Mercy School of Law, a Jesuit law school, in 1987. Ms. Sharp has been a frequent commentator on CNN, Fox News, and other national and local news channels on cases of forensic interest. She lives and practices in Marblehead, Massachusetts, with her husband, Daniel S. Sharp, Esq., and is currently working on books that detail forensic issues in high-profile cases. Ms. Sharp is an associate member of the American Academy of Forensic Sciences, the New York Academy of Sciences, the American Association for the Advancement of Science, and the American Association of Justice, where she is an active member of the Medical Malpractice and Expert Witness sections. Ms. Sharp is admitted to practice in federal courts in Michigan and Massachusetts, the U.S. Court of Appeals for the First Circuit and the Sixth Circuit, and the U.S. Court of Federal Claims, where she litigates vaccine injury and death cases under the National Childhood Vaccine Injury Compensation Acts.

Kirk L. Thibault, PhD, earned his BSE in mechanical engineering (1991) and his MS (1993) and PhD (1997) in bioengineering from the University of Pennsylvania. Dr. Thibault's research activities have included studies of the biomechanics of central nervous system injury, with a particular emphasis on the age-dependent, pathophysiologic response of the infant and young child to head impact loading. He has extensive experience in mechanical testing, analysis, and modeling of biological materials/structures and their injury mechanisms. Dr. Thibault's current research interests include the application of his basic research to the development of an age-specific computational model of pediatric head injury and the design of a more biofidelic infant head form. Kirk has published and presented numerous articles in the field of injury biomechanics and has received a number of awards, including Centers for Disease Control Research Fellow, University of Pennsylvania Fellow, and the ASME Young Engineer Award. He is currently a partner of Biomechanics, Inc. of Essington, Pennsylvania.

Contents

Foreword	xix
Preface	xxi
Acknowledgments	xxv
The Author	xxvii
Contributors	xxix
1 Pathology and Neuropathology in the Forensic Setting	1
JAN E. LEESTMA, MD, MM	
ELAINE WHITFIELD SHARP, JD	
The Pathologist and the Justice System	1
Certification of Death	1
The Forensic Autopsy	3
The Neuropathologist's Role in Forensic Pathology	4
Whom Does the Forensic Pathologist Serve?	6
The Problem of the Manner of Death	6
Issues for the Neuropathologist in the Forensic Setting	8
Preservation of Evidence and the Chain of Custody	8
The Forensic Neuropathological Report	9
Interactions of the Neuropathologist with Attorneys	11
Interactions in an Official Capacity	11
The Neuropathologist as a Witness	11
The Neuropathologist as a Retained Expert	12
Whom Do You Represent and Who Are the Parties Involved in the Case?	13
What Do You Expect Me to Do?	14
In What Court Is the Case Pending and What Difference Does This Make?	15
What Will I Be Required to Do during the Pretrial Phase of the Case?	16
The Oral Deposition	16
Written Interrogatories and Declarations	18
What Must Be Done in Preparation for Trial?	19
How Is a Trial Conducted?	19
What Will I Be Asked to Do When I Testify?	20
Implications for the Expert of Having Given Testimony	24
References	25

2	Scientific Evidence and the Courts	27
	ELAINE WHITFIELD SHARP, JD	
	Introduction	27
	The <i>Frye</i> Standard	27
	The <i>Daubert</i> Era: The Search for Reliability	30
	The <i>Joiner</i> Standard	34
	The <i>Kumho</i> Standard	35
	The Federal Rules of Evidence	37
	The Ever-Changing Face of the Admissibility Standards of Scientific and Expert Witness Testimony	38
	<i>Daubert</i> States	40
	Alaska: <i>Daubert</i> . "Capricious" <i>Frye</i> Standard Rejected	40
	Arkansas: <i>Daubert</i> and Novel Evidence	41
	Colorado: Rule Based: More Liberal Admissibility Standard to Be Tempered by Prejudice Analysis	41
	Connecticut: Gatekeeper. Four-Point Test Does Not Apply to All Science	42
	Delaware: <i>Daubert</i> , But Still Some <i>Frye</i>	42
	Kentucky: Reliable Science vs. Unfair Prejudice	42
	Louisiana: <i>Daubert</i> : Reliable Science vs. Unfair Prejudice—Where Diagnosis Is a Statement of Causation	43
	Michigan: <i>Daubert</i>	44
	Montana: <i>Daubert</i> Plus Cross-Examination	44
	Nebraska: <i>Daubert</i> . Toxic Torts and Traps for the Unwary Expert	44
	New Mexico: <i>Daubert</i> . Preserving the Line between Expert Witness Testimony and Lay Witness Credibility	46
	North Carolina: <i>Daubert</i> Plus Established Science	46
	Oklahoma: <i>Daubert</i> . Toxic Torts—General vs. Specific Causation	47
	Oregon: <i>Daubert</i>	47
	Rhode Island: <i>Daubert</i>	48
	South Dakota: <i>Daubert</i>	48
	Texas: <i>Daubert</i> —A Necessary Rule in a Complex World	48
	Vermont: <i>Daubert</i>	49
	Wyoming: <i>Daubert</i>	49
	West Virginia: <i>Daubert</i> Plus Judicial Notice of Established Science	49
	Mississippi: <i>Daubert</i>	50
	New Hampshire	50
	States Where <i>Daubert</i> Is Viewed as Instructive	50
	Hawaii: <i>Daubert</i> Instructive	50
	Indiana: <i>Daubert</i> Instructive	50
	Iowa: <i>Daubert</i> Instructive	51
	Massachusetts: <i>Daubert</i> Instructive	51
	Tennessee: <i>Daubert</i> Instructive	52
	Ohio: <i>Daubert</i> Instructive	53
	Maine: <i>Daubert</i> Instructive	53
	<i>Frye</i> and Modified- <i>Frye</i> States	54

Alabama: <i>Frye</i>	54
Arizona: <i>Frye</i>	54
District of Columbia: <i>Frye</i>	55
Florida: <i>Frye</i>	55
Illinois: <i>Frye</i>	55
Kansas: <i>Frye</i> . <i>State v. Haddock</i>	56
Maryland: <i>Frye</i>	57
Pennsylvania: <i>Frye</i>	58
Minnesota: <i>Frye</i> Plus Reliability	58
New Jersey: <i>Frye</i>	59
New York: <i>Frye</i>	59
Washington: <i>Frye</i>	60
Idaho: Gatekeeper State	61
Nevada: Gatekeeper State	61
Wisconsin: A Limited-Gatekeeper State	61
Rules-Based-Plus-Reliability States	62
Missouri: Akin to Rule 702	62
North Dakota: Rule 702 Plus Reliability	63
Utah: Rule 702 Plus Reliability	63
South Carolina: Rule 702 Plus Reliability	63
Georgia: In a Class of Its Own	64
California: <i>Frye</i> Plus Reliability	64
Virginia: Reliability (Neither <i>Daubert</i> nor <i>Frye</i>)	66
Judging the Reliability of Medical Literature Using the Three R's, or the Reasonable Reliance Requirement, of Rule 703	69
A Jury of Our Peers?	70
Madness in the Methods	71
A Few Basics	72
Getting Started	72
Mismatch between Design and Purpose	73
Case Series Studies	74
Selection Bias	74
Insufficient Data	75
Statistics: Sometimes a Tool for Those with No Proof?	75
Data-Pooling to Conjure Up the "Statistics Boogeyman"	76
Case Control Studies	76
Cross-Sectional Survey Studies	76
Cohort Studies	77
Conclusion	77
References	78

3 Forensic Aspects of Adult General Neuropathology 79

JAN E. LEESTMA, MD, MM

Introduction	79
Intracranial Pathology as a Cause of Death	79
Neurally Mediated Mechanisms of Death	81

Disorders of Respiratory Control	82
Failure of Guarding Reflexes and Vomiting	83
The Neurological Vegetative State	83
Vascular Diseases of the Nervous System	83
Cerebral Atherosclerosis	84
Arterial Hypertension	85
Cerebrovascular Accident/Stroke	86
Spontaneous Subarachnoid Hemorrhage	87
Sequelae of Subarachnoid Hemorrhage	88
Intracranial Aneurysms	89
Relationship of Rupture to External Events	90
Etiology and Pathogenesis of Berry Aneurysms	91
Pathology of Aneurysms	92
Atherosclerotic Aneurysms	96
Mycotic Aneurysms	96
Dissecting Aneurysms	96
Traumatic Aneurysms	97
Intracranial Hypertensive Hemorrhage	97
Hemorrhage Due to Blood Dyscrasias and Other Diseases	103
Vascular Malformations	104
Telangiectatic Vascular Malformations	105
Varices	107
Cavernous Angiomas	107
Arteriovenous Malformations	108
Infarction in the Central Nervous System	111
Thrombotic–Embollic Strokes	111
Hypoxic/Ischemic Brain Lesions	112
The Anemic (Pale) Infarction	115
Pathological Changes	118
The Hemorrhagic Red Infarct	124
Venous Infarction	126
The Lacunar Infarct and Related Conditions	126
Stroke and Oral Contraceptive Agents	129
Cerebral Embolic States	130
Thromboembolism	131
Fat Embolism	132
Air or Gas Embolism	133
Foreign Body and Other Unusual Emboli	134
Tumors of the Nervous System	135
Brain Tumors and the Forensic Pathologist	135
Etiology of Brain Tumors	141
Chemical Neurooncogenesis	141
Oncogenic Viruses	142
Radiation	142
Heredity	142
Trauma as an Etiology for Brain Tumors	142
Epidemiology of Brain Tumors	143

Classification of Brain Tumors	143
Infections of the Nervous System	144
Subdural Empyema	144
Bacterial Meningitis	146
The Meningococcal Syndrome	147
Bacterial Brain Abscess	148
Mycobacterial Infections of the Nervous System	151
Tuberculosis (TB)	151
Fungal Diseases of the Nervous System	153
Protozoal and Metazoal Diseases	157
Toxoplasmosis	157
Malaria	158
Helminthic and Other Parasitic Diseases	160
Cysticercosis	161
Viral Infections of the CNS	162
Pathogenesis of Viral Infections in the CNS	162
Pathological Reactions to Viral Infection in the CNS	163
Human Immunovirus and Acquired Immune Deficiency Syndrome (AIDS)	164
Herpes Simplex Encephalitis	166
Epstein-Barr Virus Infection	167
Progressive Multifocal Leukoencephalopathy	168
Infections by Unconventional Agents	170
Jakob-Creutzfeldt Disease	170
Parainfectious Brain Diseases	173
Acute Hemorrhagic Encephalitis of Hurst	173
Landry-Guillian-Barré Syndrome	173
Degenerative Diseases of the Nervous System	174
Characteristics of Neurodegenerative Diseases	175
Alzheimer's Disease	176
Pick's Disease and the Frontotemporal Dementias	183
Parkinson's Disease	183
Postencephalitic Parkinson's Disease	188
Huntington's Disease	188
Motor Neuron Disease	190
Amyotrophic Lateral Sclerosis	190
Diseases of White Matter	192
Multiple Sclerosis	193
Toxic and Miscellaneous Conditions	197
Toxicity Affecting Axonal Transport	199
Toxicity Affecting Neural Membrane Function	200
The Alcohols	201
Acute Ethyl Alcohol Intoxication	203
Chronic Alcohol Abuse	204
Wernicke's Disease	204
Alcoholic Cerebellar Degeneration	206
Central Pontine Myelinolysis	206