Dedication

The many to whom we must express gratitude and to whom we dedicate this book fall into two categories: the knowledgeable plant scientists and those in the forensic science community who work for justice.
Author Biographies

Jane H. Bock, PhD

Dr. Bock is a professor emerita in biology at the University of Colorado, Boulder. She received her bachelor’s degree from Duke University, master’s degree from Indiana University and PhD (1966) from the University of California at Berkeley. All her degrees are in Botany. She taught, carried out research, and published scientific work in population ecology and forensic botany at Boulder for over 30 years. Officially retired from teaching, she continues to do research as a forensic botanist and serves as an expert witness for the defense or the prosecution in homicide cases. She also lectures and continues to publish regularly. She is a Fellow of the American Academy of Forensic Sciences and was a founding member of both NecroSearch International and the Ecology Section of the Botanical Society of America.

David O. Norris, PhD

Dr. David Norris has done research in environmental endocrinology and neuroendocrinology for more than 50 years. Dr. Norris is a professor emeritus in the Department of Integrative Physiology at the University of Colorado. He received his bachelor’s degree from Baldwin Wallace College and his PhD in 1966 from the University of Washington. Dr. Norris has worked in the area of forensic botany with Dr. Jane H. Bock, since 1982, primarily on developing the use of plant cells in the gastrointestinal tract to aid in homicide investigations. Dr. Norris and Dr. Bock have been involved in investigations in numerous states as well as throughout the State of Colorado. Dr. Norris has been certified as an expert witness in this area for the State of Colorado. With Dr. Bock, Dr. Norris also has consulted on other botanical evidence for criminal investigations. He was elected as a Fellow of the American Academy of Forensic Sciences in 2014 and also was a founding member of NecroSearch International.
Foreword by Tom A. Ranker

I was delighted when I received a request from my long-time friends and colleagues Jane Bock and Dave Norris to write a foreword to this book. For many years now I have heard various bits and pieces about the court cases that Jane and Dave contributed to as scientists, partly from a number of presentations they gave to my botany classes at the University of Colorado. Since people are always fascinated to hear how the application of scientific principles, observations, and analyses can be applied to criminal cases, I knew that I could always rely on them to give stimulating talks about plants and crime.

Jane Bock and Dave Norris have over 50 years of combined experience of applying sound scientific principles to help solve real crimes. They have blended their scientific specialties of plant ecology (Bock) and endocrinology (Norris) to form an impressive forensic scientific team that gathers, analyzes, and interprets a wide array of plant-based evidence from crime scenes, suspects, and victims. Thus, they are ideally situated to write a textbook on forensic plant science.

As a practicing plant taxonomist with experience applying data from plant anatomy and morphology, ecology, molecular systematics, and biogeography to basic scientific research, I appreciate the great attention to detail provided in this book and, in particular, on the emphasis of doing excellent science to provide the best possible evidence to help solve crimes. As a long-time herbarium curator, I also know the importance of “knowing your stuff” when called upon by local law enforcement to assist with the interpretation of botanical evidence. This book will not only help train novices in the field of forensic botany but also will assist experienced plant scientists and other professionals to apply botanical knowledge to criminal investigations.

Forensic Plant Science is particularly timely in light of the 2009 report of the National Academy of Sciences that decried the state of forensic science. One of the primary concerns expressed in that report was the lack of standard procedures employed across forensic labs, police departments, and jurisdictions. This book will help resolve this dilemma at least for plant forensic science by providing readers with (1) introductions to basic plant biology and the subdisciplines of botany needed for forensics, (2) actual examples of how plant-based evidence can and cannot be used in court, and (3) a critical “how to” manual for gathering, analyzing, and interpreting all sorts of botanical forensic evidence.

Tom A. Ranker, PhD, Professor
Department of Botany
University of Hawai‘i at Mānoa
Past President, Botanical Society of America
Foreword by Haskell M. Pitluck

One of the perks you get when asked to write a foreword of a book is the galley copies of the unedited final draft to assist you to make an assessment which in this case is that this is a good book.

Forensic scientists have been working for years to assist our legal system in assuring that innocent people are not convicted and those who are guilty are convicted. Drs. Jane Bock and David Norris have used over 30 years of experience in their field to author a book of eleven chapters with seven detailed appendices and citations. Forensic Plant Science is packed with excellent information to further the knowledge and use of plant science forensically in assisting the conclusion of legal cases, both civil and criminal. Their combined knowledge is an asset that they are sharing in a well-organized fashion with their readers.

The authors capture your attention from the first chapter with a basic introduction of plants as well as interesting cases with direction as to where to find evidence and how to present it in court.

The photographs and explanations are excellent. The appendices and online photomicrographs will be valuable tools to aid in the collection and processing of evidence. This book is a comprehensive study of not only plant science itself, but also of issues not directly related to plants. The information will assist in preparing for a legal matter involving plant science evidence.

Drs. Bock and Norris discuss issues of plant science in the past, deal with present situations, and give insight into what may evolve in the future. Topics as diverse as the public’s perception of forensic science and the “CSI effect” as well as how to get into the plant science field and the pros and cons of doing so.

In a relatively few short years, DNA has become the standard for positive identification. Plants have DNA as well, which will aid in the development of evidence. Studies of pollen and diatoms can be used to place people as well as items at a crime scene.

The authors also make a case for a forensic science professional society recognizing contributions by plant scientists to forensic science, including the certification of forensic plant scientists.

Whether or not that happens, the advances made in plant science will continue to bring a strong arrow in the quiver of those striving to find the truth in the legal system.

The authors are to be congratulated on producing a book that gives so much information in an uncomplicated way so as to be used and understood by investigators, attorneys, and judges.

Read it. Enjoy it. Learn from it.

Haskell M. Pitluck
Retired Circuit Court Judge, State of Illinois
Past President, American Academy of Forensic Sciences 1995–1996
Jane Bock and David Norris first became friends while teaching General Biology together as young assistant professors in Boulder, CO. We enjoyed teaching together as we set about establishing our research careers. Bock was preoccupied with learning the Colorado flora and Norris with establishing a lab where he could work on the endocrinology of fishes and amphibians. Norris had a sound background in general botany and Bock knew about salamanders from fieldwork. Norris discovered that Bock knew very little about animal biology, so we formed a team teaching approach in which one did plant biology and the other covered the animals.

In General Biology, Norris described human digestion while Bock remained largely ignorant of human biology in general. A partnership was formed, Norris for human digestion and Bock for plant anatomy of food plants. Norris based his digestion lecture on human digestion of a Big Wally cheeseburger. Big Wally contents mimic those of a famous food chain’s cheeseburger. Big Wally was born lest we run afoul of the big burger franchise by naming the lecture after their product.

One autumn day, Dr. William (Ben) Galloway called Bock to ask if she could identify food plant cells from a murder victim’s stomach contents. By this time Bock had moved on from General Biology to teaching Plant Anatomy and Plant Systematics while Norris was teaching Comparative Endocrinology and related subjects.

Because of the notoriety to Galloway’s case and our contribution to its solution, regional police noticed us. We became involved in forming NecroSearch International, an organization that continues to lead in the search for clandestine graves. Bock and Norris spoke at some coroners’ conventions, wisely joined the American Academy of Forensic Sciences and received a small grant from the Department of Justice. Soon they became associated with the general subject of botany by criminal investigators in the Front Range of Colorado. From the start of our collaboration we were asked to identify plant species in nature, food plant cells in the stomach of homicide victims, and share ecological knowledge concerning plant distributions. We continue to do this today, but the geographic distribution of our work has increased greatly. Our cases at first were from Colorado, but cases now come from other states and even outside the US.

Along the way we have developed working procedures including working independently when possible and then sharing our findings. We seek consensus whenever possible. Sometimes we are unable to answer questions or lack time to take on a new case because of other career demands. We try to give priority to child deaths and cases asking unusual questions such as “Can you tell from the last meal where (in what jurisdiction) the homicide took place?”

To spread information about our work, Norris and Bock have given lectures at colleges and scientific meetings throughout the US as well as in England, Australia, and New Zealand. We have given short courses at the conventions of the Botanical Society of America (BSA), the American Academy of Forensic Sciences (AAFS), and the Colorado State Police Academy...
as well as the Oregon State Police Forensic Laboratory. Especially rewarding was our recent course for high school science teachers from around the US that was sponsored by the AAFS and the University of Colorado, Boulder.

Sometimes when we receive requests for assistance, we solicit help from botanists of good reputation who are located nearer the crime scene. These cases involve questions of taxonomy and ecology and, in one case, identification of wood anatomy. We usually find people eager to help, although in a few cases people refused because they felt threatened by how our justice system deals with homicide investigations.

Of course, plant food cells can be identified past the stomach in the digestive tract and even outside the human body. Norris furthered our investigations by using crime scene fecal samples (on clothing) from a victim and a suspect in a rape homicide that inked that victim with a suspect. We also have identified food plants from vomitus samples. Bock serves on thesis defenses from Anthropology graduate students who study such subjects as plant cells associated with mummies and fecal remains from an old outhouse. Such studies can reveal dietary habits of people from past times. Numerous undergraduate students have worked in our labs on research projects related to forensic botany, and forensic botany has been a part of Norris's lecture and laboratory class, "Forensic Biology" at the University of Colorado. Bock integrated this subject into her botanical courses as well.

Bock's and Norris's investigative work comes from many sources. In the early work, computer literate police investigators sought help in some aspect of botany. In more recent times, word of mouth and alumni from Bock's and Norris's classes and our forensic publications have brought us inquiries.

An important goal Bock and Norris have for this book is to advertise to the legal community the value and efficacy of evidence from plant science. A second goal is to encourage those who have interest in or are trained in plant science to pursue forensic botany as a career.
In acknowledgments, the common practice is to mention family members last. That behavior does not fit here. We owe our mates, Carl E. Bock and Kay W. Norris, enormous gratitude for their patience and encouragement. We have lost count of the many dinner parties we ruined when preoccupied with a case or a forensic research question. The contents of this book show matter that is not a normally acceptable dinner conversation. And our daughters, Laura, Sara, and Linda suffered, too, not always with silence. These people endlessly make our lives worthwhile and rewarding.

We also wish to thank the people who inspired us to do this work:

Dr. William (Ben) Galloway, the forensic pathologist who started us on our life of crime
Jack Swanberg, the founder of NecroSearch International
Thomas Trujillo, Detective for the City of Boulder
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Tom (Grif) Griffin, Colorado Bureau of Investigation (retired)
Dorothy Sims, Esq.
Jose Baez, Esq.
Lawrence W. (Tripp) DeMuth, Esq.

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CHAPTER 1

Introduction to Forensic Plant Science


The use of the word forensic related to crime is now especially popular because of contemporary media, in particular television. However, forensic has two definitions. The first is related to public speaking. School forensic clubs historically were debating societies. For our purposes, forensic applies to matters pertaining to courts and the law. Therefore, forensic plant science’s definition is the application of plant evidence to legal questions. It is interesting that a number of aspects of forensic science are being debated in and out of the courtroom today.

Our purpose for this book is to show several aspects of plant science that have received little attention in the past but that can be especially useful in forensic science. Three of these areas are plant anatomy (Chapter 4), plant taxonomy (Chapter 6), and plant ecology (Chapter 8) that deal primarily with seed plants (e.g., flowering plants and conifers). Our forensic research, teaching, and casework are centered on these areas. Additionally, recent advances in genetic analyses of plants show promise for plant DNA-based forensics (Chapter 3). Lastly, the examination of diatoms (microscopic algae) and pollen (male reproductive sex cells) of seed plants as well as spores of some other plants are beginning to be developed as forensic tools (Chapter 10).

We have worked mostly on homicide cases, but plant science can be useful in the forensic analyses of rape cases, burglaries, and other crimes as we will describe in later chapters. For example, plant cells can help determine time of death through the analysis of gastrointestinal contents. Wood identification and comparisons can help identify a suspect. Plant fragments lodged in a shoe (Figure 1.1), associated with clothing, or found attached to or within a vehicle may link a suspect or a victim to a specific location. Vegetation analyses can be helpful in the location of bodies or clandestine graves. Diatoms may provide evidence of drowning and also can be used to characterize a location. Pollen of different species can help determine when or where a person was killed as well as connect suspects to crime scenes.

We illustrate in the following chapters for forensic scientists, crime investigators, and forensic science students how these different aspects of plant science are simple to use, can