

Forensic Investigation of Clandestine Laboratories

Donnell R. Christian



CRC PRESS

Boca Raton London New York Washington, D.C.

Library of Congress Cataloging-in-Publication Data

Christian, Donnell R.

Forensic investigation of clandestine laboratories / Donnell R. Christian.
p. cm.

Includes bibliographical references and index.

ISBN 0-8493-1227-2 (alk. paper)

1. Forensic sciences. 2. Chemical laboratories. I. Title.

HV8073.C53 2003

363.23 — dc21

2003043976

This book contains information obtained from authentic and highly regarded sources. Reprinted material is quoted with permission, and sources are indicated. A wide variety of references are listed. Reasonable efforts have been made to publish reliable data and information, but the author and the publisher cannot assume responsibility for the validity of all materials or for the consequences of their use.

Neither this book nor any part may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, microfilming, and recording, or by any information storage or retrieval system, without prior permission in writing from the publisher.

The consent of CRC Press LLC does not extend to copying for general distribution, for promotion, for creating new works, or for resale. Specific permission must be obtained in writing from CRC Press LLC for such copying.

Direct all inquiries to CRC Press LLC, 2000 N.W. Corporate Blvd., Boca Raton, Florida 33431.

Trademark Notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation, without intent to infringe.

Visit the CRC Press Web site at www.crcpress.com

© 2004 by CRC Press LLC

No claim to original U.S. Government works

International Standard Book Number 0-8493-1227-2

Library of Congress Card Number 2003043976

Printed in the United States of America 1 2 3 4 5 6 7 8 9 0

Printed on acid-free paper

The Author

Donnell R. Christian, Jr. spent 15 years with the Arizona Department of Public Safety Crime Laboratory specializing in forensic chemistry and trace analysis, with emphasis in the clandestine manufacture of controlled substances (i.e., drugs and explosives). He responded to hundreds of clandestine lab scenes, examined thousands of exhibits, and provided untold hours of testimony. He published articles on the analysis and the clandestine manufacture of controlled substances. And, he developed training programs for investigators, laboratory examiners, and attorneys involved in the investigation, examination, and prosecution of clandestine labs.

Currently, the author is the forensic science development coordinator for the United States Department of Justice's International Criminal Investigative Training Assistance Program (ICITAP). With ICITAP, he assisted in establishing forensic science programs in the developing democracies of Armenia, Azerbaijan, Bosnia, Bulgaria, Georgia, Haiti, Kazakhstan, Kyrgyzstan, Senegal, and Uzbekistan. He served as president and chairman of the board of directors for the Southwestern Association of Forensic Scientists (SWAFS). He is a 1981 graduate of Northern Arizona University.

The author was awarded the American Academy of Forensic Sciences' Outstanding Young Scientist Award for the southwestern U.S. in 1985. He can be contacted through his Web site at: www.criminalist.us.

Introduction

Drugs of abuse in the United States have traditionally come from a variety of foreign sources. Heroin and cocaine are produced in foreign countries. A vast amount of marijuana is cultivated and smuggled in from sources outside the United States. However, law enforcement authorities must look inward to identify the source of clandestinely produced synthetic drugs that are increasing in popularity.

Clandestinely produced drugs of abuse are not the only controlled substances affecting the public order. The clandestine production of explosives and explosive mixtures placed into destructive devices and used with criminal intent has greatly impacted the feelings of safety experienced by law-abiding citizens.

The manufacturing of controlled substances in clandestine labs is an ever-increasing problem within the United States. Identifying and shutting down these operations has the greatest impact in stemming the flow of contraband substances. The effect of eliminating the ultimate source of the controlled substance being manufactured reaches far beyond jailing individuals arrested at the site. Everyone who would potentially have come in contact with the finished product, from the mid-level distributors to the end users, feels the ramifications of putting the manufacturer out of business.

The investigation of clandestine labs is one of the most challenging of law enforcement. It is a roller-coaster ride of activity that requires every tool at its disposal. Traditional investigative techniques are used to develop information concerning the location of the clandestine lab and the identity of the operator. Forensic experts are used to corroborate information by establishing the identity of the final products as well as the manufacturing methods used to produce them.

No other law enforcement activity relies on forensic experts as heavily as does the investigation of clandestine labs. The forensic expert's involvement commences with the drafting of the affidavit used to obtain the search warrant. His or her expertise is imperative to effectively process the crime scene. Experts analyze the samples from the crime scene in a forensic laboratory. Finally, they render opinions in a written report or in courtroom testimony. Occasionally, the forensic expert may be called upon further to testify on

auxiliary issues concerning the clandestine lab investigation that occur even after the criminal case has been adjudicated.

A team effort is necessary for identifying, investigating, and prosecuting a clandestine lab. It is a collaboration of the efforts of law enforcement, forensic experts, scientists, and criminal prosecutors to present a case that definitively demonstrates how a group of items with legitimate uses is being used to manufacture an illegal controlled substance. *Forensic Investigation of Clandestine Laboratories* was written to provide these groups with the general information needed to understand how the different pieces of the clandestine lab puzzle fit together.

Individuals outside of law enforcement can benefit from the information in the first three chapters of this book. Emergency responders, such as police patrol officers, firefighters, emergency medical technicians (EMTs), and representatives from certain social service agencies, routinely encounter clandestine labs. Landlords, storage locker managers, and the public at large stumble upon these operations without realizing it. The knowledge gained from reading this text will allow these groups to be able to recognize a potentially dangerous situation so they can report it to the appropriate authorities.

The goal is to provide anyone involved in the investigation or prosecution of clandestine lab activity the information to guide him or her through the process of establishing the existence of a clandestine lab beyond a reasonable doubt. Just by reading this book, the reader will not be an expert in the clandestine manufacture of controlled substances. That can only be accomplished through training and experience.

The information in this book will provide an overview of clandestine labs. This will be accomplished by dividing the process into five sections that correspond to the various phases of investigation and prosecution. Described in the first section is how to recognize clandestine labs and the physical characteristics they have in common. In the second section, processing the site of a clandestine lab will be reviewed. Covered in the third section are the analytical techniques that can be used in the laboratory to analyze evidence from a clandestine laboratory. Presented in the fourth section are the opinions that can be rendered from the physical evidence. In the fifth and final section, presenting the evidence in court is covered.

Recognition of clandestine lab activity is the first step in the process. In Chapters 1 through 3, a clandestine lab is described, along with the common elements to expect. A profile of a clandestine lab operator will be presented. And, chemical and equipment requirements, as well as the basic manufacturing techniques utilized, will be identified. In this section, the commonly held, yet faulty, notion that the manufacture of controlled substances requires higher education, sophisticated equipment, and exotic chemicals will be dispelled. The knowledge gleaned from this section should enable an individual

to recognize a clandestine lab. An investigator should be able to articulate why a clandestine lab exists and, subsequently, secure a search warrant to proceed to the next phase of the process.

Some of the explanations of the manufacturing process may seem oversimplified to a forensic chemist. Yet investigators, attorneys, and jurors involved in the various segments of the investigation and prosecution of clandestine labs cannot be expected to have acquired the scientific knowledge necessary to understand the chemical processes involved. Using nontechnical terms, with common examples, should remove the scientific mystique. For a broad audience, the understanding of the process of clandestinely manufacturing a controlled substance is more easily achieved using laymen's terms.

In *Forensic Investigation of Clandestine Laboratories*, how to clandestinely make controlled substances is not described in detail. Unfortunately, there are already numerous sources of such information available to the general public. What is addressed in this book is generally how controlled substances are made; how investigators, forensic experts, scientists, and attorneys can identify the existence of a clandestine lab and compile the information necessary to establish what was being manufactured, and how it was being manufactured; and finally, how to present the information to a jury for adjudication.

Knowing what a clandestine lab is and proving one exists are separate issues. In Chapters 4 and 5, the steps necessary to collect and identify all of the pieces of the clandestine lab puzzle are presented. The information gathered from investigators must be evaluated. The steps required to process clandestine lab sites for physical evidence are outlined, and analytical approaches that can be taken during the subsequent laboratory analysis are described.

Processing the clandestine lab scene is addressed in Chapter 4. It is more complicated than the traditional crime scene search normally associated with a narcotics investigation. Because of the chemicals involved, the site of a clandestine lab is, by definition, a "hazardous materials incident" and necessitates invoking different protocols for crime scene processing. Agencies such as the fire department, emergency medical personnel, and local health and environmental quality personnel should be involved. The equipment requirements for processing clandestine lab scenes are more extensive because of the potential chemical exposures. Finally, there are a number of preliminary opinions that should be made when evaluating the physical evidence observed at the scene, which necessitates an on-scene expert.

Addressed in Chapter 5 are the options available to the forensic chemist who analyzes the evidentiary samples. Complete forensic laboratory analysis is a critical element of a clandestine lab investigation. The analysis of a reaction mixture is more complex than identifying the controlled substance

it contains. Identification of precursor and reagent chemicals as well as reaction by-products is necessary to establish the manufacturing method used. Identification of unique chemical components can be used as an investigative tool to connect the clandestine lab under investigation to other illegal activity.

Opinions, or “What does it all mean?”, are presented in the next section. A large amount of information is collected during a clandestine lab investigation. Dealt with in this section, is collating information from various sources and creating a profile of the clandestine lab under investigation. What type of operation existed? What was it making? How was it being made? How much could it make? These are some of the questions that will be addressed in Chapter 6.

All of the work to this point may be useless if the expert’s opinions cannot be relayed effectively to a jury. Expert testimony is presented in the final section of the book. Discussed in Chapter 7 is how to effectively educate the prosecutor, deal with defense attorneys, and present technical information to nontechnical jurors.

The main focus of clandestine lab investigations in the United States is the manufacture of illicit drugs because the manufacturing of explosives is not illegal, *per se*. However, placing the explosive final product of a clandestine lab into a destructive device is illegal. All of the techniques used to investigate clandestine drug labs can also be applied to the manufacture of explosive chemicals, compounds, and mixtures. Issues involving the clandestine manufacture of explosives are addressed in Chapter 8.

The use of forensic evidence is essential to the successful investigation and prosecution of a clandestine lab, whether the final product is a drug or an explosive. The proper collection and preservation of the physical evidence followed by the complete analysis of the evidentiary samples are key elements. The information gathered is the cornerstone on which the forensic expert’s opinion is based. If forensic evidence is properly handled, the Court will have all of the information it needs to make a fully informed decision.

Donnell R. Christian, Jr.

Contents

1 Basic Clandestine Drug Manufacture

- 1.1 Lab Operators
- 1.2 Manufacturing Processes
 - 1.2.1 Extraction Process
 - 1.2.2 Conversion Process
 - 1.2.3 Synthesis Process
 - 1.2.4 Tableting
 - 1.2.5 Combination Labs
- 1.3 The Needs Triangle
 - 1.3.1 Equipment Needs
 - 1.3.1.1 Reflux
 - 1.3.1.2 Distillation
 - 1.3.1.3 Hydrogenation
 - 1.3.1.4 Bucket Chemistry
 - 1.3.1.5 Extractions
 - 1.3.2 Chemical Needs
 - 1.3.3 Knowledge Needs
- 1.4 Summary

2 Clandestine Lab Hazards

- 2.1 General Hazards
 - 2.1.1 Little Training
 - 2.1.2 Makeshift Operations
 - 2.1.3 No Two Labs Are Alike
- 2.2 Hazard Priority
 - 2.2.1 Explosion
 - 2.2.2 Fire
 - 2.2.3 Firearms
 - 2.2.4 Exposure
 - 2.2.4.1 Chemical Hazards
 - 2.2.4.2 Physical Hazards

- 2.3 Hazard Abatement
- 2.4 Summary

3 Basic Toxicology

- 3.1 Entry Routes
 - 3.1.1 Inhalation
 - 3.1.2 Dermal Absorption
 - 3.1.3 Ingestion
- 3.2 Modes of Action
- 3.3 Influences on Toxicity
 - 3.3.1 Length of Exposure
 - 3.3.2 Degree of Exposure
 - 3.3.2.1 Compound Factors
 - 3.3.2.2 Exposure Factors
 - 3.3.2.3 Personal Factors
 - 3.3.2.4 Distribution and Elimination
- 3.4 Toxicity Measurements
 - 3.4.1 Exposure Guidelines
- 3.5 Toxin Properties
 - 3.5.1 Physical States
 - 3.5.2 Toxic Properties
- 3.6 Summary

4 Scene Processing

- 4.1 Training
- 4.2 Seizure Stages
 - 4.2.1 Preraid Planning
 - 4.2.2 Briefing
 - 4.2.3 Entry and Arrest
 - 4.2.4 Hazard Evaluation and Abatement
 - 4.2.4.1 Site Control
 - 4.2.4.2 Personal Protective Equipment
 - 4.2.5 Scene Processing
 - 4.2.5.1 Planning
 - 4.2.5.2 Documentation
 - 4.2.5.3 The Search
 - 4.2.5.4 Disposal
- 4.3 Summary

5 Laboratory Analysis

- 5.1 The Chemist
 - 5.1.1 Single Chemist
 - 5.1.2 Independent Analytic Chemist
- 5.2 Types of Analysis
 - 5.2.1 Inorganic Analysis
 - 5.2.1.1 Chemical Color Tests
 - 5.2.1.2 Microscopic Techniques
 - 5.2.1.3 Infrared Spectroscopy
 - 5.2.1.4 Ion Chromatography
 - 5.2.1.5 X-Ray Analysis
 - 5.2.2 Organic Analysis
 - 5.2.2.1 Test Specificity
 - 5.2.3 Wet Chemical Procedures
 - 5.2.3.1 Chemical Color Tests
 - 5.2.3.2 Microscopic Techniques
 - 5.2.3.3 Thin-Layer Chromatography
 - 5.2.3.4 Extractions
 - 5.2.3.5 Wet Chemical Documentation
 - 5.2.4 Instrumental Examinations
 - 5.2.4.1 Ultraviolet Spectroscopy
 - 5.2.4.2 Gas Chromatography
 - 5.2.4.3 Mass Spectroscopy
 - 5.2.4.4 Infrared Spectroscopy
 - 5.2.4.5 Documentation
 - 5.2.5 Analytical Schemes
 - 5.2.5.1 Solid Samples
 - 5.2.5.2 Liquid Mixtures
 - 5.2.5.3 Chromatographic Screening
 - 5.2.6 Extractions
 - 5.2.6.1 Physical Extraction
 - 5.2.6.2 Dry Wash/Extraction
 - 5.2.6.3 Liquid/Liquid Extractions
 - 5.2.7 Isomer Determination
 - 5.2.7.1 Microcrystal Examination
 - 5.2.7.2 Derivatization
- 5.3 Quantitation
 - 5.3.1 Microscopic Examination
 - 5.3.2 Gravimetric Techniques

- 5.3.3 UV Techniques
- 5.3.4 GC Technique
- 5.4 Summary

6 Opinions

- 6.1 The Questions
 - 6.1.1 Who?
 - 6.1.2 What?
 - 6.1.3 When?
 - 6.1.4 Where?
 - 6.1.5 Why?
 - 6.1.6 How?
- 6.2 Information
 - 6.2.1 Scene Information
 - 6.2.2 Laboratory Analysis Information
- 6.3 Experience and Training
 - 6.3.1 What? How? How Much?
 - 6.3.2 What Is He Making?
 - 6.3.3 How Is He Making It?
 - 6.3.4 How Much ... ?
 - 6.3.5 How Much Product?
 - 6.3.6 How Much per Batch?
 - 6.3.6.1 Equipment Limitations
 - 6.3.6.2 Chemical Limitations
 - 6.3.6.3 Reaction Limitations
 - 6.3.7 How Much per Week?
 - 6.3.7.1 Production with Available Chemicals
- 6.4 Summary

7 Testimony

- 7.1 Case Preparation
- 7.2 Pretrial Conference
 - 7.2.1 Educate the Attorney about Clandestine Drug Labs in General
 - 7.2.2 Educate the Attorney about the Generalities of this Clandestine Drug Lab
 - 7.2.3 Tell the Attorney what Indicates that a Clandestine Drug Lab Exists in this Instance
 - 7.2.4 Tell the Attorney what Items Are Missing

- 7.2.5 Explain the Sampling Procedures that Were Used
 - 7.2.6 Explain Chemical Disposal (if Used)
 - 7.2.7 Outline Testimony
 - 7.2.8 Discuss Visual Aids
- 7.3 Testimony
 - 7.3.1 Direct Testimony
 - 7.3.2 Cross-Examination
 - 7.3.3 Independent Expert
- 7.4 Visual Aids
 - 7.4.1 Simple
 - 7.4.2 Easy to Read
 - 7.4.3 Easy to Understand
 - 7.4.4 Colorful
 - 7.4.5 Types of Visual Aids
 - 7.4.5.1 Photographs
 - 7.4.5.2 Slides
 - 7.4.5.3 Flip Charts and Overheads
 - 7.4.5.4 Power Point Presentation
 - 7.4.5.5 Evidence Exhibits
 - 7.4.5.6 Combination of Visual Aids
 - 7.4.5.7 Court Exhibits
- 7.5 Summary

8 Explosives Labs

- 8.1 Explosives Labs Operators and Manufacturers
- 8.2 Regulation
- 8.3 Scene Processing Procedures
- 8.4 Summary

9 Practical Applications and Examples

- Practical Example 1: Extraction Labs
- Practical Example 2: Extraction Labs
- Practical Example 3: Conversion Labs
- Practical Example 4: Conversion Labs
- Practical Example 5: Conversion Labs
- Practical Example 6: Synthesis and Extraction
- Practical Example 7: Distillation
- Practical Example 8: Distillation

Practical Example 9: Distillation
Practical Example 10: Extraction and Separation
Practical Example 11: Filtration
Practical Example 12: Mechanical Explosions
Practical Example 13: Mechanical Explosions
Practical Example 14: Vapor Explosions
Practical Example 15: Compressed Gas Hazards
Practical Example 16: Compressed Gas Hazards
Practical Example 17: Compressed Gas Hazards
Practical Example 18: Initial Crime Scene Evaluation
Practical Example 19: Training and Experience
Practical Example 20: Training and Experience
Practical Example 21: Sampling
Practical Application 1: Bottle Volume Estimates
Practical Application 2: Flask Volume Estimates
Practical Application 3: Separatory Funnel Volume Estimates
Practical Application 4: Reaction Flask Volume Estimates
Practical Example 22: Data Interpretation
Practical Example 23: Data Interpretation
Practical Example 24: Data Interpretation
Practical Application 5: Dry Extractions
Practical Application 6: Methamphetamine Extraction
Practical Application 7: Methamphetamine Extraction
Practical Application 8: Ephedrine/Pseudoephedrine
Separation
Practical Application 9: Methamphetamine By-Product
Profile Extraction
Practical Application 10: Quantitation
Practical Application 11: Gravimetric Quantitation
Practical Application 12: Serial Dilution Quantitation
Practical Application 13: Mathematic Application of Serial
Dilution Quantitation
Practical Application 14: Single Standard Solution
Practical Example 25: Opinions (Knowledge and Experience)
Practical Example 26: Opinions (Knowledge and Experience)
Practical Application 15: Opinions (Data Interpretation)
Practical Application 16: Opinions (Data Interpretation)
Practical Application 17: Opinions (Production Estimates)
Practical Application 18: Opinions (Production Estimates,
Multistep)
Practical Application 19: Opinions (Per Batch Production
Estimates)

Practical Example 27: Testimony

Practical Example 28: Testimony

Appendix A

Scientific Equipment Encountered at Clandestine Labs

Reflux Variations

Distillation Variations

Hydrogenator Variations

Vacuum Filtration Variations

Extraction Equipment Variations

Makeshift Ventilation

Appendix B: Legitimate Use Table

Appendix C: Drug Precursor/Reagent Table A

Appendix C: Drug Precursor/Reagent Table B

Appendix D: Reaction Mechanisms

Appendix E: Chemical Hazards

Appendix F: Toxicology Table

Appendix G: Optical Properties of Inorganic Compounds

Appendix H: Crystal Test Reagents

Appendix I: Anion IR Absorbance Table

Appendix J: Color Test Reagents

Appendix K: Mass Spec Data of Reaction Mixture Components

Appendix L: Extraction Procedures

Extraction Solubility Guidelines

Particle Picking

Dry Extraction

Dry Wash

General Liquid/Liquid Extraction Procedure
General Ion-Pairing Extraction Technique

Appendix M: General Calculation Equations

Geometric Shape Volumes
Gravimetric Quantitation
 Solid Samples
 Liquid Samples
Serial Dilution Quantitation
Single Standard Solution Quantitation
Production Estimates

Appendix N: Conversion Factor Table

Appendix O: List of Explosive Materials

List of Explosive Materials

Appendix P: Sphere Volume Estimates

Appendix Q: Glossary

Appendix R: Clandestine Drug Lab Reference Material

General Information
Amphetamine/Methamphetamine
Phenylacetone
MDA/MDMA
Cathinone/Methcathinone
Phencyclidine
General Analysis
Reagent Preparation
Analysis and Detection of Explosives