a laboratory history of chemical warfare

a laboratory history of chemical warfare unfolds as a complex narrative of scientific innovation, ethical dilemmas, and global security concerns. From the earliest experiments in chemical agents to their deployment on battlefields and modern laboratory controls, the story of chemical warfare is deeply intertwined with advances in chemistry and military strategy. This article explores the origins of chemical warfare, significant laboratory breakthroughs, the evolution of weaponized agents, and the development of detection and protection technologies. By examining laboratory practices, pivotal discoveries, and regulatory efforts, readers will gain a comprehensive understanding of how chemical warfare has shaped history and continues to influence science and policy today. Through detailed analysis and engaging insights, this guide provides a thorough overview of the laboratory history of chemical warfare, highlighting its impact, challenges, and ongoing relevance.

Origins of Chemical Warfare and Early Laboratory Experiments

The laboratory history of chemical warfare traces back to ancient times when rudimentary toxic substances were harnessed for combat. However, systematic laboratory experimentation began in the late 19th and early 20th centuries. Scientists and military strategists collaborated to identify and refine chemical compounds that could incapacitate or harm adversaries, laying the foundation for modern chemical weapons.

Early Uses of Chemicals in Warfare

Historically, armies used smoke, poisonous plants, and crude mixtures to gain tactical advantages. The laboratory era commenced with the Industrial Revolution, which provided access to purified chemicals and advanced analytical techniques. Laboratories enabled precise formulation and testing of agents like chlorine and phosgene, transforming chemical warfare from primitive methods to scientifically engineered weapons.

- Use of Greek fire and arsenic smoke in ancient battles

- Development of toxic gas shells during World War I
- Laboratory isolation of respiratory poisons

Key Scientists and Laboratory Experiments

Renowned chemists such as Fritz Haber played pivotal roles in the laboratory development of chemical weapons. Haber's synthesis of chlorine gas for battlefield use marked a paradigm shift, demonstrating how laboratory research could directly influence military tactics. Early experiments focused on toxicity, dispersal mechanisms, and environmental persistence, establishing protocols for chemical weapon production and deployment.

Major Laboratory Breakthroughs in Chemical Weapons Development

Laboratories became the epicenter of innovation in chemical warfare, driving the creation of more potent and controllable agents. Key breakthroughs during the 20th century involved advances in organic chemistry, analytical instrumentation, and large-scale synthesis, enabling rapid development and refinement of chemical weapons.

World War I and the Birth of Modern Chemical Warfare

World War I marked a turning point, with laboratories producing vast quantities of lethal agents such as mustard gas and phosgene. Researchers developed methods for synthesizing these chemicals efficiently and safely, while laboratory testing determined optimal concentrations and delivery systems. This scientific rigor resulted in devastating battlefield applications, shaping military strategy and public perception.

Laboratory Innovation: Nerve Agents and Beyond

In the decades following World War I, laboratory research led to the creation of nerve agents like Tabun, Sarin, and VX. These compounds, engineered for extreme toxicity, emerged from sophisticated chemical synthesis and pharmacological studies. Laboratory teams explored new reaction pathways, stability factors, and antidote development, further expanding the arsenal of chemical weapons.

1. Synthesis of organophosphates for nerve agents
2. Discovery of blister agents with enhanced penetration
3. Development of binary chemical weapons for safer handling

The Evolution of Chemical Agents: Laboratory Synthesis and Innovation

The laboratory history of chemical warfare is marked by continual innovation in the design and synthesis of chemical agents. As scientific understanding deepened, laboratories developed chemicals with targeted physiological effects, improved delivery methods, and greater environmental persistence.

Laboratory Synthesis Techniques

Advances in synthetic chemistry allowed laboratories to produce chemical agents with high purity and consistency. Techniques such as distillation, solvent extraction, and chromatography enabled the isolation of active compounds and removal of impurities. Researchers focused on optimizing reaction conditions to maximize yield and minimize risk during synthesis and handling.

Innovation in Chemical Agent Formulation

Laboratory teams experimented with different formulations to enhance the effectiveness and stability of chemical agents. Innovations included microencapsulation for controlled release, the use of solvents to improve aerosolization, and the development of binary systems that combine precursor chemicals only at the point of use. These improvements made chemical weapons more adaptable and difficult to detect.

- Microencapsulation for delayed release
- Solvent selection for improved dispersion
- Binary systems for on-site mixing

Laboratory Detection, Analysis, and Protective Measures

Laboratory research in chemical warfare extends beyond weapon development, encompassing detection, analysis, and protective technologies. Accurate identification of chemical agents is critical for military and civilian safety, as is the creation of effective countermeasures.

Detection and Analytical Methods

Modern laboratories employ sophisticated techniques to detect and analyze chemical warfare agents. Methods such as gas chromatography-mass spectrometry (GC-MS), infrared spectroscopy, and immunoassays allow for rapid and reliable identification of toxic substances. Laboratory protocols are continually refined to improve sensitivity and reduce false positives.

Development of Protective Equipment

Laboratory advances have driven the creation of personal protective equipment and decontamination solutions. Scientists test materials for chemical resistance, develop filters for gas masks, and formulate skin protectants. Laboratory research has also optimized emergency response strategies, minimizing casualties and environmental impact during chemical incidents.

1. Design and testing of gas mask filters
2. Formulation of chemical-resistant suits
3. Development of rapid decontamination agents

Regulation, Ethics, and the Future of Chemical Warfare Research

The laboratory history of chemical warfare is closely linked to international regulation, ethical debates, and future scientific directions. As awareness of the destructive potential of chemical weapons grew, laboratories became subject to strict oversight and evolving norms.

International Treaties and Laboratory Compliance

International agreements such as the Chemical Weapons Convention (CWC) mandate rigorous controls on laboratory activities related to chemical warfare. Laboratories must adhere to protocols for safe handling, reporting, and disposal of hazardous materials. Regulatory bodies conduct inspections and enforce compliance to prevent misuse of chemical research.

Ethical Challenges and Scientific Responsibility

Ethical considerations in laboratory research are paramount. Scientists must balance the pursuit of knowledge with societal responsibility, ensuring that research does not

contribute to harm. Laboratory codes of conduct emphasize transparency, safety, and the prioritization of humanitarian values. Ongoing debates focus on dual-use research and the potential for scientific advances to be repurposed for warfare.

The Future of Laboratory Research in Chemical Warfare

Looking ahead, laboratory research in chemical warfare is likely to focus on defensive technologies, improved detection systems, and rapid response capabilities. Advances in biotechnology, nanomaterials, and artificial intelligence could reshape both the risks and protections associated with chemical agents. Laboratories will remain central to efforts to prevent, detect, and mitigate chemical threats in a changing global landscape.

Q: What were the earliest laboratory experiments in chemical warfare?

A: The earliest laboratory experiments in chemical warfare involved isolating toxic gases like chlorine and phosgene, testing their effects on animals, and refining methods for battlefield deployment, primarily during the late 19th and early 20th centuries.

Q: Who was Fritz Haber and what was his role in chemical warfare laboratories?

A: Fritz Haber was a German chemist who pioneered the laboratory synthesis of chlorine gas for warfare during World War I, significantly influencing the development and deployment of chemical weapons.

Q: How did laboratories contribute to the development of nerve agents?

A: Laboratories contributed by synthesizing organophosphate compounds, testing their toxicity, and developing safe handling and antidote protocols, leading to the creation of nerve agents like Sarin and VX.

Q: What analytical methods are used in laboratories to detect chemical warfare agents?

A: Laboratories use gas chromatography-mass spectrometry (GC-MS), infrared spectroscopy, and immunoassays to detect and analyze chemical warfare agents with high precision and reliability.

Q: What protective technologies have laboratories

developed against chemical agents?

A: Laboratories have developed gas mask filters, chemical-resistant suits, and rapid decontamination agents to protect individuals from exposure to chemical warfare agents.

Q: How do international regulations impact laboratory research in chemical warfare?

A: International regulations like the Chemical Weapons Convention require laboratories to follow strict protocols for handling, reporting, and disposing of chemical agents, with regular inspections to ensure compliance.

Q: What is dual-use research in the context of chemical warfare laboratories?

A: Dual-use research refers to scientific studies that can be applied for both civilian and military purposes, raising ethical concerns about the potential misuse of laboratory findings for chemical weapon development.

Q: How have laboratory innovations changed the delivery of chemical agents?

A: Laboratory innovations such as binary chemical systems, microencapsulation, and improved aerosolization techniques have made the delivery of chemical agents more efficient and harder to detect.

Q: What role do laboratories play in emergency response to chemical warfare incidents?

A: Laboratories are essential for rapidly detecting chemical agents, advising on protective measures, and developing decontamination solutions during emergency responses to chemical warfare incidents.

Q: What future trends are anticipated in laboratory research on chemical warfare?

A: Future trends include the development of advanced detection technologies, improved protective gear, and defensive strategies using biotechnology, nanomaterials, and artificial intelligence in laboratory settings.

[A Laboratory History Of Chemical Warfare]

A Laboratory History of Chemical Warfare: From Poison Arrows to Nerve Agents

The chilling history of chemical warfare isn't confined to battlefields; it's etched into the annals of scientific laboratories. This post delves into the grim evolution of chemical weapons, tracing their development from ancient poisons to the sophisticated nerve agents of today. We'll explore the key figures, pivotal discoveries, and ethical dilemmas that have shaped this dark chapter in human history, providing a comprehensive overview of the laboratory's crucial role in creating and refining these devastating weapons. Get ready to uncover a history as complex and deadly as the weapons themselves.

Early Experiments: The Genesis of Chemical Warfare (Pre-20th Century)

While the widespread use of chemical weapons is a 20th-century phenomenon, their conceptual roots stretch far back. Ancient civilizations employed rudimentary chemical agents, often derived from natural sources. Think of poison arrows dipped in plant toxins or the use of burning sulfur and pitch to choke enemies. These weren't sophisticated chemical weapons in the modern sense, but they represent the earliest attempts to leverage the power of chemistry for warfare. The lack of sophisticated laboratory techniques limited their effectiveness, but the underlying principle – using chemicals to inflict harm – was established.

The Alchemists' Contribution:

Early alchemists, though primarily focused on transmutation, unwittingly contributed to the development of chemical warfare. Their experiments with various substances and their attempts to understand their properties inadvertently expanded the knowledge base that would later be exploited for military purposes. While they didn't aim to create weapons, their findings laid the groundwork for future generations of chemists to weaponize their discoveries.

The First World War: The Industrialization of Death

The First World War marked a turning point. The industrial revolution, with its advances in chemical production and engineering, provided the means to mass-produce chemical weapons on an unprecedented scale. Laboratories across warring nations became factories of death, churning out chlorine gas, phosgene, and mustard gas. The horrific consequences of these weapons, vividly documented in firsthand accounts and photographs, shocked the world.

The Race for Deadlier Agents:

The war fueled a frenzied arms race. Chemists on both sides competed to develop more lethal and effective chemical agents. This spurred advancements in chemical synthesis and delivery systems, transforming the nature of warfare irrevocably. Laboratories became crucial not only for production but also for research into antidotes and protective measures – a grim arms race of offense and defense.

The Interwar Period: Refining the Arsenal

Despite the horrors of World War I, the development of chemical weapons didn't cease. The interwar period saw continued research and refinement, leading to the creation of more potent and persistent agents. Laboratories continued to explore new chemical compounds, seeking to improve lethality, persistence, and delivery methods. This period laid the groundwork for the even more devastating chemical weapons of the subsequent world war.

World War II and Beyond: Nerve Agents and the Cold War

World War II witnessed the emergence of nerve agents, a class of organophosphate compounds far more toxic than anything used previously. Laboratories developed nerve agents like Sarin, Soman, and Tabun, demonstrating the terrifying potential of chemical synthesis in creating weapons of mass destruction. The Cold War further intensified the development and stockpiling of chemical weapons, with both the US and the Soviet Union investing heavily in research and production.

The Ethical Quandary:

The history of chemical warfare is inextricably linked to ethical dilemmas. The development and use of these weapons raise profound questions about morality, the responsibilities of scientists, and the balance between national security and humanitarian concerns. The scientific community has grappled with its role in creating such destructive forces, leading to ongoing debates about the ethical implications of scientific research and its potential for misuse.

Conclusion: A Legacy of Destruction and the Path Forward

The laboratory history of chemical warfare is a chilling testament to the destructive potential of scientific innovation. From ancient poisons to modern nerve agents, the relentless pursuit of more effective weapons has left a legacy of suffering and environmental damage. Understanding this history is crucial for preventing future atrocities and fostering international cooperation to eliminate these weapons of mass destruction. The ongoing efforts towards disarmament and the strengthening of international treaties are essential steps toward a future free from the threat of chemical warfare.

FAQs:

1. What were some of the early methods of delivering chemical weapons? Early methods included simple containers for throwing or spraying, crude projectiles, and even the wind itself to disperse gases.

2. How did the development of chemical warfare impact the development of protective measures? The threat of chemical attacks spurred significant advancements in gas masks, protective clothing, and decontamination techniques.

3. What international treaties exist to regulate chemical weapons? The Chemical Weapons Convention (CWC) is the primary international agreement banning the development, production, stockpiling, and use of chemical weapons.

4. Are there any ongoing concerns regarding the use of chemical weapons in modern conflicts? The use of chemical weapons in Syria and other conflicts highlights the persistent threat and the need for continued vigilance and enforcement of international norms.

5. What role do scientists play in preventing the misuse of chemical research for weapons development? Scientists have a crucial role in promoting ethical conduct, advocating for responsible research practices, and supporting international efforts towards disarmament and the prevention of chemical warfare.

a laboratory history of chemical warfare: A Laboratory History of Chemical Warfare Agents Jared Ledgard, 2007-02 A Laboratory History of Chemical Warfare Agents is a revolutionary new book discussing the laboratory preparation of some of the most interesting toxic substances known to man. However broad the field may be, this book is an invaluable collection of nearly 100 years of chemical warfare research and history. From the researcher to the student or just plain novice, the information contained herein will change the way you think about warfare agents and their properties. The book is a valuable educational tool designed to give the reader a full picture of the world of chemical warfare agents. NOTE TO CUSTOMERS: This book has been renamed from the Preparatory Manual of Chemical Warfare Agents, to A Laboratory History of Chemical Warfare Agents.

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new book discussing the laboratory preparation of some of the most interesting toxic substances known to man. However broad the field may be, this book is an invaluable collection of nearly 100 years of chemical warfare research and history. From the researcher to the student or just plain novice, the information contained herein will change the way you think about warfare agents and their properties. The book is a valuable educational tool designed to give the reader a full picture of the world of chemical warfare agents. NOTE TO CUSTOMERS, this book has been renamed from The Preparatory Manual of Chemical Warfare Agents so if you have already purchased The Preparatory Manual of Chemical Warfare Agents in the past, then you don't need to purchase A Laboratory History of Chemical Warfare Agents.

a laboratory history of chemical warfare: Handbook of Toxicology of Chemical Warfare Agents Ramesh C Gupta, 2009-04-02 This groundbreaking book covers every aspect of deadly toxic chemicals used as weapons of mass destruction and employed in conflicts, warfare and terrorism. Including findings from experimental as well as clinical studies, this one-of-a-kind handbook is prepared in a very user- friendly format that can easily be followed by students, teachers and researchers, as well as lay people. Stand-alone chapters on individual chemicals and major topics allow the reader to easily access required information without searching through the entire book.This is the first book that offers in-depth coverage of individual toxicants, target organ toxicity, major incidents, toxic effects in humans, animals and wildlife, biosensors, biomarkers, on-site and laboratory analytical methods, decontamination and detoxification procedures, prophylactic, therapeutic and countermeasures, and the role of homeland security. - Presents a comprehensive look at all aspects of chemical warfare toxicology in one reference work. This saves researchers time in quickly accessing the very latest definitive details on toxicity of specific agents used in chemical warfare as opposed to searching through thousands of journal articles. Will include the most agent-specific information on the market - Includes detailed coverage of the most exhaustive list of agents possibly used as chemical warfare agents in one source. Section 4: Agents That Can Be Used as Weapons of Mass Destruction ? 25 chapters long. Other books on the market only include a sample selection of specific agents. Offering all possible agents detailed under one cover makes this appealing to a wider audience and saves researchers time - The Forward will be written by Dr. Tetsuo Satoh, Chiba University, Japan. He is one of the most respected, recognizable authorities on chemical warfare agents which will set the authoritative tone for the book - Covers risk to humans, animals and the environment equally. Researchers involved in assessing the risks involved with a possible chemical warfare attack and those who are developing response plans to such attacks must look at not only the risks to human health but to our wildlife and environment as well. The holistic approach taken in this book ensures that the researchers have ready access to the details no matter which aspect of the effects of CWA's they might be concerned with

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a laboratory history of chemical warfare: Historical Dictionary of Nuclear, Biological, and Chemical Warfare Benjamin C. Garrett, 2017-08-25 The history of biological weapons (BW), chemical weapons (CW), and nuclear weapons is complicated. It can be disturbing, tragic, and occasionally encouraging. It is rarely amusing, although the names selected for certain weapons suggest a casualness toward the consequences of their use: Atomic Annie, Blue Peacock, Dew of Death, Fat Man, Flying cow, George, Gilda, Helen of Bikini, Hurricane, Katie, Little Boy, Lulu, Mike, Red Beard, Sewer Pipe, Squirt. Use of BW and CW in warfare has produced mixed results in terms of effecting the outcome of a battle or campaign; despite this mixed record, both weapon types have attracted intense interest and strong advocacy for further use. The sole experience with use of nuclear weapons in warfare is viewed as hastening surrender by Japan, created competition among nations to develop more such weapons, and influenced efforts to ban any use or even stockpiling of such weapons. Each of these three weapon types has its own peculiar history, as recounted in this dictionary. This second edition of Historical Dictionary of Nuclear, Biological and Chemical Warfare contains a chronology, an introduction, and an extensive bibliography. The dictionary section has over 700 cross-referenced entries onterms related to NBC warfare, ranging from basic descriptions of substances used to details on incidents and episodes where NBC weapons were used, historical events, persons important to NBC warfare, countries where such weapons have been developed or used, and international treaties and treaty-related organizations.

a laboratory history of chemical warfare: *Dew of Death* Joel A. Vilensky, 2005-09-07 Dr. Vilensky raises important concerns regarding the threats posed by lewisite and other weapons of mass destruction. As he describes, non-proliferation programs are a vital component in the War on Terror. -- Richard G. Lugar, United States Senator Joel Vilensky's book is a detailed and immensely useful account of the development and history of one of the major chemical weapons.... We will always know how to make lewisite, the 'Dew of Death,' but that does not mean that we should, or be compelled to accept such weapons in our lives. -- from the Foreword by Richard Butler, former head of UN Special Commission to Disarm Iraq In 1919, when the Great War was over, the New York Times reported on a new chemical weapon with the fragrance of geranium blossoms, a poison gas that was the climax of this country's achievements in the lethal arts. The name of this substance was lewisite and this is its story -- the story of an American weapon of mass destruction. Discovered by accident by a graduate student and priest in a chemistry laboratory at the Catholic University of America in Washington, D.C., lewisite was developed into a weapon by Winford Lewis, who became its namesake, working with a team led by James Conant, later president of Harvard and head of government oversight for the U.S.'s atomic bomb program, the Manhattan Project. After a powerful German counterattack in the spring of 1918, the government began frantic production of lewisite in hopes of delivering 3,000 tons of the stuff to be ready for use in Europe the following year. The end of war came just as the first shipment was being prepared. It was dumped into the sea, but not forgotten. Joel A. Vilensky tells the intriguing story of the discovery and development of lewisite and its curious history. During World War II, the United States produced more than 20,000 tons of lewisite, testing it on soldiers and secretly dropping it from airplanes. In the end, the substance was abandoned as a weapon because it was too unstable under most combat conditions. But a weapon once discovered never disappears. It was used by Japan in Manchuria and by Iraq in its war with Iran. The Soviet Union was once a major manufacturer. Strangely enough, although it was developed for lethal purposes, lewisite led to an effective treatment for a rare neurological disease.

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molecular images, molecular physical properties, and laboratory chemistry, procedures, and safety. The third edition Volume 1 includes brand new chapters and sections including: Section I: LABORATORY TUTORIAL AND REFERENCE GUIDE, Chapter 1: Laboratory tutorial on techniques and procedures; Chapter 2: Reference guide. Section II: LACHRYMATOR, DISABLING, AND IRRITANT AGENTS, Chapter 3: Physical Nature of Lachrymator, disabling, and irritant substances; Chapter 4: Preparation of Lachrymator, disabling, and irritant substances. Section III: BLOOD AGENTS, Chapter 5: Physical Nature of Blood Agents; Chapter 6: The Preparation of blood agents. Section IV: BLISTER AGENTS (POTENT VESICANTS: TISSUE DAMAGING AGENTS), Chapter 7: Physical Nature of Blister agents, including sulfur mustards, nitrogen mustards, and arsenicals; Chapter 8: Preparation of Blister Agents including sulfur mustards, nitrogen mustards, and arsenicals. Section V: NERVE AGENTS (POTENT ACETYLCHOLINESTERASE INHIBITORS), Chapter 9: Physical Nature of Nerve agents; and Chapter 10: Preparation of Nerve Agents. The Preparatory Manual of Chemical Warfare Agents Third Edition Volume 1 is an extremely valuable reference book used to teach scientific, laboratory, and toxicity data for students, researchers, government agencies, contractors, first responders, and military operatives.

a laboratory history of chemical warfare: *Toxicology of Cyanides and Cyanogens* Alan H. Hall, Gary E. Isom, Gary A. Rockwood, 2015-10-13 The basic and applied toxicology of cyanides and cyanogens has widespread commercial, occupational, environmental, clinical, forensic, military, and public health implications. This book provides a detailed and updated reference describing the properties, uses, general and human toxicology, clinical recognition, diagnosis and medical management, and countermeasures is therefore required in academic, medical, occupational, environmental, medico-legal, regulatory, emergency response, and military arenas. Edited by a world-renowned team of experts from academia, defense and industry, this book will be an invaluable reference for professionals, researchers and students in cyanide and cyanogens.

a laboratory history of chemical warfare: *One Hundred Years of Chemical Warfare: Research, Deployment, Consequences* Bretislav Friedrich, Dieter Hoffmann, Jürgen Renn, Florian Schmaltz, Martin Wolf, 2017-11-26 This book is open access under a CC BY-NC 2.5 license. On April 22, 1915, the German military released 150 tons of chlorine gas at Ypres, Belgium. Carried by a long-awaited wind, the chlorine cloud passed within a few minutes through the British and French trenches, leaving behind at least 1,000 dead and 4,000 injured. This chemical attack, which amounted to the first use of a weapon of mass destruction, marks a turning point in world history. The preparation as well as the execution of the gas attack was orchestrated by Fritz Haber, the director of the Kaiser Wilhelm Institute for Physical Chemistry and Electrochemistry in Berlin-Dahlem. During World War I, Haber transformed his research institute into a center for the development of chemical weapons (and of the means of protection against them). Bretislav Friedrich and Martin Wolf (Fritz Haber Institute of the Max Planck Society, the successor institution of Haber’s institute) together with Dieter Hoffmann, Jürgen Renn, and Florian Schmaltz (Max Planck Institute for the History of Science) organized an international symposium to commemorate the centenary of the infamous chemical attack. The symposium examined crucial facets of chemical warfare from the first research on and deployment of chemical weapons in WWI to the development and use of chemical warfare during the century hence. The focus was on scientific, ethical, legal, and political issues of chemical weapons research and deployment — including the issue of dual use — as well as the ongoing effort to control the possession of chemical weapons and to ultimately achieve their elimination. The volume consists of papers presented at the symposium and supplemented by additional articles that together cover key aspects of chemical warfare from 22 April 1915 until the summer of 2015.

a laboratory history of chemical warfare: The A to Z of Nuclear, Biological and Chemical Warfare Benjamin C. Garrett, John Hart, 2009-09-16 Human experience with nuclear, biological, and chemical (NBC) warfare has been limited, especially in comparison to conventional forms of warfare. Our experience with nuclear warfare is confined to a period of less than one week during the end of World War II, when the United States successfully used two nuclear weapons

against targets in Japan. The course of biological warfare and modern use of biological weapons are difficult to track owing to the difficulty of differentiating deliberate use from natural outbreaks. However, the keen potential of biological weapons in acts of terror was shown in the mass disruption caused in the fall 2001 experience in the U.S. with the release of anthrax through the American postal system. Chemical weapons have been used in a handful of conflicts since their introduction to modern warfare during World War I, most recently during the Iran-Iraq War during the 1980s. Despite this limited experience, NBC warfare continues to exert a certain fascination among states. The A to Z of Nuclear, Biological, and Chemical Warfare covers the development and use of NBC weapons as well as efforts to limit or control the use of these weapons through a chronology, a bibliography, an introductory essay, and dictionary entries. Over 500 cross-referenced dictionary entries provide a unique selection of terms related to NBC warfare, ranging from basic descriptions of substances used in NBC warfare to details on incidents and episodes where NBC weapons were used. Entries are structured around historical events, persons important to NBC warfare, countries where such weapons have been developed or used, and international treaties and treaty-related organizations.

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Fire and Rescue Services, and other First Responders need to know when dealing with dangerous chemical agents.

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a laboratory history of chemical warfare: CBRN Protection Andre Richardt, Birgit Hülseweh, Bernd Niemeyer, Frank Sabath, 2013-03-01 Originating in the armed forces of the early 20th century, weapons based on chemical, biological or nuclear agents have become an everpresent threat that has not vanished after the end of the cold war. Since the technology to produce these agents is nowadays available to many countries and organizations, including those with terrorist aims, civil authorities across the world need to prepare against incidents involving these agents and train their personnel accordingly. As an introductory text on NBC CBRN weapons and agents, this book leads the reader from the scientific basics to the current threats and strategies to prepare against them. After an introductory part on the history of NBC CBRN weapons and their international control, the three classes of nuclear/radiological, biological, and chemical weapons are introduced, focusing on agents and delivery vehicles. Current methods for the rapid detection of NBC CBRN agents are introduced, and the principles of physical protection of humans and structures are explained. The final parts addresses more general issues of risk management, preparedness and response management, as the set of tools that authorities and civil services will be needed in a future CBRN scenario as well as the likely future scenarios that authorities and civil services will be faced with in the coming years. This book is a must-have for Health Officers, Public Health Agencies, and Military Authorities.

a laboratory history of chemical warfare: Unit 731: Laboratory of the Devil, Auschwitz of the East Yang Yan-Jun, Tam Yue-Him, 2018-04-28 This book exposes Unit 731 as being the largest bacterial warfare force in the history of the Second World War. Manufacture and the use of biological weapons, the entire process of preparation and implementation of germ warfare, with the reflection on war and human nature, medical and ethical issues, is given by the testimony of the veterans of Unit 731. This evidence is provided by the surviving Chinese labourers and the families of the victims. The book focuses on five aspects: first, the inhuman medical crimes of Unit 731 weapons, the biological combats, and human experiments; secondly, the war damage and the postwar effects of biological war by Unit 731 brought to China and other Asian countries; thirdly, the survey and cover-up at the Khabarovsk War Crime Trials; fourthly the protection status of the site with development status of the exhibition and international exchanges of the Unit 731 Museum; fifthly and finally, there is a separate chapter discussing Japanese chemical warfare.

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a laboratory history of chemical warfare: A History of Chemical and Biological Weapons Edward M. Spiers, 2010-04-30 Following the 9/11 attacks and the anthrax letters that appeared in their wake, the threat posed by the widespread accessibility of chemical and biological weapons has continually been used to stir public fear and opinion by politicians and the media alike. In Chemical and Biological Weapons, Edward M. Spiers cuts through the scare tactics and hype to provide a thorough and even-handed examination of the weapons themselves—the various types and effects—and their evolution from World War I to the present. Spiers describes the similarities and differences between the two types of weapons and how technological advancements have led to tactical innovations in their use over time. As well, he gives equal attention to the international response to the proliferation of chemical and biological weapons, analyzing global efforts aimed at restraining their use, such as deterrence and disarmament, and the effectiveness of these

approaches in the twentieth century. Using Iraq as a case study, Spiers also investigates its deployment of chemical weapons in the Iran-Iraq War and the attempts by the international community to disarm Iraq through the United Nations Special Commission and the United States-led war in 2003. A timely and balanced historical survey, Chemical and Biological Weapons will be of interest to readers studying the proliferation and use of chemical and biological warfare and the reactions of the international community throughout the last several decades.

a laboratory history of chemical warfare: *The Challenge of Old Chemical Munitions and Toxic Armament Wastes* Thomas Stock, Karlheinz Lohs, 1997 In October 1993, eighteen experts from ten countries met in Munster, Germany to discuss various aspects of the problem of old chemical munitions and toxic armaments wastes. This comprehensive study discusses the characteristics of chemical warfare agents and toxic armament wastes, past chemical weapons production activities, chemical weapons disposal and destruction, sea dumping of chemical weapons, and legal issues related to old chemical munitions and toxic armament wastes.

a laboratory history of chemical warfare: Germs Judith Miller, William J Broad, Stephen Engelberg, 2012-02-01 In this “engrossing, well-documented, and highly readable” (San Francisco Chronicle) New York Times bestseller, three veteran reporters draw on top sources inside and outside the U.S. government to reveal Washington's secret strategies for combating germ warfare and the deadly threat of biological and chemical weapons. Today Americans have begun to grapple with two difficult truths: that there is no terrorist threat more horrifying—and less understood—than germ warfare, and that it would take very little to mount a devastating attack on American soil. Featuring an inside look at how germ warfare has been waged throughout history and what form its future might take (and in whose hands), Germs reads like a gripping detective story told by fascinating key figures: American and Soviet medical specialists who once made germ weapons but now fight their spread, FBI agents who track Islamic radicals, the Iraqis who built Saddam Hussein's secret arsenal, spies who travel the world collecting lethal microbes, and scientists who see ominous developments on the horizon. With clear scientific explanations and harrowing insights, Germs is a vivid, masterfully written—and timely—work of investigative journalism.

a laboratory history of chemical warfare: *Chemical Warfare in World War I* Charles E Heller, 2018-09-16 This Leavenworth Paper chronicles the introduction of chemical agents in World War I, the U.S. Army's tentative preparations for gas warfare prior to and after American entry into the war, and the AEF experience with gas on the Western Front. Chemical warfare affected tactics and almost changed the outcome of World War I. The overwhelming success of the first use of gas caught both sides by surprise. Fortunately, the pace of hostilities permitted the Allies to develop a suitable defense to German gas attacks and eventually to field a considerable offensive chemical capability. Nonetheless, from the introduction of chemical warfare in early 1915 until Armistice Day in November, 1918, the Allies were usually one step behind their German counterparts in the development of gas doctrine and the employment of gas tactics and procedures. In his final report to Congress on World War I, General John J. Pershing expressed the sentiment of contemporary senior officers when he said, Whether or not gas will be employed in future wars is a matter of conjecture, but the effect is so deadly to the unprepared that we can never afford to neglect the question. General Pershing was the last American field commander actually to confront chemical agents on the battlefield. Today, in light of a significant Soviet chemical threat and solid evidence of chemical warfare in Southeast and Southwest Asia, it is by no means certain he will retain that distinction. Over 50 percent of the Total Army's Chemical Corps assets are located within the United States Army Reserve. This Leavenworth Paper was prepared by the USAA Staff Officer serving with the Combat Studies Institute, USACGSC, after a number of requests from USAA Chemical Corps officers for a historical study on the nature of chemical warfare in World War I. Despite originally being published in 1984, this Leavenworth Paper also meets the needs of the Total Army in its preparations to fight, if necessary, on a battlefield where chemical agents might be employed.

a laboratory history of chemical warfare: Toxic Exposures Susan L. Smith, 2017-01-17 Mustard gas is typically associated with the horrors of World War I battlefields and trenches, where

chemical weapons were responsible for tens of thousands of deaths. Few realize, however, that mustard gas had a resurgence during the Second World War, when its uses and effects were widespread and insidious. Toxic Exposures tells the shocking story of how the United States and its allies intentionally subjected thousands of their own servicemen to poison gas as part of their preparation for chemical warfare. In addition, it reveals the racialized dimension of these mustard gas experiments, as scientists tested whether the effects of toxic exposure might vary between Asian, Hispanic, black, and white Americans. Drawing from once-classified American and Canadian government records, military reports, scientists' papers, and veterans' testimony, historian Susan L. Smith explores not only the human cost of this research, but also the environmental degradation caused by ocean dumping of unwanted mustard gas. As she assesses the poisonous legacy of these chemical warfare experiments, Smith also considers their surprising impact on the origins of chemotherapy as cancer treatment and the development of veterans' rights movements. Toxic Exposures thus traces the scars left when the interests of national security and scientific curiosity battled with medical ethics and human rights.

a laboratory history of chemical warfare: Public Health Response to Biological and Chemical Weapons World Health Organization, 2004-01-21 This is the second edition of this publication which focuses on the public health aspects of the possible deliberate use of biological or chemical agents. Issues discussed include: the key principles for public health planning, risk assessment, hazard identification and evaluation, risk management strategies, and response planning as part of existing national emergency plans, disease surveillance and early warning systems, the national and international legal framework, and international sources of assistance. Technical annexes cover a range of issues including chemical agents, toxins, biological agents, principles of protection, precautions against the sabotage of drinking water, food and other products, information resources and the affiliation of WHO Member States to the international treaties on biological and chemical weapons.

a laboratory history of chemical warfare: *Lab 257* Michael C. Carroll, 2009-10-13 Strictly off limits to the public, Plum Island is home to virginal beaches, cliffs, forests, ponds -- and the deadliest germs that have ever roamed the planet. Lab 257 blows the lid off the stunning true nature and checkered history of Plum Island. It shows that the seemingly bucolic island in the shadow of New York City is a ticking biological time bomb that none of us can safely ignore. Based on declassified government documents, in-depth interviews, and access to Plum Island itself, this is an eye-opening, suspenseful account of a federal government germ laboratory gone terribly wrong. For the first time, Lab 257 takes you deep inside this secret world and presents startling revelations on virus outbreaks, biological meltdowns, infected workers, the periodic flushing of contaminated raw sewage into area waters, and the insidious connections between Plum Island, Lyme disease, and the deadly West Nile virus. The book also probes what's in store for Plum Island's new owner, the Department of Homeland Security, in this age of bioterrorism. Lab 257 is a call to action for those concerned with protecting present and future generations from preventable biological catastrophes.

a laboratory history of chemical warfare: A Short History of Biological Warfare W. Seth Carus, National Defense University (U S), National Defense University. Center for the Study of Weapons of Mass Destruction, 2017 This publication gives a history of biological warfare (BW) from the prehistoric period through the present, with a section on the future of BW. The publication relies on works by historians who used primary sources dealing with BW. In-depth definitions of biological agents, biological weapons, and biological warfare (BW) are included, as well as an appendix of further reading on the subject. Related items: Arms & Weapons publications can be found here: https://bookstore.gpo.gov/catalog/arms-weapons Hazardous Materials (HAZMAT & CBRNE) publications can be found here: https://bookstore.gpo.gov/catalog/hazardous-materials-hazmat-cbrne

a laboratory history of chemical warfare: Chemical Warfare Agents Brian J. Lukey, James A. Romano Jr., Harry Salem, 2019-04-11 The first edition of this book, Chemical Warfare Agents: Toxicity at Low Levels, was published just prior to the terrorist attacks of September 11, 2001. The second edition titled, Chemical Warfare Agents: Pharmacology, Toxicology, and Therapeutics,

included new epidemiological and clinical studies of exposed or potentially exposed populations; new treatment concepts and products; improved organization of the national response apparatus addressing the potential for CWA terrorism; and improved diagnostic tests that enable rapid diagnosis and treatment. Since the second edition, the chemical warfare agent community has worked hard to advance research for protection and treatment and develop/improve response approaches for individuals and definitive care. Consequently, in addition to updating previous chapters, Chemical Warfare Agents: Biomedical and Psychological Effects, Medical Countermeasures, and Emergency Response, Third Edition features several new chapters that address the Syrian War, chemical destruction, the Organisation for the Prohibition of Chemical Weapons, biomarkers for chemical warfare agent exposure, field sensors, aircraft decontamination, lung/human on a chip, chemical warfare response decision making, and other research advancements. Features: Describes the newest medical interventions, and the latest technologies deployed in the field, as well as developments in the international response to CW usage highlighting recent events in the Middle East Discusses the latest in organizational/interagency partitioning in terms of responsibilities for emergency response, not just in the United States but at the international level—whether prevention, mitigation, medical care, reclamation, or medico-legal aspects of such response Contains the most current research from bench-level experts The third edition contains the most up-to-date and comprehensive coverage of the question of chemical warfare agent employment on the battlefield or in terrorism. Edited by workers that have been in the field for 35+ years, it remains faithful to the scientific constants, while evaluating and crediting the advances by the industry that have made us safer.

a laboratory history of chemical warfare: *The Great Secret: The Classified World War II Disaster that Launched the War on Cancer* Jennet Conant, 2020-09-08 The gripping story of a chemical weapons catastrophe, the cover-up, and how one American Army doctor’s discovery led to the development of the first drug to combat cancer, known today as chemotherapy. On the night of December 2, 1943, the Luftwaffe bombed a critical Allied port in Bari, Italy, sinking seventeen ships and killing over a thousand servicemen and hundreds of civilians. Caught in the surprise air raid was the John Harvey, an American Liberty ship carrying a top-secret cargo of 2,000 mustard bombs to be used in retaliation if the Germans resorted to gas warfare. When one young sailor after another began suddenly dying of mysterious symptoms, Lieutenant Colonel Stewart Alexander, a doctor and chemical weapons expert, was dispatched to investigate. He quickly diagnosed mustard gas exposure, but was overruled by British officials determined to cover up the presence of poison gas in the devastating naval disaster, which the press dubbed little Pearl Harbor. Prime Minister Winston Churchill and General Dwight D. Eisenhower acted in concert to suppress the truth, insisting the censorship was necessitated by military security. Alexander defied British port officials and heroically persevered in his investigation. His final report on the Bari casualties was immediately classified, but not before his breakthrough observations about the toxic effects of mustard on white blood cells caught the attention of Colonel Cornelius P. Rhoads—a pioneering physician and research scientist as brilliant as he was arrogant and self-destructive—who recognized that the poison was both a killer and a cure, and ushered in a new era of cancer research led by the Sloan Kettering Institute. Meanwhile, the Bari incident remained cloaked in military secrecy, resulting in lost records, misinformation, and considerable confusion about how a deadly chemical weapon came to be tamed for medical use. Deeply researched and beautifully written, The Great Secret is the remarkable story of how horrific tragedy gave birth to medical triumph.

a laboratory history of chemical warfare: A History of Chemical Warfare K. Coleman, 2005-05-23 This book provides an analysis of the development and deployment of chemical weapons from 700BC to the present day. The First World War is examined in detail since it remains the most significant experience of the chemical threat, but the Second World War, and post-war conflicts are also evaluated. Additionally, protocols attempting to control the proliferation and use of chemical weapons are assessed. Finally, the book examines the threat (real and imagined) from a chemical warfare attack today by rationally assessing to what extent terrorist groups around the world are

capable of making and using such weapons.

a laboratory history of chemical warfare: The Chemical Age Frank A. von Hippel, 2020-09-04 This sweeping history reveals how the use of chemicals has saved lives, destroyed species, and radically changed our planet: “Remarkable . . . highly recommended.” —Choice In The Chemical Age, ecologist Frank A. von Hippel explores humanity’s long and uneasy coexistence with pests, and how the battles to exterminate them have shaped our modern world. He also tells the captivating story of the scientists who waged war on famine and disease with chemistry. Beginning with the potato blight tragedy of the 1840s, which led scientists on an urgent mission to prevent famine using pesticides, von Hippel traces the history of pesticide use to the 1960s, when Rachel Carson’s Silent Spring revealed that those same chemicals were insidiously damaging our health and driving species toward extinction. Telling the story in vivid detail, von Hippel showcases the thrills—and complex consequences—of scientific discovery. He describes the creation of chemicals used to kill pests—and people. And, finally, he shows how scientists turned those wartime chemicals on the landscape at a massive scale, prompting the vital environmental movement that continues today.

a laboratory history of chemical warfare: A Lab of One's Own Patricia Fara, 2018 2018 marks the centenary not only of the Armistice but also of women gaining the vote in the United Kingdom. A Lab of One's Own commemorates both anniversaries by exploring how the War gave female scientists, doctors, and engineers unprecedented opportunities to undertake endeavors normally reserved for men.

a laboratory history of chemical warfare: Silent Spring Rachel Carson, 2020-03-26 Now recognized as one of the most influential books of the twentieth century, Silent Spring exposed the destruction of wildlife through the widespread use of pesticides Rachel Carson's Silent Spring alerted a large audience to the environmental and human dangers of pesticides, spurring revolutionary changes in the laws affecting our air, land, and water. Despite condemnation in the press and heavy-handed attempts by the chemical industry to ban the book, Carson succeeded in creating a new public awareness of the environment which led to changes in government and inspired the ecological movement. It is thanks to this book, and the help of many environmentalists, that harmful pesticides such as DDT were banned from use in the US and countries around the world. This Penguin Modern Classics edition includes an introduction by Lord Shackleton, a preface by World Wildlife Fund founder Julian Huxley, and an afterword by Carson's biographer Linda Lear.

a laboratory history of chemical warfare: *The Politics of Chemistry* Agustí Nieto-Galan, 2019-08-22 Agust Nieto-Galan argues that chemistry in the twentieth century was deeply and profoundly political. Far from existing in a distinct public sphere, chemical knowledge was applied in ways that created strong links with industrial and military projects, and national rivalries and international endeavours, that materially shaped the living conditions of millions of citizens. It is within this framework that Nieto-Galan analyses how Spanish chemists became powerful ideological agents in different political contexts, from liberal to dictatorial regimes, throughout the century. He unveils chemists' position of power in Spain, their place in international scientific networks, and their engagement in fierce ideological battles in an age of extremes. Shared discourses between chemistry and liberalism, war, totalitarianism, religion, and diplomacy, he argues, led to advancements in both fields.

a laboratory history of chemical warfare: Possible Long-term Health Effects of Short-term Exposure to Chemical Agents , 1982

a laboratory history of chemical warfare: Dirty War Glenn Cross, 2017-03-21 Dirty War is the first comprehensive look at the Rhodesia’s top secret use of chemical and biological weapons (CBW) during their long counterinsurgency against native African nationalists. Having declared its independence from Great Britain in 1965, the government—made up of European settlers and their descendants—almost immediately faced a growing threat from native African nationalists. In the midst of this long and terrible conflict, Rhodesia resorted to chemical and biological weapons against an elusive guerrilla adversary. A small team made up of a few scientists and their students at a remote Rhodesian fort to produce lethal agents for use. Cloaked in the strictest secrecy, these

efforts were overseen by a battle-hardened and ruthless officer of Rhodesia's Special Branch and his select team of policemen. Answerable only to the head of Rhodesian intelligence and the Prime Minister, these men working alongside Rhodesia's elite counterguerrilla military unit, the Selous Scouts, developed the ingenious means to deploy their poisons against the insurgents. The effect of the poisons and disease agents devastated the insurgent groups both inside Rhodesia and at their base camps in neighboring countries. At times in the conflict, the Rhodesians thought that their poisons effort would bring the decisive blow against the guerrillas. For months at a time, the Rhodesian use of CBW accounted for higher casualty rates than conventional weapons. In the end, however, neither CBW use nor conventional battlefield successes could turn the tide. Lacking international political or economic support, Rhodesia's fate from the outset was doomed. Eventually the conflict was settled by the ballot box and Rhodesia became independent Zimbabwe in April 1980. Dirty War is the culmination of nearly two decades of painstaking research and interviews of dozens of former Rhodesian officers who either participated or were knowledgeable about the top secret development and use of CBW. The book also draws on the handful of remaining classified Rhodesian documents that tell the story of the CBW program. Dirty War combines all of the available evidence to provide a compelling account of how a small group of men prepared and used CBW to devastating effect against a largely unprepared and unwitting enemy. Looking at the use of CBW in the context of the Rhodesian conflict, Dirty War provides unique insights into the motivation behind CBW development and use by states, especially by states combating internal insurgencies. As the norms against CBW use have seemingly eroded with CW use evident in Iraq and most recently in Syria, the lessons of the Rhodesian experience are all the more valid and timely.

a laboratory history of chemical warfare: Pathogens for War Donald H. Avery, 2013-04-28 Pathogens for War explores how Canada and its allies have attempted to deal with the threat of germ warfare, one of the most fearful weapons of mass destruction, since the Second World War. In addressing this subject, distinguished historian Donald Avery investigates the relationship between bioweapons, poison gas, and nuclear devices, as well as the connection between bioattacks and natural disease pandemics. Avery emphasizes the crucially important activities of Canadian biodefence scientists – beginning with Nobel Laureate Frederick Banting – at both the national level and through cooperative projects within the framework of an elaborate alliance system. Delving into history through a rich collection of declassified documents, Pathogens for War also devotes several chapters to the contemporary challenges of bioterrorism and disease pandemics from both national and international perspectives. As such, readers will not only learn about Canada's secret involvement with biological warfare, but will also gain new insights into current debates about the peril of bioweapons – one of today's greatest threats to world peace.

a laboratory history of chemical warfare: Napalm Robert M. Neer, 2013-04-01 Napalm, incendiary gel that sticks to skin and burns to the bone, came into the world on Valentine's Day 1942 at a secret Harvard war research laboratory. On March 9, 1945, it created an inferno that killed over 87,500 people in Tokyo—more than died in the atomic explosions at Hiroshima or Nagasaki. It went on to incinerate sixty-four of Japan's largest cities. The Bomb got the press, but napalm did the work. After World War II, the incendiary held the line against communism in Greece and Korea—Napalm Day led the 1950 counter-attack from Inchon—and fought elsewhere under many flags. Americans generally applauded, until the Vietnam War. Today, napalm lives on as a pariah: a symbol of American cruelty and the misguided use of power, according to anti-war protesters in the 1960s and popular culture from Apocalypse Now to the punk band Napalm Death and British street artist Banksy. Its use by Serbia in 1994 and by the United States in Iraq in 2003 drew condemnation. United Nations delegates judged deployment against concentrations of civilians a war crime in 1980. After thirty-one years, America joined the global consensus, in 2011. Robert Neer has written the first history of napalm, from its inaugural test on the Harvard College soccer field, to a Marine Corps plan to attack Japan with millions of bats armed with tiny napalm time bombs, to the reflections of Phan Thi Kim Phuc, a girl who knew firsthand about its power and its morality.

a laboratory history of chemical warfare: The Poisonous Cloud L. F. Haber, 1986-02-20 The

author examines fully the military role of chemical warfare and its effects on the people, industries, and administrations on both sides; he also considers the growing moral problems it created. The launching of an entirely new weapon that did not discriminate between soldiers and civilians raised complex issues which were debated endlessly between the wars and which, in recent years, have led to agreement among the powers not to use chemical or biological warfare.

a laboratory history of chemical warfare: *The Preparatory Manual of Explosives* Jared Ledgard, 2018-11-25 The Preparatory Manual of Explosives: Radical, Extreme, Experimental Explosives Chemistry Vol.1 is broken down into Section 1: a) Introduction; b) Dual bonding; c) The Element Nitrogen; d) The element oxygen; e) The element chlorine; f) Introduction to filtration; 1) Gravity filtration; a) Fluting Filter Paper for use in gravity filtration; 2) Vacuum Filtration (suction filtration); a) General Laboratory Techniques: Methods of heating; 1) Free flame; 2) Steam bath, or water bath; 3) Oil bath; 4) Electric Heating Mantles; 5) Hot Plates; a) Methods of Cooling; 1) Cold water bath; 2) Ice water bath; 3) Standard ice bath; 4) Salt/ice bath; 5) Dry ice/acetone bath; a) Cooling tricks of the trade; b) Recrystallization, and solid product recovery; c) Recrystallization; 1) General recrystallization utilizing heat only; a) Working example of recrystallization using heat only; 2) Recrystallization using seed crystals; 3) Recovering the product through low heat and vacuum; a) Washing liquids; b) Washing solids using non-vacuum techniques; c) Washing solids using vacuum techniques; d) Drying solids; e) Drying liquids to remove water; f) Laboratory safety; g) Laboratory glassware; h) Laboratory equipment; Section 2: Intermediates, Reagents, and Solvents; Section 3: Experimental Explosives Chemistry; Theoretical Preparation 1: 1,3,5-trinitrohexazinane; Azinane; Theoretical Preparation 2: trisodium hexazinane-1,3,5-triide; SOD; Theoretical Preparation 3: 3,3',3''-hexazinane-1,3,5-triyltris(triaza-1,2-dien-2-ium-1-ide); HEXAAZIDE; HTA; Theoretical Preparation 4: diammonium trioxidane-1,3-diide; diammonium trioxide; DATD; Theoretical Preparation 5: 3,3'-trioxidane-1,3-diylbis(triaza-1,2-dien-2-ium-1-ide); TDTD; Theoretical Preparation 6: benzene-1,3,5-triyltris(chlorane) nonaoxide; BTCN; Chlorane; Theoretical Preparation 7: 2,4,6-trinitro-1,3,5,2,4,6-trioxatriazinane; TNTOTA; oxatriazinane; Theoretical Preparation 8: (2,4,6-trinitrobenzene-1,3,5-triyl)tris(chlorane) nonaoxide; Chlorane; Theoretical Preparation 9: 1,3,5-triazido-2,4,6-trinitrobenzene; Nitrazide; TATNB; Theoretical Preparation 10: 1,3,5-trinitrohexasilinane; nitrosilane; 2-TNHS; Theoretical Preparation 11: 1,3,5-trinitro-1,3,5-tris(nitrooxy)hexasilinane-1,3,5-triium; TNNHS; Si-135; Theoretical Preparation 12: 1,3,5-trinitrohexaphosphinane; TNHP; High Explosive Phosphorus; Theoretical Preparation 13: pentanitro-l5-phosphane; 5-PNP; Theoretical Preparation 14: trinitroamine oxide; TNAOX; NITROXIDE; Theoretical Preparation 15: pentachloryl-l5-phosphane; Theoretical Preparation 16: Tetranitrodiborane; TNDB; Nitro Boron; Theoretical Preparation 17: 1,2,3,4,5,6-hexanitrocyclohexaborane; KNCHB; 6-Nitrocycloborane; Theoretical Preparation 18: N'-perchlorylperchloric hydrazide; N'PCPH, Perchloryl hydrazine; Theoretical Preparation 19: tetranitrohydrazine; TNH-X; Theoretical Preparation 20: hexaaza-1,2,4,5-tetraene-2,5-diium-1,6-diide; Hexazide; HTDD; Theoretical Preparation 21: hexaazidobenzene; HAAB; 6-Azide; Theoretical Preparation 22: 1,2,3,4,5,6-hexanitro-1l4,2l4,3l4,4l4,5l4,6l4-hexathiine; Nitro hexathiine; Gamma-HNH; Theoretical Preparation 23: pentakis(dioxidobromanyl)-l5-chlorane; Chlorane; pentabromate chloride; PDDBC; Theoretical Preparation 24: hexa-1,3,5-triyne-1,6-diyl dinitrate; HTDD; poly acetylene dinitrate; Theoretical Preparation 25: 1,2,3,4,5,6-hexanitrohexa-1,3,5-triene-1,6-diyl dinitrate; HNHTDD; Hexanitro-Triene; Triene dinitrate; Theoretical Preparation 26: (1Z,3E,5Z)-1,2,3,4,5,6-hexaazidohexa-1,3,5-triene-1,6-diyl dinitrate; EZ-Azido Triene; HAHTDN; Theoretical Preparation 27: 1,2,3,4,5,6-hexafluoro-1,2,3,4,5,6-hexaperchlorylhexane-1,6-diyl dinitrate; Fluoroperchlorylhexane; HFGPHDD; Theoretical Preparation 28: 3,3':4',3''-ter-1,2-dioxetane-4,4''-diyl dinitrate; Dioxetane; Dioxetane dinitrate; ter-DDD; Theoretical Preparation 29: 2H,3'H,3H-2,2':3',2-teraluminum-3,3-diyl dinitrate; Aluminum-3H-dinitrate; Aluminum-3-3-dinitrate; 2H'3H'-Aluminum d

a laboratory history of chemical warfare: The Kitchen as Laboratory Cesar Vega, Job

Ubbink, Erik van der Linden, 2013-08-13 In this global collaboration of essays, chefs and scientists test various hypotheses and theories concerning? the physical and chemical properties of food. Using traditional and cutting-edge tools, ingredients, and techniques, these pioneers create--and sometimes revamp--dishes that respond to specific desires, serving up an original encounter with gastronomic practice. From grilled cheese sandwiches, pizzas, and soft-boiled eggs to Turkish ice cream, sugar glasses, and jellified beads, the essays in The Kitchen as Laboratory cover a range of culinary creations and their history and culture. They consider the significance of an eater's background and dining atmosphere and the importance of a chef's methods, as well as strategies used to create a great diversity of foods and dishes. Contributors end each essay with their personal thoughts on food, cooking, and science, thus offering rare insight into a professional's passion for experimenting with food.