《火灾安全科学简史》是个人对安全科学发展中认为重要的学术成果、学术事件和学术活动等内容的梳理，仅代表个人的认知程度（内容不一定完整和科学）。如有任何不同意见，欢迎反馈。后续《火灾安全科学简史》将持续完善，并免费向学术界共享。

安全科学系列科普资料

火灾安全科学简史

A Brief History of Fire Safety Science

李 杰
中国科学院 文献情报中心
lijie_jerry@126.com

In every science the highest watchword is the task of seeking order and continuity from the abundance of individual experiences and individual facts, in order, by filling the gaps, to integrate them into a coherent view（在每一门科学中，最高准则都是从海量的个体经验与事实中探寻规律与连贯性，通过填补空白，将其整合为一套连贯的认知体系）.德国物理学家 马克斯·普朗克

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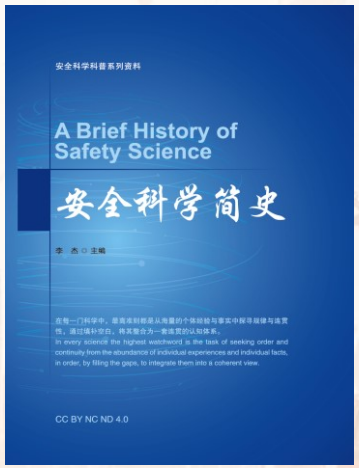
注释：图片由AI生成（李杰，2026）

献给未来的安全科学家、安全工程师与安全从业者！

This work is dedicated to the future safety scientists, safety engineers, and safety professionals who will advance the understanding and practice of safety.

自从有了人类，就有了安全问题。安全科学则是人类对群体可持续发展的探索、认识和反思，是人类对安全问题经验和规律的提炼与总结，是体系化的安全知识（李杰，2025）。

《火灾安全科学简史》



李杰，中国科学院文献情报中心青年创新研究员。入选中国科学院高层次人才、中国科学技术情报学会青年情报科学家以及中国科学院文献情报领域优秀人才。主持了国家自然科学基金青年项目、中国科学院高层次人才项目以及中国科学院文献情报中心“十四五”重点项目等。发表学术论文 100 余篇，出版著作 10 余部，获得软件著作权 20 余项。目前担任北京科学技术情报学会理事（兼元科学专业委员会主任）、Journal of Integrated Security and Safety Science共同主编、《中国安全科学学报》《安全与环境学报》《消防科学与技术》等学术期刊青年编委会副主任以及*Safety Science*等学术期刊编委。主编出版了“科学计量与知识图谱丛书”、“安全科学学术地图丛书”以及“新时代情报学理论与实践丛书”，代表作有《CiteSpace科技文本挖掘及可视化》（被引 5500 余次）、《科学计量学手册》《科学计量学导论》以及《安全科学学术地图》（综合卷、火灾卷、热爆炸卷以及问题-方法卷）等。主持研发了SciExplorer科学计量数据可视化分析平台、CiteInsight科学引文网络智能分析平台、科学计量学在线百科以及开放科学计量学学习平台等系统及工具。

最新电子版《火灾安全科学简史》获取请联系：lijie_jerry@126.com

绪论

泾溪

唐·杜荀鹤

泾溪石险人兢慎
终岁不闻倾覆人
却是平流无石处
时时闻说有沉沦

The Jingxi Stream By Du Xunhe (Tang Dynasty)

Dangerous are the rocks in Jingxi Stream, so men take utmost care; No one's heard drowned there the whole year through. Yet where the stream runs smooth with no rocks bare, Oft comes the news that someone's sunk through.

杜荀鹤（846年—904年），字彦之，号九华山人，池州石埭（今安徽省石台县贡溪乡杜村）人。晚唐诗人。

2. BC

公元前2世纪：亚历山大的克特西比乌斯（Ctesibius）发明了最早的消防泵。中世纪欧洲：消防泵在欧洲被重新发明和应用，例如1518年在奥格斯堡和1655年在纽伦堡的使用记录。

Yet aside from these built-in fire protection devices, tools, and agents, the age-old natural commodity of water still remained the primary tool in the fire protection arsenal. Delivering water to control a fire was viewed as critical in the ancient world, and it remains so today. The earliest fire pump is generally credited to Ctesibius of Alexandria in the second century B.C. During medieval times, the fire pump was reinvented in Europe and is reported to have been used in several German cities, including Augsburg in 1518 and Nuremberg in 1655. Various reports exist throughout the next several hundred years of fire apparatus used in cities such as Boston, London, and Philadelphia, with the eventual development of steam-powered, horse-drawn pumpers replacing more primitive hand pumps, which

A hypothetical reconstruction of Ctesibius' and Heron's first fire pump at Kotsanas Museum of Ancient Greek Technology, in Athens, Greece. 位于希腊雅典的科察纳斯古希腊科技博物馆内，一件根据假设复原的克特西比乌斯与希罗的第一台消防泵。

History of firefighting：https://en.wikipedia.org/wiki/History_of_firefighting

Cote, A. E. (Ed.). (2008). Fire Protection Handbook (20th ed., Vol. I). National Fire Protection Association.

1736

1736 年，本杰明·富兰克林在北美殖民地组织了首支志愿消防队 —— 费城联合消防公司。1752 年，富兰克林又创立了费城捐赠火灾保险公司（The Philadelphia Contributorship），该公司的工程师会定期检查投保人的住宅与商铺，排查火灾隐患。

Fire was an ever-present threat to industry in the nineteenth century, when fire-resistant and fireproof building materials were unknown. Industry utilized open fires, candles, and whale oil lamps. Fires were fought using a method called the "bucket brigade." A line of persons was formed from the fire to a source of water, a bucket filled with water was then passed from person to person, and the person closest to the fire dumped the water on the fire.

In 1736, Benjamin Franklin organized the first volunteer fire department in the colonies, The Union Fire Company of Philadelphia. In 1752, Franklin also founded a fire insurance company, The Philadelphia Contributorship. Company engineers periodically inspected policyholders' homes and shops for fire hazards.

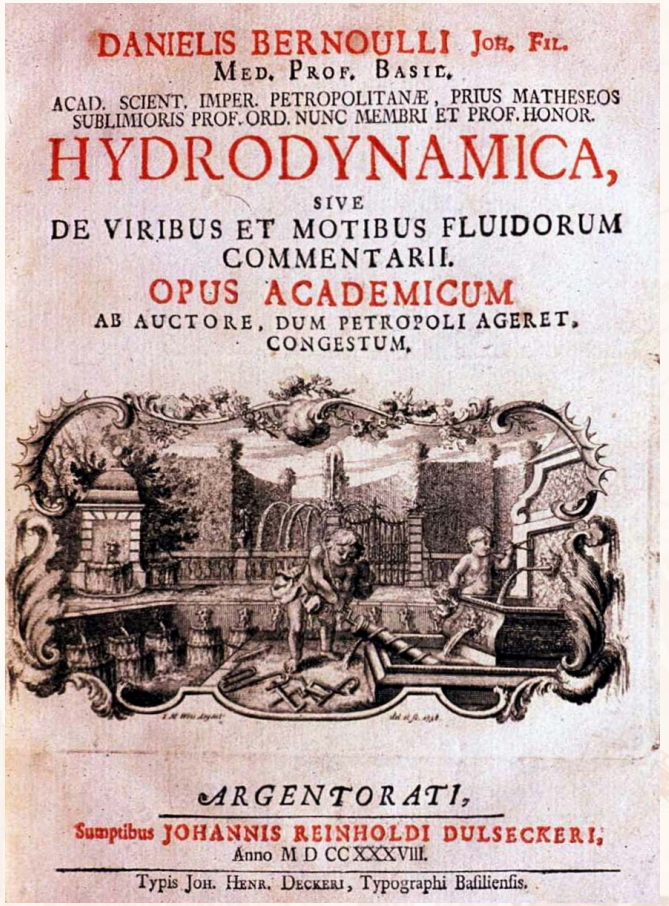
During the early 1800s, volunteer fire companies frequently proved themselves as ineffective as the old bucket brigades at extinguishing big fires. On one occasion, competing volunteer fire companies fought each other while buildings were reduced to ashes. Major fires also drove several

Gloss, D. S., & Wardle, M. G. (1984). Introduction to safety engineering. John Wiley & Sons.

1738

《流体力学，或论流体的力与运动的评论》（拉丁文：Hydrodynamica, sive de Viribus et Motibus Fluidorum Commentarii）是丹尼尔·伯努利于1738年出版的一本书。这本书的书名最终为流体力学领域命名为“水动力学”（hydrodynamics）。

Hydrodynamica, sive de Viribus et Motibus Fluidorum Commentarii (Latin for Hydrodynamics, or commentaries on the forces and motions of fluids) is a book published by Daniel Bernoulli in 1738. The title of this book eventually christened the field of fluid mechanics as hydrodynamics.

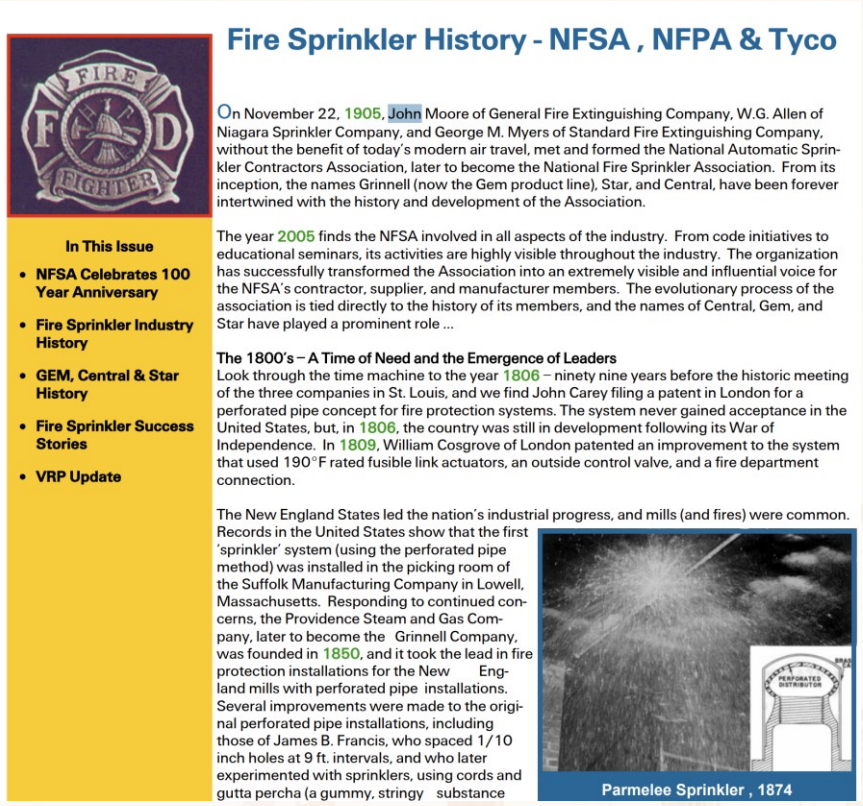

DANIELIS BERNOULLI Joh. Fil.
Med. Prof. Basil.
ACAD. SCIENT. IMPER. PETROPOLITANÆ, PRIUS MATHESEOS SUBLIMIORIS PROF. ORD. NUNC MEMBRI ET PROF. HONOR.
HYDRODYNAMICA,
SIVE
DE VIRIBUS ET MOTIBUS FLUIDORUM COMMENTARII.
OPUS ACADEMICUM
AB AUCTORE, DUM PETROPOLI AGERET, CONGESTUM.
ARGENTORATI,
Sumptibus JOHANNIS REINHOLDI DULSECKERI,
Anno M D CC XXXVIII.
Typis Joh. Henr. Deckeri, Typographi Basilienſis.

Bernoulli, D. (1738). Hydrodynamica, sive de viribus et motibus fluidorum commentarii. Johann Reinhold Dulsecker.

1800

英国人约翰·卡雷（John Carrey）发明了原始的自动洒水喷头。有文献显示1806年其获得了专利、

novation for fire protection. The proverbial parade of advancements is noteworthy: in 1800 Englishman John Carrey invented a crude automatic sprinkler; in 1821 Joseph Boyd patented the first rubber-lined cotton fire hose; in 1845 William Channing was credited with the invention of the first fire alarm telegraph; in 1852 a patent was issued for the first sprinkler perforated pipe system; also in 1852 the first Central Office (i.e., central station) and fire alarm boxes were installed in Boston; in 1853 the first practical motorized fire pumper was tested in Cincinnati; in 1860 Philip Pratt produced the first practical automatic sprinkler system; in 1863 Alanson Crane patented the first portable fire extinguisher; in 1864 Stewart Harrison produced the first practical sprinkler, significantly improved in 1874 by Henry Parmelee and again in 1880 by Frederick Grinnell. These inventions continued into the twentieth century with important technological innovations, such as the invention in 1940 of soy protein aerofoam by Percy Julian, the introduction of high-pressure water mist fog nozzles in 1942 by the U.S. Navy, and the invention in 1969 of the first battery-powered smoke detector by Randolph Smith and Ken House.[9]



Fire Sprinkler History - NFSA , NFPA & Tyco

In This Issue

- NFSA Celebrates 100 Year Anniversary
- Fire Sprinkler Industry History
- GEM, Central & Star History
- Fire Sprinkler Success Stories
- VRP Update

On November 22, 1905, John Moore of General Fire Extinguishing Company, W.G. Allen of Niagara Sprinkler Company, and George M. Myers of Standard Fire Extinguishing Company, without the benefit of today's modern air travel, met and formed the National Automatic Sprinkler Contractors Association, later to become the National Fire Sprinkler Association. From its inception, the names Grinnell (now the Gem product line), Star, and Central, have been forever intertwined with the history and development of the Association.

The year 2005 finds the NFSA involved in all aspects of the industry. From code initiatives to educational seminars, its activities are highly visible throughout the industry. The organization has successfully transformed the Association into an extremely visible and influential voice for the NFSA's contractor, supplier, and manufacturer members. The evolutionary process of the association is tied directly to the history of its members, and the names of Central, Gem, and Star have played a prominent role ...

The 1800's – A Time of Need and the Emergence of Leaders

Look through the time machine to the year 1806 – ninety nine years before the historic meeting of the three companies in St. Louis, and we find John Carey filing a patent in London for a perforated pipe concept for fire protection systems. The system never gained acceptance in the United States, but, in 1806, the country was still in development following its War of Independence. In 1809, William Cosgrove of London patented an improvement to the system that used 190°F rated fusible link actuators, an outside control valve, and a fire department connection.

The New England States led the nation's industrial progress, and mills (and fires) were common. Records in the United States show that the first 'sprinkler' system (using the perforated pipe method) was installed in the picking room of the Suffolk Manufacturing Company in Lowell, Massachusetts. Responding to continued concerns, the Providence Steam and Gas Company, later to become the Grinnell Company, was founded in 1850, and it took the lead in fire protection installations for the New England mills with perforated pipe installations. Several improvements were made to the original perforated pipe installations, including those of James B. Francis, who spaced 1/10 inch holes at 9 ft. intervals, and who later experimented with sprinklers, using cords and gutta percha (a gummy, stringy substance

Parmelee Sprinkler , 1874

Cote, A. E. (Ed.). (2008). Fire Protection Handbook (20th ed., Vol. I). National Fire Protection Association.

Holzman, R. S., The Romance of Firefighting, Harper & Brothers, New York, 1956, pp. 136–154; Lyons, P. R., Fire in America!, National Fire Protection Association, Quincy, MA, 1976, pp. 230–236.

History of Sprinkler Systems & NFPA 25 Presented by:Steven Schneider-CFPS. https://www.pennboc.org/wp-content/uploads/2022/10/2022-09-21-Historical-Sprinkler-Systems-Handouts-ver-2-Steven-Schneider.pdf

Fire Sprinkler History - NFSA , NFPA & Tyco -https://fireprotectionsupport.nl/wp-content/uploads/2019/05/200-jaar-Sprinklers.pdf

The introduction to England of automatic fire sprinkler 1881 – 1888： https://canutesoft.com/information-and-resources/history-of-fire-sprinkler-systems-1881-1888

1821

约瑟夫·博伊德（James Boyd）获得了首条橡胶衬里棉质消防水带的专利。詹姆斯·博伊德（James Boyd）于1821年5月30日获得的这项专利，其完整原始文本文件目前已不存在。造成文件缺失的核心原因是 1836年美国专利局大火。这场大火摧毁了当时专利局内约10,000份所有的早期专利记录、图纸和模型。

novation for fire protection. The proverbial parade of advancements is noteworthy: in 1800 Englishman John Carrey invented a crude automatic sprinkler; in 1821 Joseph Boyd patented the first rubber-lined cotton fire hose; in 1845 William Channing was credited with the invention of the first fire alarm telegraph; in 1852 a patent was issued for the first sprinkler perforated pipe system; also in 1852 the first Central Office (i.e., central station) and fi… 1853 the first practic… cinnati; in 1860 Philip… sprinkler system; in … rtable fire extinguishe… first practical sprinkler, significantly improved in 1874 by Henry Parmelee and again in 1880 by Frederick Grinnell. These inventions continued into the twentieth century with important technological innovations, such as the invention in 1940 of soy protein aerofoam by Percy Julian, the introduction of high-pressure water mist fog nozzles in 1942 by the U.S. Navy, and the invention in 1969 of the first battery-powered smoke detector by Randolph Smith and Ken House.[9]

该文献中对发明人的名字写法存在一些误差，应该为James Boyd

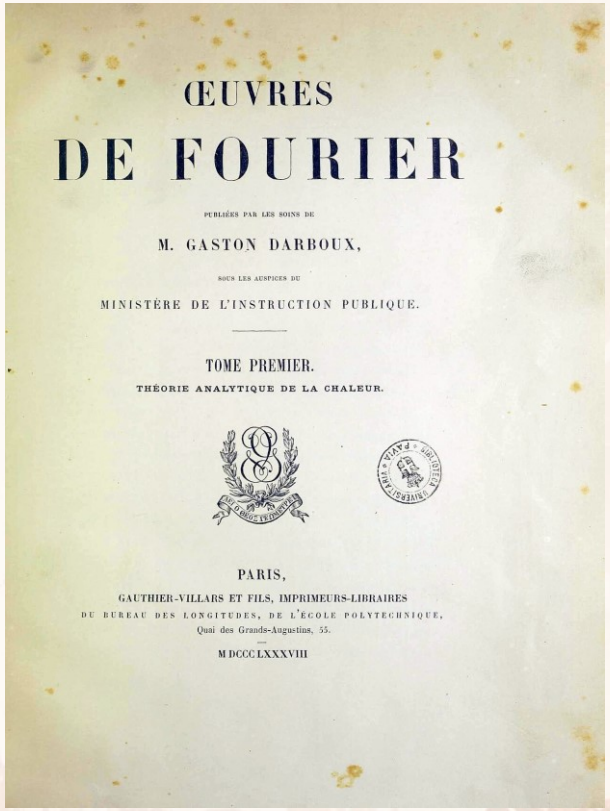
James Boyd an Irish immigrant came to Boston, MA, in 1817 and set up a saddlery and leather company, James Boyd, Saddler, who manufactured harnesses, fire buckets, and leather fire hose. A story from an article in Fire Engineering Magazine back in 1937 related that Nathan Hunt of Boston Belting Company developed a method to replace leather drive belts for machinery with cotton belts coated with rubber on one side. James Boyd saw this and came up with the idea to join the belt with rivets into a tube with rubber on the inside creating a new type of fire hose.33 Around 1821 he received a patent for a cotton "rubber-lined fire hose."34 The Mayor of Boston "reported a 100 feet of Boyd's fire hose would do the same work as 60 men – and do it more efficiently, faster and safer."35 James Boyd was also a volunteer with Boston Fire Department and established a charitable organization for firemen killed or injured in the line of duty.

Cote, A. E. (Ed.). (2008). Fire Protection Handbook (20th ed., Vol. I). National Fire Protection Association.

1822

1822年，Joseph Fourier 在其著作《热的解析理论》（Théorie analytique de la chaleur）中发表了关于热流的理论。在这部著作中，他将推理建立在Newton's law of cooling之上，即两个相邻粒子之间的热流与它们温度之间的极微小差异成正比。

让-巴蒂斯特·约瑟夫·傅里叶（Jean-Baptiste Joseph Fourier；1768年3月21日－1830年5月16日）是法国数学家和物理学家，出生于勃艮第的欧塞尔。他最著名的贡献是开创了对傅里叶级数的研究，这一工作后来发展为傅里叶分析和调和分析，并广泛应用于热传导和振动等问题。傅里叶变换和傅里叶导热定律也都是以他的名字命名的。此外，傅里叶通常也被认为是最早发现温室效应的人之一。



1824

詹姆斯·布雷德伍德 (James Braidwood)于1824年在爱丁堡建立了世界上第一支市政消防队。他最早提出了深入火场内部寻找火源（室内强攻）的原则，并撰写了早期的消防技术手册。他的研究奠定了建筑构造与火灾蔓延关系的知识基础。

詹姆斯·布雷德伍德 (James Braidwood) 现代消防服务之父。

詹姆斯·布雷德伍德 (James Braidwood)
现代消防服务之父。

James Braidwood. The mantle of father of the modern fire service must go to a man born in Edinburgh, Scotland. James Braidwood (1800–1861) was first trained as a surveyor of buildings, which provided him with an exceptional knowledge of building construction and materials. At age 24, he was appointed the master of fire engines for Edinburgh after a serious fire nearly destroyed the city center. Braidwood soon established the foundational principles of firefighting that are still applied today, specifically the critical importance of getting fire hoses inside to the seat of the fire.

6 pioneers of fire-behavior research
https://www.firerescue1.com/fire-chief/articles/6-pioneers-of-fire-behavior-research-Q2GIZRAGza3cwNsN/
The Scottish Father of the American Fire Service
https://www.fireengineering.com/firefighter-training/the-scottish-father-of-the-american-fire-service/#:~:text=James%20Braidwood's%20contributions%20to%20the,seat%20of%20the%20fire%20directly.
James Braidwood– first Superintendent of the London Fire Engine Establishment.
https://www.london-fire.gov.uk/museum/london-fire-brigade-history-and-stories/trailblazers/james-braidwood/

1835

FM Global成立。

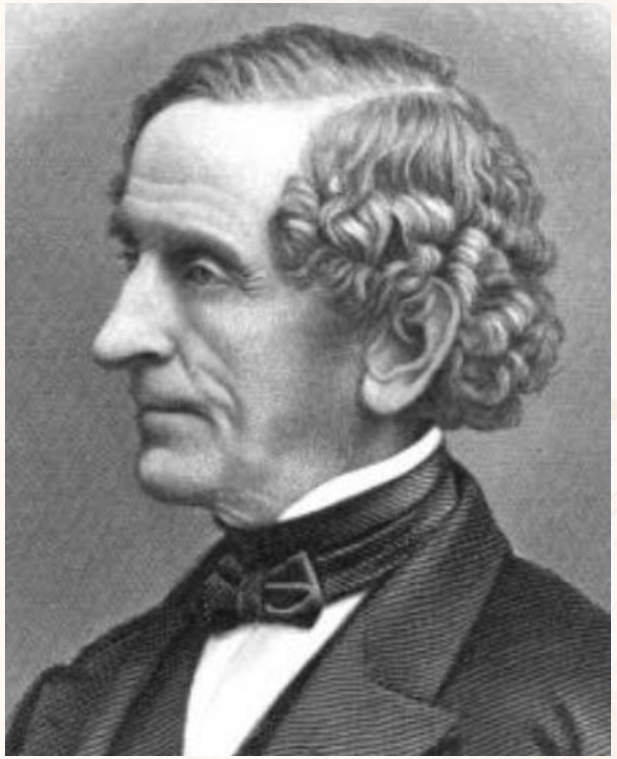
FACTORY MUTUAL

Insurance companies such as the Factory Mutual System (FM) and Industrial Risk Insurers (IRI) are at the forefront of industrial fire safety. They provide engineering and inspection services, development of standards and fire research, and development of their own standards.

Founded in 1835, the Factory Mutual System consists of four member companies. These include the Allendale Mutual Insurance Company, the Arkwright-Boston Insurance Company, the Protection Mutual Insurance Company, and the Philadelphia Mutual Company. The Factory Mutual System stipulates good loss control practices as a prerequisite when issuing insurance coverage to manufacturing plants.

The Factory Mutual System conducts basic and applied research, develops standards, and issues approval on materials and fire protection equipment. Inspections and evaluations are conducted by the Division of Engineering. They analyze existing hazards, the protection systems, and management's property conservation methods.

Della-Giustina, D. E. (2014). Fire safety management handbook (3rd ed.). CRC Press/Taylor & Francis Group.
https://en.wikipedia.org/wiki/FM_(insurance)
https://www.fm.com/about-us/our-history

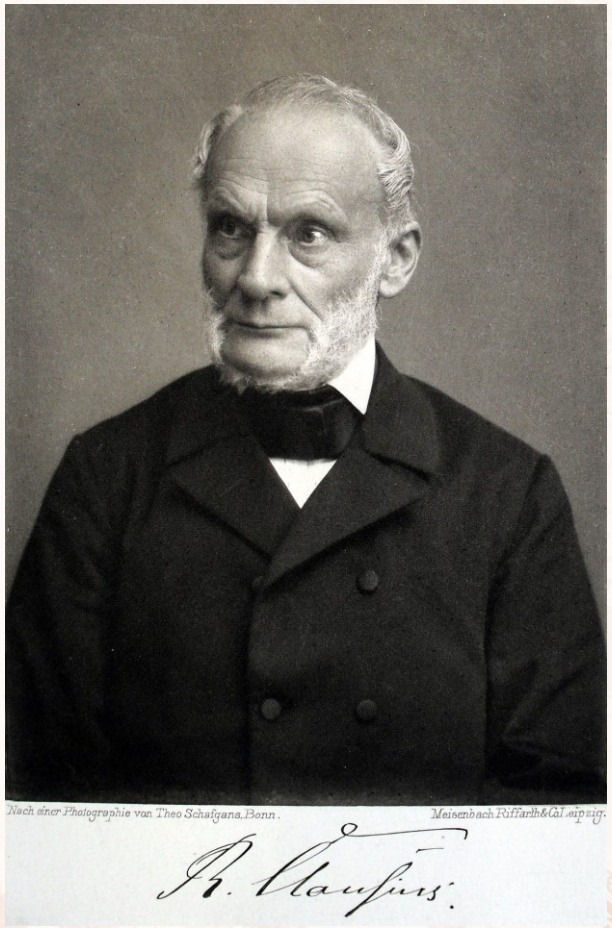


扎卡赖亚·艾伦（1795 年 9 月 15 日 —1882 年 3 月 17 日），美国罗德岛州普罗维登斯人，身兼纺织品制造商、科学家、律师、作家、发明家与社会公共领袖多重身份。他先后就读于菲利普斯埃克塞特中学与布朗大学，于 1813 年毕业。艾伦投身纺织制造业，1822 年建成一座毛纺工厂，厂房融入创新消防安全设计，并应用多项自主改良的机械设备。他还研发出首套家用热风供暖炉系统。1833 年，他为自己最知名的发明 —— 蒸汽机自动断流阀，取得专利授权。1835 年，艾伦创立制造商互助火灾保险公司，该公司即为现今FM 环球保险（FM Global） 的前身。

1850

热力学第二定律的提出（second law of thermodynamics）。

鲁道夫·尤利乌斯·埃马努埃尔·克劳修斯（Rudolf Julius Emanuel Clausius，德语发音：[ˈʁuːdɔlf ˈklaʊziʊ̯s]；1822年1月2日－1888年8月24日）是一位德国物理学家和数学家，被认为是热力学这门科学的核心奠基人之一。通过对Sadi Carnot原理（即卡诺循环）的重新表述，他为热理论奠定了更加严谨和可靠的基础。他最重要的论文《论热的动力》（"On the Moving Force of Heat"）发表于1850年，在其中首次阐明了热力学第二定律的基本思想。1865年，他提出了“熵”的概念；1870年，他提出了维里定理，并将其应用于热学领域。

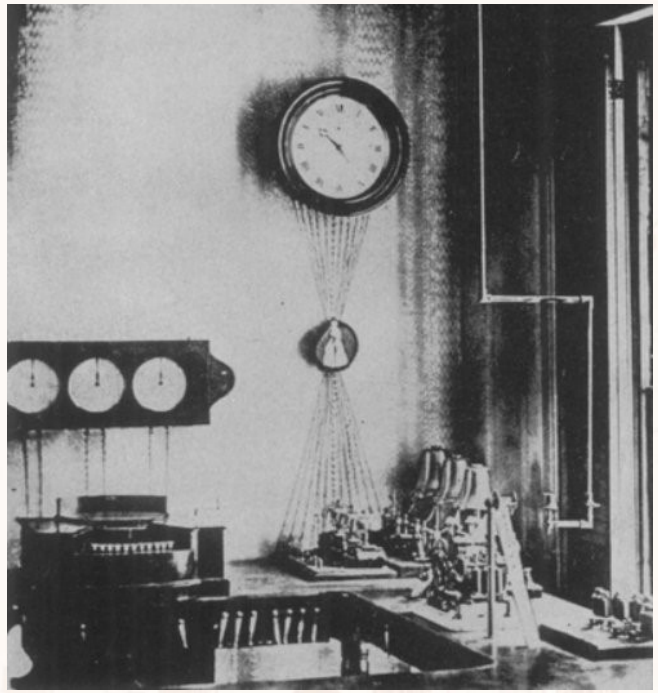


1852

威廉·弗朗西斯·钱宁（William Francis Channing）于 1852 年在马萨诸塞州波士顿与 摩西·法默（Moses G. Farmer）共同开发了世界上首个全市范围的电报火灾报警系统。两人在 1854 年为这项名为“城市电磁火灾报警电报”的发明申请了专利。

novation for fire protection. The proverbial parade of advancements is noteworthy: in 1800 Englishman John Carrey invented a crude automatic sprinkler; in 1821 Joseph Boyd patented the first rubber-lined cotton fire hose; in 1845 William Channing was credited with the invention of the first fire alarm telegraph; in 1852 a patent was issued for the first sprinkler perforated pipe system; also in 1852 the first Central Office (i.e., central station) ar…on; in 1853 the first pra… Cincinnati; in 1860 P… matic sprinkler system… st portable fire extinguisher; in 1864 Stewart Harrison produced the first practical sprinkler, significantly improved in 1874 by Henry Parmelee and again in 1880 by Frederick Grinnell. These inventions continued into the twentieth century with important technological innovations, such as the invention in 1940 of soy protein aerofoam by Percy Julian, the introduction of high-pressure water mist fog nozzles in 1942 by the U.S. Navy, and the invention in 1969 of the first battery-powered smoke detector by Randolph Smith and Ken House.[9]

该文献为1845年，但1852年的说法更加可靠。



Fire-alarm system installed at Boston City Hall in 1852.

Cote, A. E. (Ed.). (2008). Fire Protection Handbook (20th ed., Vol. I). National Fire Protection Association.

1852

首个洒水穿孔管道系统获得专利；同年，第一个中央办公室（中央站）和火灾报警箱在波士顿安装。

novation for fire protection. The proverbial parade of advancements is noteworthy: in 1800 Englishman John Carrey invented a crude automatic sprinkler; in 1821 Joseph Boyd patented the first rubber-lined cotton fire hose; in 1845 William Channing was credited with the invention of the first fire alarm telegraph; in 1852 a patent was issued for the first sprinkler perforated pipe system; also in 1852 the first Central Office (i.e., central station) and fire alarm boxes were installed in Boston; in 1853 the first practical motorized fire pumper was tested in Cincinnati; in 1860 Philip Pratt produced the first practical automatic sprinkler system; in 1863 Alanson Crane patented the first portable fire extinguisher; in 1864 Stewart Harrison produced the first practical sprinkler, significantly improved in 1874 by Henry Parmelee and again in 1880 by Frederick Grinnell. These inventions continued into the twentieth century with important technological innovations, such as the invention in 1940 of soy protein aerofoam by Percy Julian, the introduction of high-pressure water mist fog nozzles in 1942 by the U.S. Navy, and the invention in 1969 of the first battery-powered smoke detector by Randolph Smith and Ken House.[9]


FIRE PROTECTION HANDBOOK®

Twentieth Edition

VOLUME I

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NFPA

National Fire Protection Association®
Quincy, Massachusetts

Cote, A. E. (Ed.). (2008). Fire Protection Handbook (20th ed., Vol. I). National Fire Protection Association.

1853

1853年1月1日，世界上第一台实用机动蒸汽消防车“乔·罗斯叔叔”（Uncle Joe Ross）在俄亥俄州辛辛那提进行了公开测试并正式交付使用。

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Cote, A. E. (Ed.). (2008). Fire Protection Handbook (20th ed., Vol. I). National Fire Protection Association.
Cincinnati Fire Department: First In The Nation. https://www.cincinnati-oh.gov/fire/about-fire/history/

1853

1853年的辛辛那提消防局，不仅是美国第一个职业消防部门，也代表了消防体系从“临时应对”向“专业化公共服务”的历史性升级。

On April 1, 1853, Cincinnati, Ohio, established the first professional and fully paid fire department in the United States.

1855

费克定律描述了物质在介质中的扩散过程。这个定律以阿道夫·费克（Adolf Fick）命名，他于1855年首次提出了该定律。费克定律主要包括两种形式：第一定律和第二定律。

$$J = -D\frac{d\varphi}{dx}$$

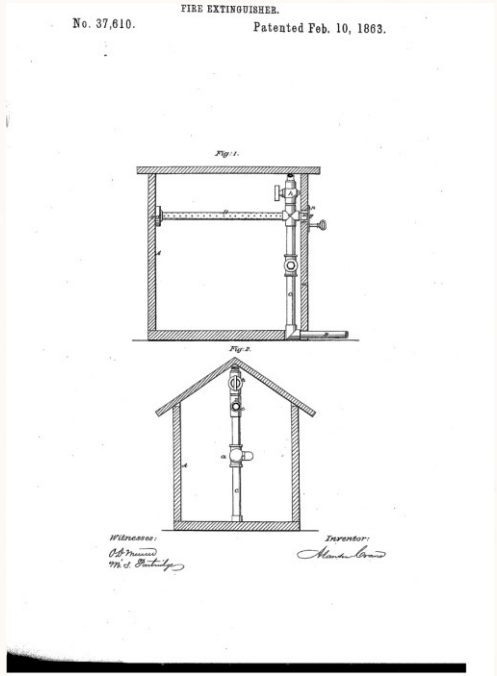
Adolf Eugen Fick (3 September 1829 – 21 August 1901) was a German-born physician and physiologist. In 1855, he introduced Fick's laws of diffusion, which govern the diffusion of a gas across a fluid membrane. In 1870, he was the first to measure cardiac output, using what is now called the Fick principle.

1863

阿兰森·克兰（Alanson Crane）获得第一套建筑室内灭火管道系统专利。

novation for fire protection. The proverbial parade of advancements is noteworthy: in 1800 Englishman John Carrey invented a crude automatic sprinkler; in 1821 Joseph Boyd patented the first rubber-lined cotton fire hose; in 1845 William Channing was credited with the invention of the first fire alarm telegraph; in 1852 a patent was issued for the first sprinkler perforated pipe system; also in 1852 the first Central Office (i.e., central station) and fire alarm boxes were installed in Boston; in 1853 the first practical motorized fire pumper was tested in Cincinnati; in 1860 Philip Pratt produced the first practical automatic sprinkler system; in 1863 Alanson Crane patented the first portable fire extinguisher; in 1864 Stewart Harrison produced the first practical sprinkler, significantly improved in 1874 by Henry Parmelee and again in 1880 by Frederick Grinnell. These inventions continued into the twentieth century with important technological inno y protein aero-foan pressure water mist he invention in 1969 of the first battery-powered smoke detector by Randolph Smith and Ken House.[9]

部分文献表述错误：阿兰森·克兰（Alanson Crane）获得了第一台便携式灭火器的专利。



https://www.hagley.org/research/news/hagley-vault/first-us-patent-fire-extinguishing-system-buildings-was-granted-date

Cote, A. E. (Ed.). (2008). Fire Protection Handbook (20th ed., Vol. I). National Fire Protection Association（左侧截图来自该文献）.

1864

斯图尔特·哈里森（Stewart Harrison）制造了第一个实用的洒水喷头，后于1874年由亨利·帕米利（Henry Parmelee）和1880年由弗雷德里克·格林内尔（Frederick Grinnell）分别进行了重大改进。

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Major A Stewart Harrison - 1864

British engineer, Major A Stewart Harrison of the FireEnineer Volunteers, invented the first modern fire sprinkler head in 1864. The sprinkler was a hollow perforated brass ball around 50 mm (2in) in diameter. A plunger running through the brass ball was held in place by a retaining string. Fire would burn through the string, and the plunger would drop out and release the seal.

https://canutesoft.com/information-and-resources/history-of-fire-sprinkler-systems

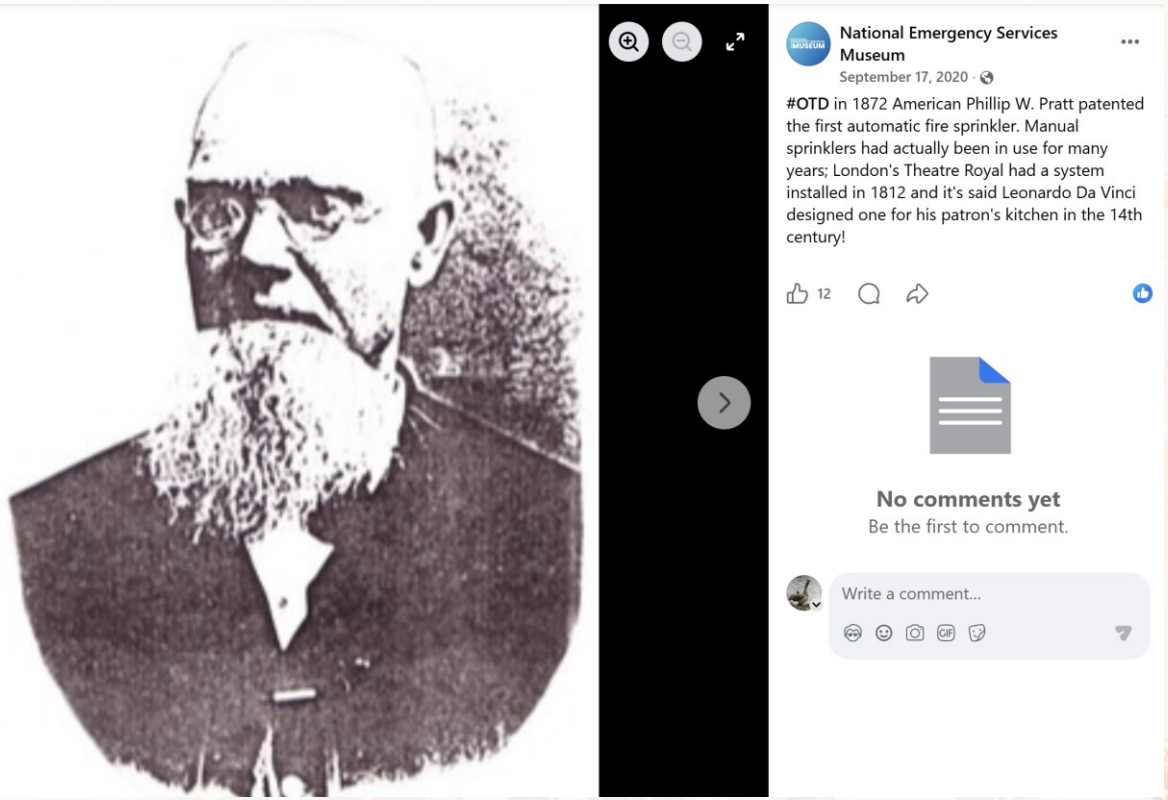
Cote, A. E. (Ed.). (2008). Fire Protection Handbook (20th ed., Vol. I). National Fire Protection Association.

1872

菲利普·普拉特（Philip Pratt）制造了第一套实用的自动洒水灭火系统。

novation for fire protection. The proverbial parade of advancements is noteworthy: in 1800 Englishman John Carrey invented a crude automatic sprinkler; in 1821 Joseph Boyd patented the first rubber-lined cotton fire hose; in 1845 William Channing was credited with the invention of the first fire alarm telegraph; in 1852 a patent was issued for the first sprinkler perforated pipe system; also in 1852 the first Central Office (i.e., central station) and fire alarm boxes were installed in Boston; in 1853 the first practical motorized fire pumper was tested in Cincinnati; in 1860 Philip Pratt produced the first practical automatic sprinkler system; in 1863 Alanson Crane patented the first portable fire extinguisher; in 1864 Stewart Harrison produced the first practical sprinkler, sig Henry Parmelee and again in 188 inventions continued into the t t technological innovations, such as the invention in 1940 of soy protein aerofoam by Percy Julian, the introduction of high-pressure water mist fog nozzles in 1942 by the U.S. Navy, and the invention in 1969 of the first battery-powered smoke detector by Randolph Smith and Ken House.[9]

部分文献标注存在偏差，应该是1872



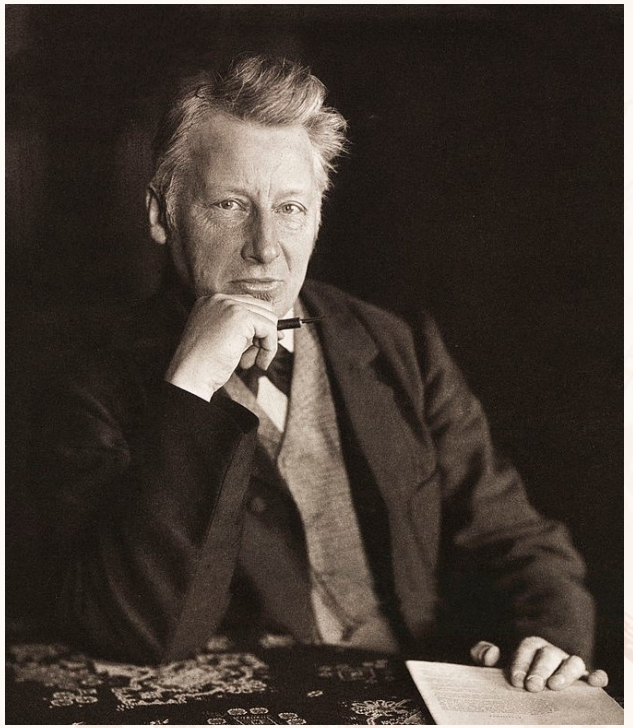
Cote, A. E. (Ed.). (2008). Fire Protection Handbook (20th ed., Vol. I). National Fire Protection Association.

$$\frac{\mathrm{d}}{\mathrm{d}T}\ln K_{\mathrm{eq}} = \frac{\Delta_r H^{\ominus}}{RT^2}$$

1884

范特霍夫方程（Van 't Hoff equation）是一个用于计算在不同温度下某反应的平衡常数的方程。该方程由荷兰化学家Jacobus Henricus van 't Hoff于1884年在其著作《化学动力学研究》（Études de Dynamique chimique）中提出。

雅各布斯·亨利克斯·范特霍夫（Jacobus Henricus van ’t Hoff，1852–1911）是荷兰物理化学家，被公认为现代物理化学与立体化学的奠基人之一。因其在化学动力学、化学平衡和渗透压研究方面的开创性贡献，他成为1901年首届诺贝尔化学奖得主。



1889

$$k = A e^{\frac{-E_a}{RT}} = A \exp\left(\frac{-E_a}{RT}\right)$$

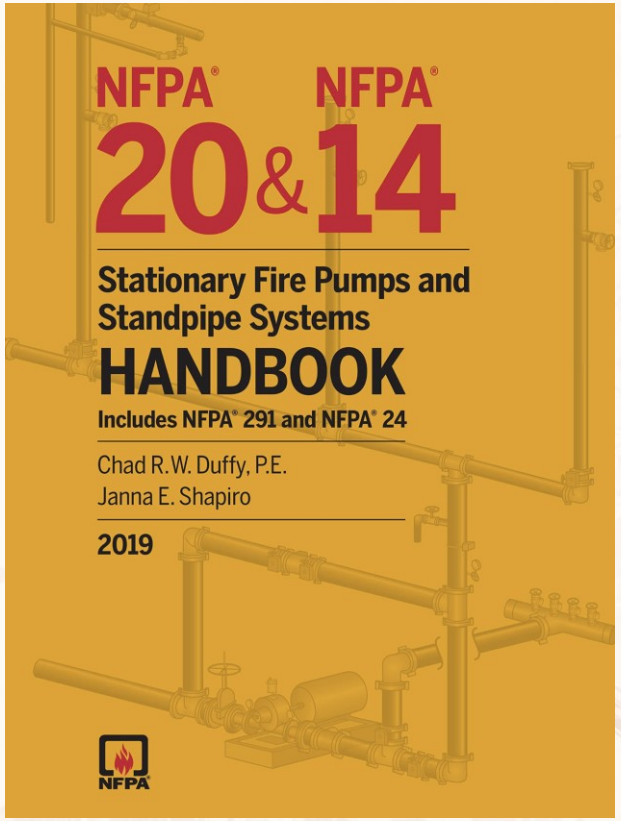
阿伦尼乌斯方程是描述反应速率随温度变化关系的一个公式。该方程由Svante Arrhenius于1889年提出，其理论基础来源于荷兰化学家Jacobus Henricus van 't Hoff的研究。范特霍夫在1884年指出，描述平衡常数温度依赖关系的范特霍夫方程暗示了正反应与逆反应速率也应具有类似的温度依赖形式。该方程在化学反应速率的确定以及活化能的计算中具有广泛而重要的应用。阿伦尼乌斯为这一公式提供了物理解释和理论依据。不过，从现代观点来看，它更常被视为一种经验关系。该方程不仅适用于化学反应，还可用于描述许多热激发过程，例如扩散系数、晶体空位浓度以及材料蠕变速率等随温度的变化。此外，1935年提出的Eyring equation同样用于描述速率与能量之间的关系。

Svante August(19 February 1859 – 2 October 1927) was a Swedish scientist. Originally a physicist, but often referred to as a chemist, Arrhenius was one of the founders of the science of physical chemistry. In 1903, he received the Nobel Prize in Chemistry, becoming the first Swedish Nobel laureate. In 1905, he became the director of the Nobel Institute, where he remained until his death.

1896 主动消防系统的核心：NFPA 13《自动喷水灭火系统安装标准》

美国国家消防协会（NFPA）首版自动喷水灭火系统标准于 1896 年发布，其中包含的蒸汽消防泵与旋转消防泵相关要求至今仍有效。该标准的核心要求包括：需设置用于测试的 2½ 英寸（65 毫米）出水口；设备防护要求：消防泵必须设置在砖砌或石砌围护结构内，并通过防火门与主体建筑分隔；每周运行测试要求。该标准规定，消防泵的额定流量最小不得低于 500 加仑 / 分钟（1892 升 / 分钟），并要求配备可维持 60 分钟的供水保障。同时，标准还强制要求配置弹簧式泄压阀与压力表。

Fire pumps have been used to supply flow and pressure to fire protection systems for over 100 years. The first NFPA standard on automatic sprinkler systems was published in 1896 and included information on steam and rotary fire pumps that is still valid today. Among its requirements were 2½ in. (65 mm) outlets for testing purposes, equipment protection (the pump had to be located in a brick or stone enclosure and cut off from the main building by fire doors), and a weekly running test. The standard established the minimum size for fire pumps to be not less than 500 gpm (1892 L/min) rated capacity and required a 60-minute water supply. A spring-type pressure relief valve and pressure gauge were also required. These requirements amounted to less than one page of text for the installation of a fire pump.



Duffy, C. R. W., & Shapiro, J. E. (Eds.). (2019). Stationary fire pumps and standpipe systems handbook (6th ed.). National Fire Protection Association.

1896

成立美国国家消防协会（NFPA），初衷主要是规范自动喷水灭火系统的应用并制定相关标准。

At the start of the twentieth century there were significant activities in US fire safety. The National Fire Protection Association (NFPA) was founded in 1897 principally to address sprinkler use and its standardization. The Underwriter's Laboratory (UL) was founded in 1894 by William H. Merrill to address electrical standards and testing. In 1904, Congress created the National Bureau of Standards (NBS), later becoming the National Institute of Standards and Technology (NIST) in 1987. After the Baltimore conflagration (1904), Congress directed NBS to address the structural fire safety of buildings. That program began in 1914 under Simon Ingberg, and had a profound influence on standards and testing dealing with structural fire protection over the next 60 years. It is noteworthy to consider the words of the NBS Director to Congress in 1914 when US fire losses were

The group continued meeting, and following one such meeting in March 1896 released the "Report of Committee on Automatic Sprinkler Protection," which would eventually become NFPA 13, Standard for the Installation of Sprinkler Systems. At a subsequent meeting on November 6, 1896, the group voted to start an entire organization dedicated to advancing fire safety. "This organization shall be known as the National Fire Protection Association," the approved article stated, and NFPA was officially born（来源官网）.

Quintiere, J. G. (2006). Fundamentals of fire phenomena. John Wiley & Sons, Ltd.

1897

英国防火委员会（BFPC）成立于1897年，是一个非官方的科学技术组织。核心目标是通过科学实验和调查，推广预防火灾的实用手段，并流通相关研究信息。该委员会于1898年建立了欧洲第一个永久性防火测试站。其著名的“红皮书”（Red Books）系列出版物详尽记录了各种材料的防火测试结果和重大火灾案例，是现代防火工程学的奠基文献之一。

BFPC 于 1924 年并入国家消防协会（NFBA），而 BFSA 的历史与其紧密相连，网站详细介绍了这段合并历史。

British Fire Prevention Committee

1897 Committee established

1898/9 Formed the first permanent fire testing station in Europe; the committee conducted a series of tests of many different types of flammable object, including non-proprietary materials, the cost of testing of these being born by the members of the committee.[1]

1899 Registered with limited liability without the word "Limited".[2]

1905 The Committee had to move its testing station from its original position; the new site was provided by the Central Electric Supply Co and was within easy reach of Baker-street Railway Station, i.e. an easy cab drive from Charing Cross making it possible for members of the committee (i.e. "busy men") to conduct the tests there.

1907 Tests of containers for inflammable liquids were conducted by the Safety Non-Explosive Reservoir Co at the BFPC's Regent's Park testing station[3]

1908 Some member of the committee, led by Edwin O. Sachs, promoted the formation of the Concrete Institute

1909 Testing of fire-resistant doors at the testing station; the chairman of the committee was Edwin O. Sachs; Major O'Meara, chief engineer of the GPO, represented the council of the committee[4]

1914 Tests at the Regent's Park testing station of types of liquids and chemicals used in fire extinguishers, under Mr D. W. Wood chairman of the Extinguishers' Research Sub-Committee[5]

1919 The founder and chairman of the committee, Mr Edwin O. Sachs died.

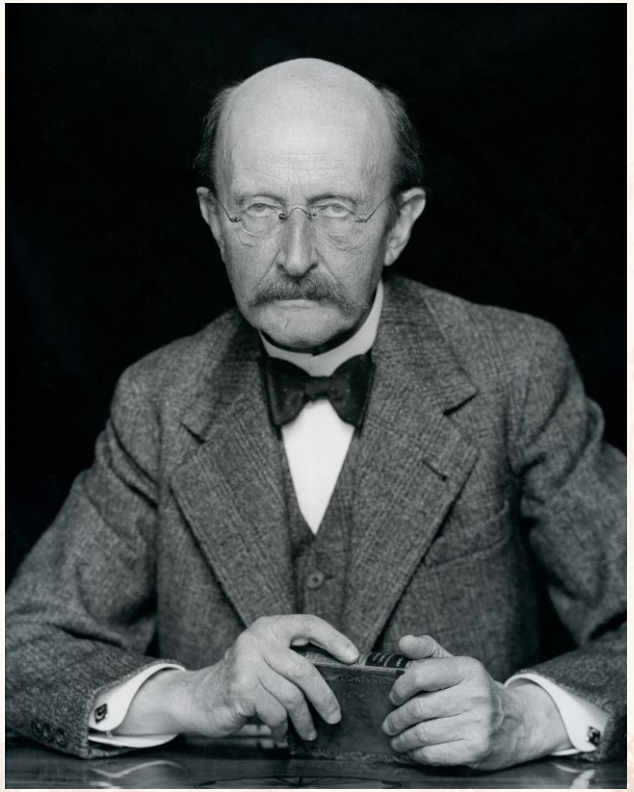
Sometime after 1918, the Committee was dissolved.

https://www.gracesguide.co.uk/British_Fire_Prevention_Committee#:~:text=From%20Graces%20Guide,the%20council%20of%20the%20committee

1900

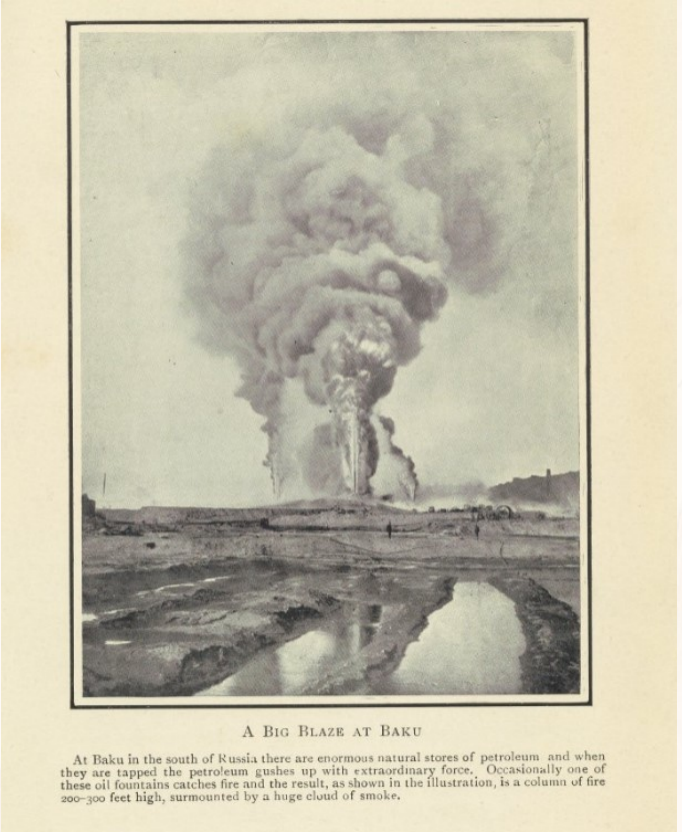
在物理学中，普朗克定律（Planck’s law，也称普朗克辐射定律）描述了在热平衡状态下，黑体在给定温度 T 时所发出的电磁辐射的光谱分布。当黑体与环境之间不存在物质或能量的净交换时，该定律成立。该定律由Max Planck于1900提出。

Max Karl Ernst Ludwig Planck (23 April 1858 – 4 October 1947)was a German theoretical physicist. He won the 1918 Nobel Prize in Physics "for the services he rendered to the advancement of physics by his discovery of energy quanta."



1901

1901年巴库油井大火（Great Fire at Baku）被视为20世纪首例重大工业灾难。



https://digital.sciencehistory.org/works/jw827c92n

1901

1901 年：NBS 成立。

1904 年：巴尔的摩大火促使 NBS 开展消防标准化（尤其是接口标准化）工作。

1914 年：西蒙·英伯格启动系统性的结构防火试验研究。

1988 年：NBS 正式更名为 NIST。

1901 年，美国国会设立国家标准局（NBS），该机构后于 1987 年更名为美国国家标准与技术研究院（NIST）。1904 年巴尔的摩特大火灾发生后，国会责成国家标准局研究建筑结构消防安全问题。该项研究工作于 1914 年在西蒙·英伯格的主导下正式启动，在此后六十年间，深刻影响了建筑结构防火领域的标准制定与试验技术发展。

At the start of the twentieth century there were significant activities in US fire safety. The National Fire Protection Association (NFPA) was founded in 1897 principally to address sprinkler use and its standard[s]. [Underwriters] Laboratory (UL) was founded in 1894 by William H. Merrill [to] [test] and testing. In 1904, Congress created the National Bureau of Standards (NBS), later becoming the National Institute of Standards and Technology (NIST) in 1987. After the Baltimore conflagration (1904), Congress directed NBS to address the structural fire safety of buildings. That program began in 1914 under Simon Ingberg, and had a profound influence on standards and testing dealing with structural fire protection over the next 60 years. It is noteworthy to consider the words of the NBS Director to Congress in 1914 when US fire losses were

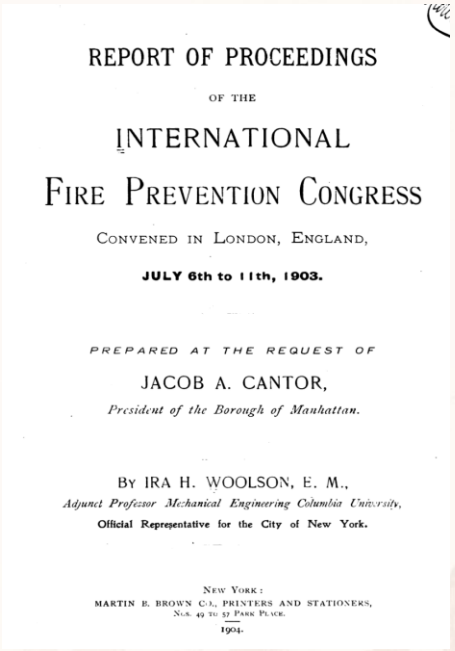
部分文献引用有偏差

Quintiere, J. G. (2006). Fundamentals of fire phenomena. John Wiley & Sons, Ltd.

1903

1903年在伦敦举行的国际防火大会，标志着标准化的火灾测试思想在国际层面的初步探讨，为后续技术标准乃至法规的制定埋下了伏笔。

The idea of a standardised approach to fire testing dates back to the International Fire Prevention Congress held in London in 1903. In 1917 ASTM-C19 (later altered to E119[2.3]) was issued. This document included a specification for a standard heating curve. The first edition of BS 476 on fire resistance testing was published in 1932. Subsequent revisions have attempted to harmonise both the heating curve on an international basis through the adoption of the international standard, ISO 834[2.1] and the control of furnaces within the European Community.


REPORT OF PROCEEDINGS

OF THE

INTERNATIONAL

FIRE PREVENTION CONGRESS

CONVENED IN LONDON, ENGLAND,

JULY 6th to 11th, 1903.

PREPARED AT THE REQUEST OF

JACOB A. CANTOR,

President of the Borough of Manhattan.

BY IRA H. WOOLSON, E. M.,

Adjunct Professor Mechanical Engineering Columbia University,

Official Representative for the City of New York.

NEW YORK:

MARTIN B. BROWN CO., PRINTERS AND STATIONERS,

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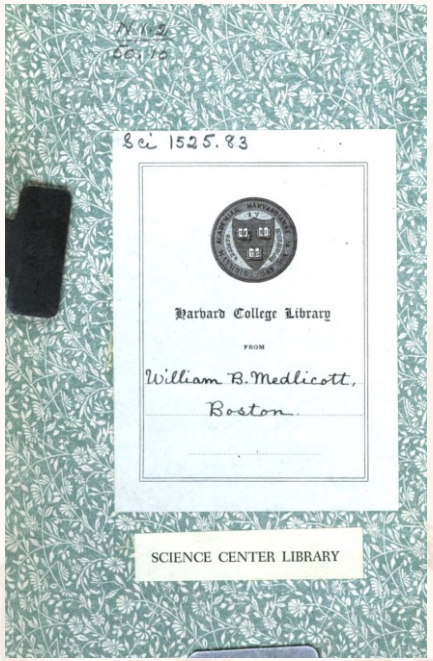
1904.

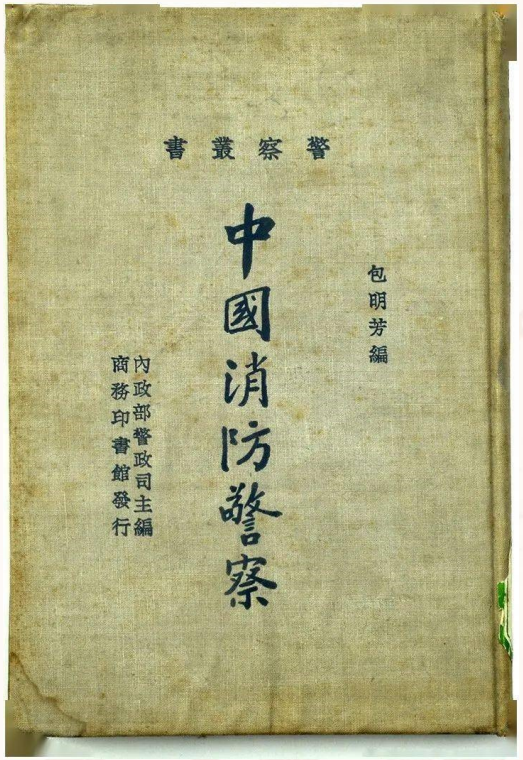


右侧图片来源：https://babel.hathitrust.org/cgi/pt?id=hvd.hxhhr3&seq=7

Green, M., Bailey, C. G., Burd, A., Bussey, P., Faller, G., Fisher, K., Harding, G., Kirby, B. R., Mettem, C. J., Newman, G., Plank, R., Purkiss, J., Charters, D., Ferguson, A., Lamont, S., & Chan, B. (2003). Introduction to the fire safety engineering of structures. The Institution of Structural Engineers.

1906

1906年（清光绪三十二年）正月由上海商务印书馆出版。《消防警察全编》是中国近代第一部消防专著，由清政府公派留日学生杜鸿宾编辑/翻译。 该书为《警察讲义录》丛书的第七册。



1907

1907 年，ASTM P 委员会发布了其首项耐火炉测试标准。该标准编号为 C2，规定了基于哥伦比亚测试站早期实验的楼盖系统耐火性能评估程序（1907 年的 C2 在 1934 年被重新指定为 ASTM E119）。

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STANDARDIZATION News

DECEMBER 2004

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Feature

John R. Hall, Jr., is assistant vice president for fire analysis and research at the National Fire Protection Association, where he has worked for 20 years on fire safety work involving statistics, risk assessment, and fire service management. For most of that time, he has served as NFPA representative to ASTM Committee E05. Hall is also a fellow of the Institute for Operations Research and the Management Sciences, convenor of Working Group 10 on Fire Risk Assessment of ISO TC92 SC4, and a member of the Society of Fire Protection Engineers task group on Fire Risk Assessment.

A Century of Fire Standards

The History of Committee E05, 1904-2004

by John R. Hall, Jr.

On Feb. 7, 1904, Baltimore suffered direct fire losses of $50 million — worth roughly $1 billion today — in the third costliest U.S. fire to date.

By spotlighting the continuing problem of building-to-building fire spread, the Baltimore conflagration led to a new committee in the eight-year-old ASTM, initially designated Committee P on Fireproofing Materials.

By 1910, it was Committee C-5, which would be its name for a third of a century. Its early history is an important part of the history of tests for fire resistance. (1,2)

As high-rise buildings grew taller in the late 19th century, there was a move to skeleton frame construction using iron columns, a technology developed in the 1880s. Meanwhile, flooring was shifting from heavier to lighter brick and other lightweight materials like terra cotta.

Through the 1890s, evaluation of the fire performance of these new technologies was largely limited to post-mortems after a major fire. Serious testing work began in Germany in the 1880s, then spread to the United Kingdom and the United States in the 1890s.

With the largest share of high-rise buildings in the United States, New York City became the early focus for the new technologies and testing related to them. In 1902, Professor Ira H. Woolson of Columbia University's Department of Mechanical Engineering established the first permanent U.S. station for testing building component fire resistance.

Ira H. Woolson (COURTESY OF COLUMBIA UNIVERSITY)

Woolson's laboratory focused not on basic research but on practical tests for the New York Bureau of Buildings, which wanted to reduce the need for subjective judgment. The first test standard was adopted by the New York Building Code in 1899.

Not surprisingly, then, when the members of ASTM's new committee on fireproofing materials met to organize in 1905, they chose Woolson as chair and then-New York Superintendent of Buildings Rudolph H. Miller as secretary. Miller would serve as secretary until Woolson's death, then serve as chair in his own right from 1927 to 1943.

In 1906, Committee P began assembling results of relevant U.S. and U.K. fire tests. By 1907, the committee had issued its first standard, C 2, Method of Test for Fireproof Floor Construction, unchanged in all essentials from Woolson's specifications for New York City. A wall partition standard, C 3, followed in 1909. Meanwhile, other countries were lining up behind an alternative standard promulgated in 1903 by the British Fire Protection Committee.

ASTM Fire Standards 100 Years PDF. https://www.scribd.com/document/183557035/ASTM-Fire-Standards-100-years-pdf

1909

1909 年发布了针对墙体隔断的 C3 标准。

ASTM Test Standards. The American Society of Testing and Materials was the first standards development organization in the United States to publish a fire resistance furnace test standard.[17,18] The Baltimore conflagration on February 7, 1904, resulted in the formation of ASTM Committee P on Fireproofing Materials. In 1910 the designation of the committee was changed to C5, and 35 years later it was changed again to E05. From its inception until 1927 the committee was chaired by Professor Ira H. Woolson of Columbia University. Professor Woolson was chosen to lead the committee because a few years earlier he had established the first U.S. station for fire resistance testing in New York City. In 1907 ASTM Committee P issued its first fire resistance furnace test standard. This standard, designated C2, specified a procedure to evaluate floor systems based on tests conducted earlier at the Columbia test station. A wall partition standard, C3, followed in 1909. In 1916 and 1917, the American Society of Testing and Materials and the National Fire Protection Association held a series of meetings to revise the C2 and C3 standards. The resulting standard, C19, superseded standards C2 and C3 and specified the standard temperature-time curve that is still used today. The current version of the standard, now designated ASTM E119, is essentially unchanged from the first edition published in 1918.


FIRE PROTECTION HANDBOOK®

Twentieth Edition

VOLUME I

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National Fire Protection Association®
Quincy, Massachusetts

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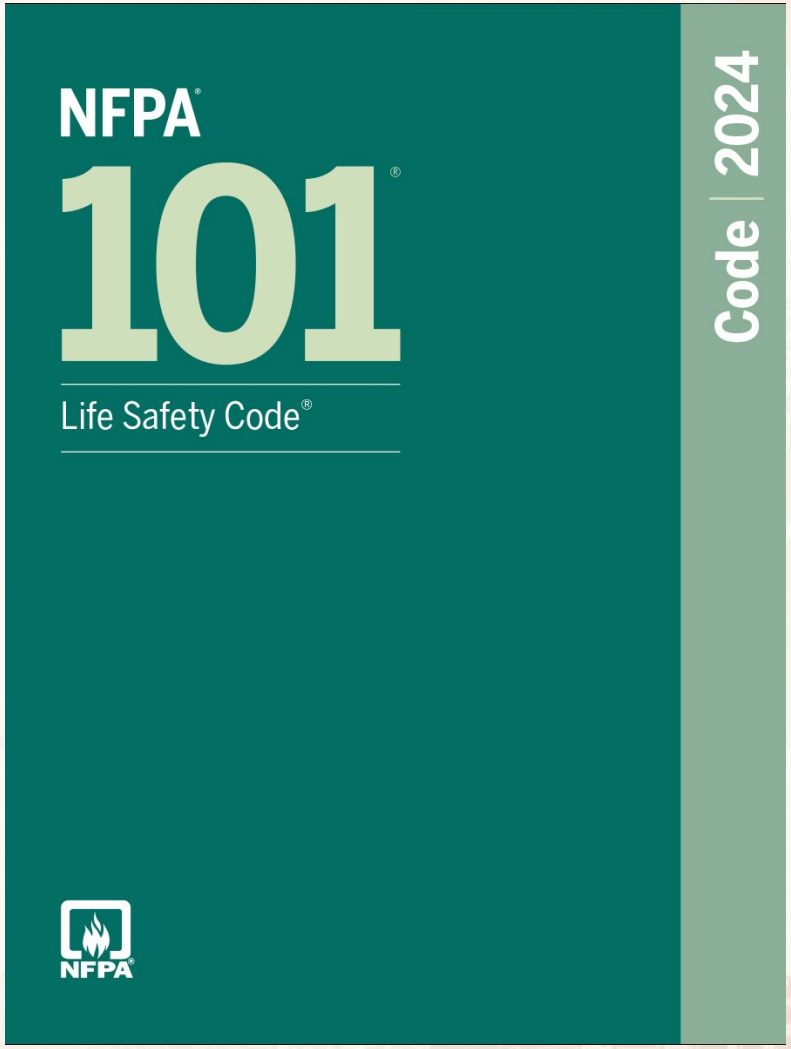
1913

生命安全设计的典范：NFPA 101®《生命安全规范》与NFPA 72。

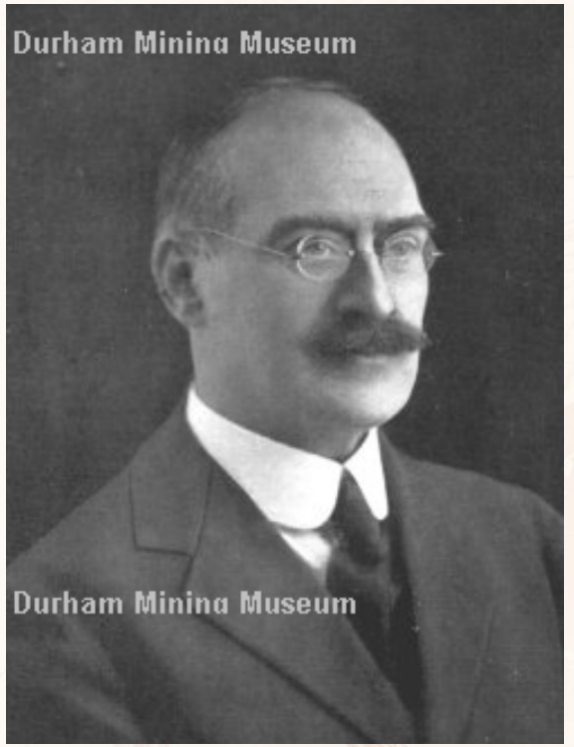
1911年纽约三角内衣厂火灾的惨痛教训直接催化了其前身——NFPA建筑出口规范的制定（1913年）。

NFPA 101并非单一设备标准，而是一套综合性的建筑安全解决方案规范。它全面规定了建筑布局、疏散通道宽度、安全出口数量、内部装修材料燃烧性能、应急照明等，核心目标是保障建筑物内人员在紧急情况下有足够的疏散时间和安全路径。NFPA 72则专门规范火灾探测、报警设备的安装与信号传输。



1917

威廉·索恩顿（William Thornton） 在 1917 年的研究中发现，绝大多数有机燃料在燃烧时，消耗单位质量氧气所释放出的热量几乎是一个常数（约为 13.1 MJ/kg）。在英文学术界，这一发现通常被称为 Thornton's Rule。重新发现：1970 年代，NIST 的研究员 Clayton Huggett 验证了索恩顿法则，并确认了这一常数在火灾实验中的准确性。设备发明：基于此原理，Vytenis Babrauskas 于 1982 年左右在 NIST 开发了锥形量热仪 (Cone Calorimeter)，这是目前世界上测量热释放速率 (HRR) 最重要的标准仪器。技术术语：在英文文献中，这种测量方法被称为 Oxygen Consumption Calorimetry (OCC)。



William Thornton of Armstrong College in England (now Newcastle University)

Thornton, W. M. (1917). The relation of oxygen to the heat of combustion of organic compounds. The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science, 33(194), 196–203.

http://w.dmm.org.uk/whoswho/t001.htm

1918 构件耐火性能的量化基石：ASTM E119 标准火曲线

1918 年发布ASTM E119建筑构件耐火性能测试，确立的温升曲线沿用至今，是消防工程领域的里程碑式标准。

ASTM Test Standards. The American Society of Testing and Materials was the first standards development organization in the United States to publish a fire resistance furnace test standard.[17,18] The Baltimore conflagration on February 7, 1904, resulted in the formation of ASTM Committee P on Fireproofing Materials. In 1910 the designation of the committee was changed to C5, and 35 years later it was changed again to E05. From its inception until 1927 the committee was chaired by Professor Ira H. Woolson of Columbia University. Professor Woolson was chosen to lead the committee because a few years earlier he had established the first U.S. station for fire resistance testing in New York City. In 1907 ASTM Committee P issued its first fire resistance furnace test standard. This standard, designated C2, specified a procedure to evaluate floor systems based on tests conducted earlier at the Columbia test station. A wall partition standard, C3, followed in 1909. In 1916 and 1917, the American Society of Testing and Materials and the National Fire Protection Association held a series of meetings to revise the C2 and C3 standards. The resulting standard, C19, superseded standards C2 and C3 and specified the standard temperature-time curve that is still used today. The current version of the standard, now designated ASTM E119, is essentially unchanged from the first edition published in 1918.

This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: E119 – 20

An American National Standard

Standard Test Methods for Fire Tests of Building Construction and Materials[1]

This standard is issued under the fixed designation E119; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

INTRODUCTION

The performance of walls, columns, floors, and other building members under fire-exposure conditions is an item of major importance in securing constructions that are safe, and that are not a menace to neighboring structures or to the public. Recognition of this is registered in the codes of many authorities, municipal and other. It is important to secure balance of the many units in a single building, and of buildings of like character and use in a community; and also to promote uniformity in requirements of various authorities throughout the country. To do this it is necessary that the fire-resistive properties of materials and assemblies be measured and specified according to a common standard expressed in terms that are applicable alike to a wide variety of materials, situations, and conditions of exposure.

Such a standard is found in the test methods that follow. They prescribe a standard exposing fire of controlled extent and severity. Performance is defined as the period of resistance to standard exposure elapsing before the first critical point in behavior is observed. Results are reported in units in which field exposures can be judged and expressed.

The test methods may be cited as the "Standard Fire Tests," and the performance or exposure shall be expressed as "2-h," "6-h," "½-h," etc.

When a factor of safety exceeding that inherent in the test conditions is desired, a proportional increase should be made in the specified time-classification period.

1. Scope*

1.1 The test methods described in this fire-test-response standard are applicable to assemblies of masonry units and to composite assemblies of structural materials for buildings, including loadbearing and other walls and partitions, columns, girders, beams, slabs, and composite slab and beam assemblies for floors and roofs. They are also applicable to other assemblies and structural units that constitute permanent integral parts of a finished building.

1.2 It is the intent that classifications shall register comparative performance to specific fire-test conditions during the period of exposure and shall not be construed as having determined suitability under other conditions or for use after fire exposure.

1.3 *This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of the materials, products or assemblies under actual fire conditions.*

1.4 These test methods prescribe a standard fire exposure for comparing the test results of building construction assemblies. The results of these tests are one factor in assessing predicted fire performance of building construction and assemblies. Application of these test results to predict the performance of actual building construction requires the evaluation of test conditions.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the*

[1] These test methods are under the jurisdiction of ASTM Committee E05 on Fire Standards and are the direct responsibility of Subcommittee E05.11 on Fire Resistance.

Current edition approved May 1, 2020. Published June 2020. Originally approved in 1917 as C19-1917 T. Last previous edition approved in 2019 as E119 – 19. DOI: 10.1520/E0119-20.

These test methods, of which the present standard represents a revision, were prepared by Sectional Committee on Fire Tests of Materials and Construction, under the joint sponsorship of the National Bureau of Standards, the ANSI Fire Protection Group, and ASTM, functioning under the procedure of the American National Standards Institute.

*A Summary of Changes section appears at the end of this standard

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1

Cote, A. E. (Ed.). (2008). Fire Protection Handbook (20th ed., Vol. I). National Fire Protection Association.
ASTM E119 − 20: Standard Test Methods for Fire Tests of Building Construction and Materials：
https://archive.org/details/gov.law.astm.E0119.20

1918

1918年成立英国消防工程师学会（Institution of Fire Engineers）。

The Institution of Fire Engineers

https://www.ife.org.uk/

Institution of Fire Engineers

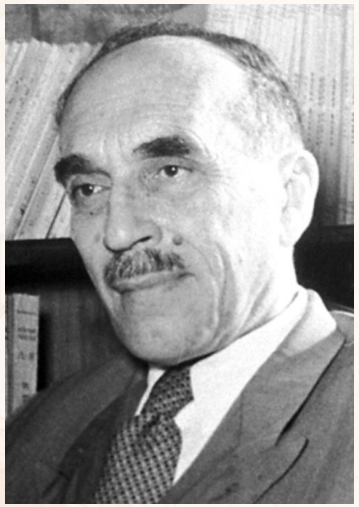
Abbreviation	IFE
Formation	31 October 1918
Type	Professional membership body
Headquarters	Stratford-upon-Avon, UK
Region served	Worldwide
Services	Professional membership, qualifications, training, events
Membership	Over 10,000 (February 2022)
Website	ife.org.uk

Founded in 1918 to advance and improve the knowledge, practice, and recognition of fire engineering, we have long been committed to fostering inclusion, promoting learning and development, and today proudly support a diverse community of members and affiliates across the globe.

1928

热爆炸研究的起点！

前苏联化学家谢苗诺夫的论文《关于燃烧过程的理论》开创了热爆炸的研究。

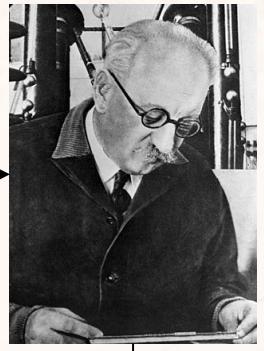


尼古拉·尼古拉耶维奇·谢苗诺夫（1896年4月15日－1986年9月25日）1956年他与西里尔·欣谢尔伍德一起获得诺贝尔化学奖。

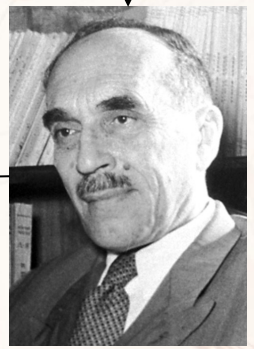
Semenov, N. N. (1928). On the theory of combustion processes. Zeitschrift für Physik, 48(7-8), 571–600.

谢苗诺夫的师承关系

亚伯拉罕·费多尔维奇·约费（1880年10月29日－1960年10月14日）



威廉·康拉德·伦琴（1845年3月27日－1923年2月10日），德国物理学家。



大卫-阿尔贝托维奇-弗兰克-卡缅涅茨基（1910年8月3日-1970年6月2日，苏联莫斯科）。发展了Semenov NN热爆炸理论，他的理论后来被称为Frank-Kamenetskii理论。

尼古拉·尼古拉耶维奇·谢苗诺夫（1896年4月15日－1986年9月25日）1956年他与西里尔·欣谢尔伍德一起获得诺贝尔化学奖。

1940

1940 年，珀西·朱利安（Percy Julian）发明了大豆蛋白空气泡沫灭火剂。

novation for fire protection. The proverbial parade of advancements is noteworthy: in 1800 Englishman John Carrey invented a crude automatic sprinkler; in 1821 Joseph Boyd patented the first rubber-lined cotton fire hose; in 1845 William Channing was credited with the invention of the first fire alarm telegraph; in 1852 a patent was issued for the first sprinkler perforated pipe system; also in 1852 the first Central Office (i.e., central station) and fire alarm boxes were installed in Boston; in 1853 the first practical motorized fire pumper was tested in Cincinnati; in 1860 Philip Pratt produced the first practical automatic sprinkler system; in 1863 Alanson Crane patented the first portable fire extinguisher; in 1864 Stewart Harrison produced the first practical sprinkler, significantly improved in 1874 by Henry Parmelee and again in 1880 by Frederick Grinnell. These inventions continued into the twentieth century with important technological innovations, such as the invention in 1940 of soy protein aerofoam by Percy Julian, the introduction of high-pressure water mist fog nozzles in 1942 by the U.S. Navy, and the invention in 1969 of the first battery-powered smoke detector by Randolph Smith and Ken House.[9]

珀西·拉冯·朱利安（Percy Lavon Julian，1899年4月11日－1975年4月19日）是一位美国研究化学家，也是从植物中合成药物化学的重要先驱。朱利安是首位成功合成天然产物毒扁豆碱（physostigmine）的人，并在将植物来源的化合物用于工业规模合成方面取得了突破性进展。他率先实现了从植物甾醇（如豆甾醇和谷甾醇）中大规模合成人体激素，包括孕酮和睾酮。他的研究为类固醇药物工业奠定了基础，使得可的松及其他皮质类固醇以及人工激素得以规模化生产，并最终推动了避孕药的发展。

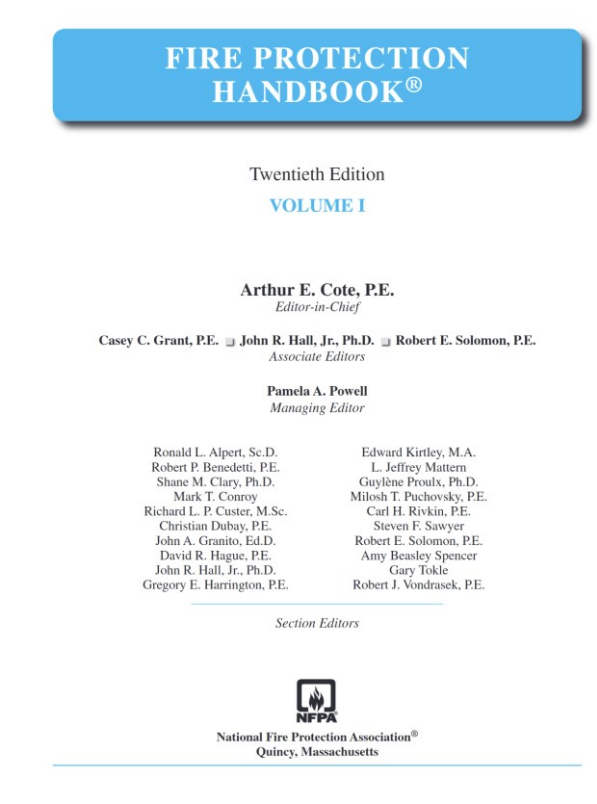
Cote, A. E. (Ed.). (2008). Fire Protection Handbook (20th ed., Vol. I). National Fire Protection Association.

1942

美国海军和海岸警卫队在二战背景下开始大规模引入并应用细水雾（Fog Nozzle）消防技术。

novation for fire protection. The proverbial parade of advancements is noteworthy: in 1800 Englishman John Carrey invented a crude automatic sprinkler; in 1821 Joseph Boyd patented the first rubber-lined cotton fire hose; in 1845 William Channing was credited with the invention of the first fire alarm telegraph; in 1852 a patent was issued for the first sprinkler perforated pipe system; also in 1852 the first Central Office (i.e., central station) and fire alarm boxes were installed in Boston; in 1853 the first practical motorized fire pumper was tested in Cincinnati; in 1860 Philip Pratt produced the first practical automatic sprinkler system; in 1863 Alanson Crane patented the first portable fire extinguisher; in 1864 Stewart Harrison produced the first practical sprinkler, significantly improved in 1874 by Henry Parmelee and again in 1880 by Frederick Grinnell. These inventions continued into the twentieth century with important technological innovations, such as the invention in 1940 of soy protein aerofoam by Percy Julian, the introduction of high-pressure water mist fog nozzles in 1942 by the U.S. Navy, and the invention in 1969 of the first battery-powered smoke detector by Randolph Smith and Ken House.[9]

诺曼底号火灾的教训：1942 年 2 月，运兵船“诺曼底号”（SS Normandie）在纽约港因焊接火花引发火灾。由于传统消防方法向船体内灌入了数千吨水，导致重心不稳而翻覆。这一事故促使美国军方寻找耗水量更少且灭火效率更高的技术。



Cote, A. E. (Ed.). (2008). Fire Protection Handbook (20th ed., Vol. I). National Fire Protection Association.

1949

英国成立了建筑研究院火灾研究站（Fire Research Station）。

Parallel growth occurred, primarily independently, in several countries. The effort in the United Kingdom was focused at the Building Research Establishment's Fire Research Station begun in 1948 in Borehamwood. The progress of fire physics can be traced in the Information Papers, Fire Research Notes, journal articles and books (19, 20) authored by the FRS staff. Particularly noteworthy is the recent volume of selected papers by P.H. Thomas covering 35 years of fire physics scholarship from 1951 to 1986 (21). In Canada, the activities of the National Re
those of the NB
of Edinburgh's
standing text o
mental program,

In 1949, England developed one of the most advanced scientific laboratories for fire study in the world (the Fire Research Station, formerly at Borehamwood). Much of the work through the 1960s was performed under the leadership of Dennis Lawson, Philip H. Thomas, and David Rasbash. Rasbash went on to establish the first graduate program in fire engineering at the University of Edinburgh. P.H. Thomas has been a main force in disseminating the benefits of fire science throughout the world. Some have said that he was first to work on many of the subjects of fire and got them right. Their work has not been fully appreciated today because much of it was never published in mainstream fire journals. However, today the Fire Research Notes (1952–1978) can be accessed online through the International Association for Fire Safety Science (IAFSS, www.iafss.org). The IAFSS was formed in 1986 with P.H. Thomas as its first head. It was established to facilitate the transfer of fire research around the world, and its proceedings contain some of the best of fire research developed.

Fire Research Station

1946 The Department of Scientific and Industrial Research and the Fire Offices' Committee (representing fire insurance companies) established a **Joint Fire Research Organisation** to conduct research on all aspects of prevention and extinction of fires, safety of life in fires and the mitigation of damage, working in collaboration with the Building Research Organisation on fire resistance of buildings.

The costs of the organisation were shared equally by the department and the committee; as part of its contribution to the capital cost, the committee transferred its Fire Testing Station to the government.

The Fire Research Board was appointed to make recommendation for fire research and to supervise the conduct of investigations at the station

1949 The Fire Testing Station was renamed the **Fire Research Station**.

1965 responsibility for the Joint Fire Research Organisation was passed to the Ministry of Technology and the board ceased to function.

1970 The research station was transferred to the Department of Trade and Industry

1971 Transferred to the Department of the Environment

1972 Amalgamated with the Building Research Station and the Forest Products Research Laboratory to form the **Building Research Establishment** of the Department of the Environment

Some facilities for fire testing undertaken by the station in association with the Fire Offices' Committee, mostly routine in character, were transferred to that committee.

The station is now mainly engaged on research leading to the specification of requirements for fire prevention and to the formulation of suitable testing methods.

1993 Became an executive agency

1994 the Station moved to the Building Research Establishment site at Garston, near Watford.

https://www.gracesguide.co.uk/Fire_Research_Station

Wakamatsu, T., Cox, G., Friedman, R., & Hirano, T. (Eds.). (1989). Fire safety science—Proceedings of the second international symposium. Hemisphere Publishing Corporation.
Quintiere, J. G. (2017). Principles of fire behavior (2nd ed.). CRC Press/Taylor & Francis Group.

1950

1950年，消防防护工程师学会（SFPE）自成立，1971 年正式注册为非营利组织。

The Society of Fire Protection Engineers (SFPE) has been a prominent professional organization since its establishment in 1950 and its incorporation as a nonprofit organization in 1971. As a leading global society, it represents professionals working in the field of fire protection and fire safety engineering. With over 5,000 members and more than 120 chapters worldwide, including more than 20 student chapters, SFPE has been rapidly growing.

1953

布莱恩·斯波尔丁（Brian D. Spalding）：提出了“斯波尔丁 B 数”（Spalding B number），用于描述扩散燃烧。

parameter. Spalding [9] and Emmons [10] laid a foundation for solutions to diffusive burning of the condensed phase. This foundation served as a guidepost to other far more complex problems involving soot, radiation and flame spread. The Spalding B number is a key dimensionless group that emerges in these problems, and represents the ratio of energy released in combustion to that needed for fuel vaporization. The energy production rate by fire (more specifically its rate of change of enthalpy due to chemical changes at 25 °C and 1 atmosphere pressure) will be termed here as firepower. Many have used the term heat release rate (HRR), but this is viewed as a misnomer by this author as the firepower has the same chemical production rate that would be attributed to a combustion-based power plant, and is not identical to the heat transferred in the reaction. Such misnomers have occurred throughout thermodynamics as represented in the terms: heat capacity, heat of vaporization and heat of combustion – all related to enthalpies. These misnomers might be attributed to remnants of the caloric theory of heat in which heat was viewed as being part of matter.

斯波尔丁（Spalding）与埃蒙斯（Emmons）为凝聚相扩散燃烧问题的求解奠定了基础。这一基础也为后续涉及炭黑、辐射及火焰传播等更为复杂的问题提供了重要指引。斯波尔丁 B 数是这类问题中出现的关键无量纲数，代表了燃烧释放的能量与燃料汽化所需能量的比值。

Spalding, D. B., The combustion of liquid fuels, Proc. Comb. Inst., 1953, 4, pp. 847–64.10.
Emmons, H. W., The film combustion of liquid fuel, Z. Angew Math. Mech., 1956, 36, 60–71.

1955

1955年，中华人民共和国公安部消防局成立（原隶属于中华人民共和国公安部）。2018年10月9日10时，“公安消防部队移交应急管理部交接仪式”举行，53年的消防部队成为历史。

关联信息：国家消防救援局是中华人民共和国应急管理部管理的副部级国家局，成立于2023年1月6日，由原应急管理部消防救援局和森林消防局整合组建，作为国家综合性消防救援队伍的领导指挥机关。

1956

马里兰大学成立消防工程系，这是全球消防高等教育的先驱，标志着消防从一种“技能”开始向“工程学科”转变。该系至今仍是全球顶尖的消防研究机构。

1956年3 月 12 日《华盛顿邮报》发布题为《马里兰大学开设消防专业课程》的文章，正式宣布马里兰大学工程学院开办四年制消防专业；消防推广教育部高级讲师约翰·L·布莱恩出任该新项目负责人。马里兰州议会批准专项经费，将消防专业办学资金纳入大学财政预算。

A. JAMES CLARK SCHOOL OF ENGINEERING | DEPARTMENT OF FIRE PROTECTION ENGINEERING

https://fpe.umd.edu/FPE-history

马里兰大学消防工程系（FPE）的创建人是约翰·L·布莱恩（John L. Bryan，1918–2003）。John L. Bryan (1926-2014) was the founding Professor and Chair of the Department of Fire Protection Engineering (FPE) at the University of Maryland, from the department's initiation in 1956 until 1993. Following his retirement on August 1, 1993, he was granted the rank of Professor Emeritus, with 37 years of service in the department and 39 years of service with the University.

1956

1956年1月9日，公安部沈阳第一民警干校增设消防培训班，学期6个月。从1956年到1982年共开办了41期，累计为国家培训消防人才4000余人。

资料来源：李思成教授提供

新中国的消防教育事业起步于 1956 年，第一个消防专业队和消防教研室是沈阳民警干校组建。1957 年，宋光积等 25 位有志青年为了新中国的消防事业，远赴万里之外的俄罗斯列宁格勒消防技术学校，也就是现在的圣彼得堡国立消防大学求学深造，为共和国消防教育事业和消防部队建设播下了生生不息的火种（来源：https://www.cppu.edu.cn/wdpdf/1.pdf）。

学员们在上企业防火课（中国消防博物馆馆藏照片）

1959年留苏毕业照（中国消防博物馆馆藏照片）

1957

我国颁布《消防监督条例》。

《中华人民共和国消防条例》（1984年）：替代了1957年的《消防监督条例》，成为当时消防领域的主要法规。它首次以专门法规的形式明确了“预防为主，防消结合”的消防工作方针，系统规定了火灾预防、消防组织、灭火救援等内容。它的实施，标志着中国的消防管理工作开始走向系统化、专门化的法制轨道。

《中华人民共和国消防法》（1998年）：这是中国消防法制建设史上最具里程碑意义的事件。随着社会主义市场经济体制的建立，《消防条例》已难以适应复杂的火灾防控新形势。1998年9月1日正式实施的《消防法》，旨在“预防火灾和减少火灾危害，保护公民人身、公共财产和公民财产的安全，维护公共安全”。它系统构建了火灾预防、消防组织、灭火救援、监督检查和法律责任的法律框架，并明确了政府、部门、单位、公民的消防责任，确立了消防设计审核、验收等关键制度。这部法律的颁布，标志着中国消防工作全面进入了法治化时代。

1958

Zone Fire Model的提出与后续发展。

1. 核心理论的奠基（1950年代）

区域模型的最早雏形可以追溯到日本学者川越邦雄（Kunio Kawagoe）。他在 1958 年发表的经典论文中，首次系统地通过质量和能量守恒定律描述了室内火灾的通风行为。

2. 双层假设的提出与计算化（1970年代）

James G. Quintiere 教授（马里兰大学）在 1976 年左右将这一理论推向了“双层模型”的实用阶段。他提出了将房间简化为“高温烟气层”和“低温空气层”的明确数学框架。Quintiere 参与开发的 FIRST 模型是早期最著名的计算机区域模型之一。

3. 现代工业标准（1980-1990年代至今）

随着计算机普及，美国国家标准与技术研究院（NIST）整合了前人的研究，推出了目前全球最通用的区域模型软件 CFAST。CFAST 能够快速模拟多房间建筑内的火灾蔓延，是消防工程师进行性能化设计的主要工具。CFAST – Consolidated Fire and Smoke Transport (Version 7) Volume 1: Technical Reference Guide

Kawagoe, K. (1958). Fire behavior in rooms (Report No. 27). Building Research Institute. https://www.kenken.go.jp/japanese/contents/publications/report/27.htm

Quintiere, J. G. Growth of Fire in Building Compartments. In: Fire Standards and Safety. Proceedings, pp. 300-311. National Bureau of Standards and the American Society for Testing Materials, Gaithersburg, Md., April 5-6, 1976. ASTM STP 614 (1977).


研究所概要 研究開発 関連事業 お知らせ 情報公開

■建築研究報告

Fire Behaviour in Rooms

Kunio KAWAGOE

建築研究報告 No.27, 1958 建設省建築研究所

＜概要＞

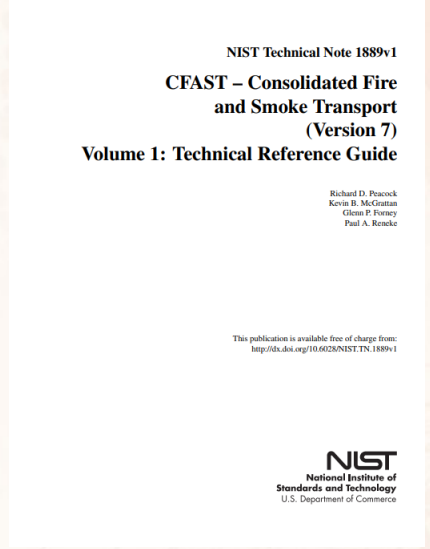
When the rational plan of fire protection or strength judgement of damaged buildings are made, the fire behaviour in fire resistive constructions is fundamentally important. For instance, "time temperature curve"of fire corresponds to "load"in the structural mechanics, which is called "fire load"in Japanese fire engineering.

Before the World War Ⅱ only two fire tests concerning fire resistive constructions were made in Japan; the fire test in Dojunkai apartment house by Tokyo University and in Premium House sponsored by Osaka City. In other countries also there are only few research papers concerned. Soon after the War the Building Research Institute Began to engage in the strength judgement of fire-damaged buildings, but there were difficulties in judging the rate of fire-damage, since the method to assume the fire duration had not been established.

In U.S.A. it has been regarded that the weight of fuel (timbers) per unit floor area ("fire load") is proportional to the fire duration.

1. In U.K. the calorific value per unit floor area has been regarded as proportional to the fire duration.
2. However, it is evident, as this study will show, that the window area plays an influential role in the fire duration as well as calorific value. In Japan, therefore, it has been convinced that the method to assume the fire duration will be established from the window area and the weight of fuel.

For this reason our institute made fourteen fire experiments with full-scale

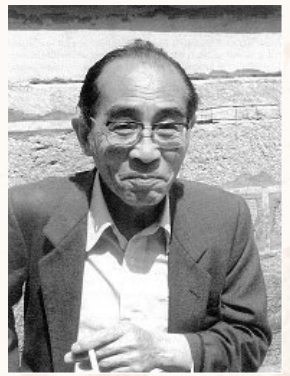

NIST Technical Note 1889v1

CFAST – Consolidated Fire and Smoke Transport (Version 7)
Volume 1: Technical Reference Guide

Richard D. Peacock
Kevin B. McGrattan
Glenn P. Forney
Paul A. Reneke

This publication is available free of charge from:
http://dx.doi.org/10.6028/NIST.TN.1889v1

NIST National Institute of Standards and Technology U.S. Department of Commerce



川越邦雄 (Kunio Kawagoe)
日本著名建筑火灾专家
提出了提出“通风因子”

詹姆斯·昆蒂尔
James G. Quintiere

1958

P. H. Thomas在 1958 年首次研究了地下火灾中浮力流的运动，并于 1968 年提出了临界风速 (Critical Velocity) 的概念——即防止烟气向火源上游蔓延（背层流动）所需的最小纵向风速。这一概念至今仍是全球隧道通风设计的核心标准。

Professor Philip Thomas.
founding father of the IAFSS

Thomas, P., "The movement of buoyant fluid against a stream and the venting of underground fires", Fire Research Station, F.R. Note No. 351/1958, Boreham Wood, 1958.

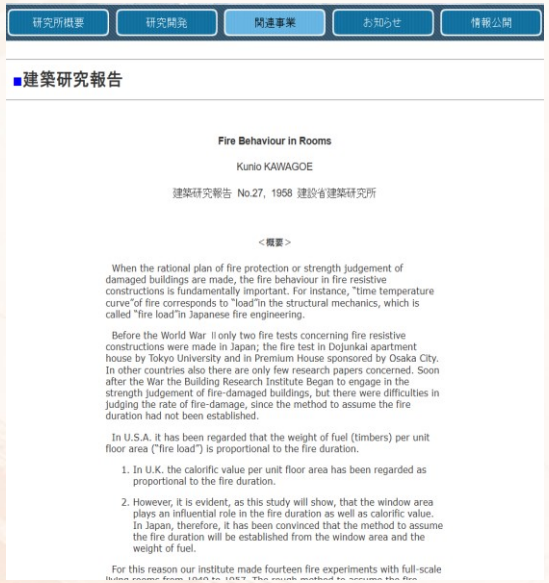
This research paper, published in 1958 by P.H. Thomas at the Fire Research Station in Boreham Wood, is a seminal work in the field of tunnel and underground fire safety. It established the fundamental physics governing back-layering, a phenomenon where buoyant smoke flows in the opposite direction of the ventilation current.

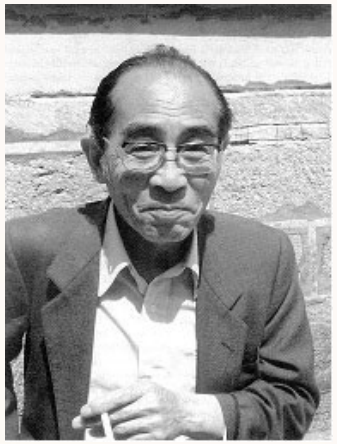
A. J. M. Heselden (1976)：他在 1976 年首次提出了道路隧道设计火灾规模的建议。他估算的汽车（5 MW）和重型货车（20 MW）的热释放率至今仍是许多设计规范的基础。

Haukur Ingason：瑞典 RISE 研究院的高级研究员，当代隧道火灾动力学的权威。他合著的《隧道火灾动力学》(Tunnel Fire Dynamics) 是该领域的百科全书式著作，总结了过去几十年的实验与理论成果。

1958

川越邦雄（Kunio Kawagoe） 教授在 1958 年提出了“通风因子”（Ventilation Factor），发现了轰燃后火灾的质量燃烧速率与通风口面积和高度之间的关系，成为分析室内火灾发展的关键参数，至今被广泛应用。被公认为现代火灾安全工程的基石之一。





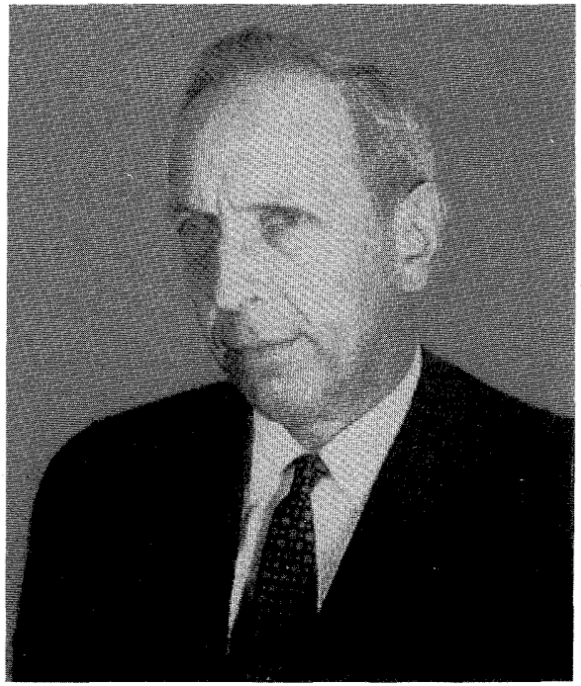
川越邦雄 (Kunio Kawagoe)
日本著名建筑火灾专家
提出了提出“通风因子”

Kawagoe, K. (1958). Fire behavior in rooms (Report No. 27). Building Research Institute. https://www.kenken.go.jp/japanese/contents/publications/report/27.htm

1959

拜拉姆火线强度 (Byram’s Fire Line Intensity)这是Byram最杰出的成就。他首次定义了火线强度，即火头单位长度、单位时间内释放的热量。该指标直接与火焰长度相关，是评估灭火难度（是否可以使用手动工具或必须出动重型机械）的关键标准。

Byram, G. M. (1959). Combustion of forest fuels. 载于 K. P. Davis (编), Forest Fire: Control and Use. McGraw-Hill. 。



IN MEMORY

George M. Byram
1909-1996

1959

1959年9月19日，中国留苏学员以优异的成绩毕业。归国后，他们编写了《中国建筑设计防火规范》《火灾自动报警》《防排烟系统》《防火检查手册》《中国火灾大典》《中国消防简史》等消防行业规范和专业著作，在防火、灭火、消防宣传教育各领域发挥了重要的推动作用，为新中国消防事业的发展奠定了坚实的基础。

留苏学员的课堂笔记、成绩单和毕业证书
（中国消防博物馆馆藏照片）

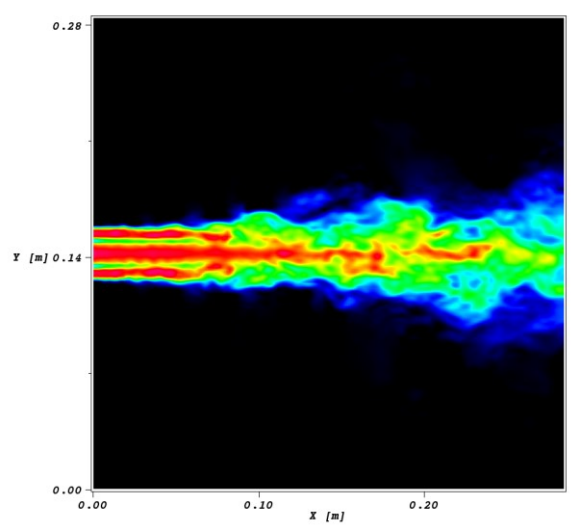
资料来源：由中国人民警察大学李思成教授提供。

1963

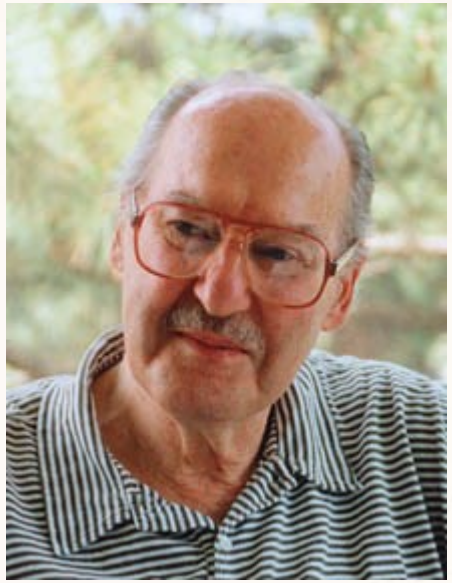
应急管理部四川消防研究所（原公安部消防研究所）是应急管理部直属的公益性消防科研机构，始建于 1963 年，是国内最早成立的综合性建筑防火研究所，也是我国消防科研领域的重要 “国家队” 之一。

1963

大涡模拟(Large eddy simulation, LES) 是用于计算流体动力学的湍流数学模型。它最初由约瑟夫·斯玛格林斯（Joseph Smagorinsky）基于1963 年提出，用于模拟大气气流，并借助像NIST FDS这样的公开软件平台，在21世纪初成为火灾科学和工程中进行高精度湍流流动模拟的主流工具之一。



Large eddy simulation of
a turbulent gas velocity field.



Joseph Smagorinsky (29 January 1924 – 21 September 2005) was an American meteorologist and the first director of the National Oceanic and Atmospheric Administration (NOAA)'s Geophysical Fluid Dynamics Laboratory (GFDL).

1965

Fire Technology 创刊。

Guillermo Rein is Professor of Fire Science and Director of Research in the Department of Mechanical Engineering at Imperial College London, where he also founded the research group Hazelab. He is Editor in Chief of the journal Fire Technology and a Fellow of the Combustion Institute. His work sits at the intersection of fire science, engineering, and public safety, combining laboratory experiments, field studies, and computer modelling. He works closely with industry, fire services, and policymakers to translate research into the real world.

Editor-in-Chief：Guillermo Rein

1965

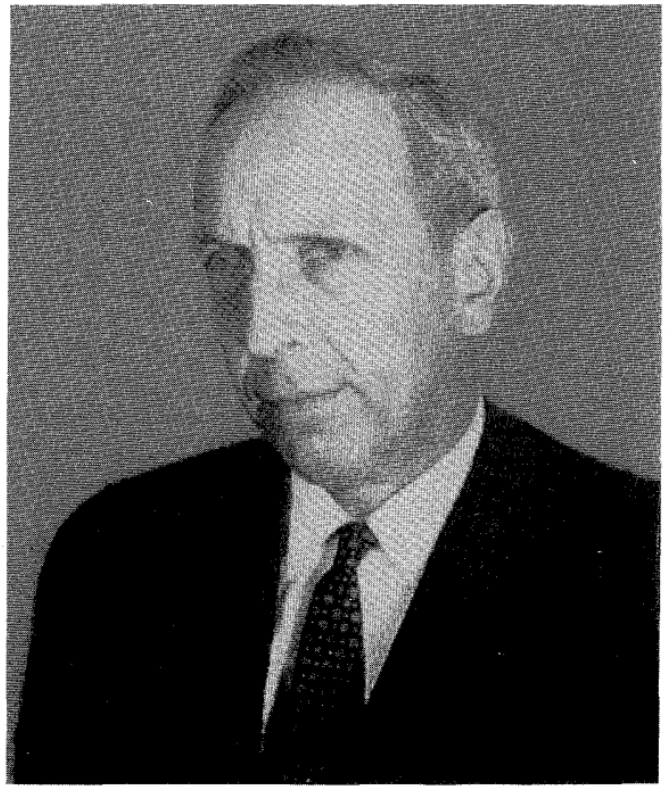
应急管理部天津消防研究所、应急管理部上海消防研究所以及应急管理部沈阳消防研究所成立（原公安部消防研究所）。

1968

1968年，Byram与 John Keetch 共同开发了基奇-拜拉姆干旱指数 (Keetch-Byram Drought Index, KBDI)。通过追踪降水量和蒸发量，估算土壤和枯枝落叶层的水分亏缺。该指数至今仍是全球森林防火预警系统（如美国 NFDRS 和澳大利亚预警系统）的核心参数，用于预测火灾潜势。

Keetch, J. J., & Byram, G. M. (1968). A drought index for forest fire control. USDA Forest Service Research Paper SE-38. Southeastern Forest Experiment Station.

IN MEMORY George M. Byram 1909-1996
https://www.fs.usda.gov/rm/pubs_other/rmrs_1996_nelson_r001.pdf



IN MEMORY

George M. Byram
1909-1996

1968

P. H. Thomas于 1968 年提出了临界风速 (Critical Velocity) 的概念——即防止烟气向火源上游蔓延（背层流动）所需的最小纵向风速。

Professor Philip Thomas.
founding father of the IAFSS

Thomas, P. H. (1968). The movement of smoke in horizontal passages against an air flow (Fire Research Note No. 723). Fire Research Station.

It is most famous for introducing the concept of critical velocity—the minimum air speed required to prevent smoke from traveling upstream (against the wind) in a tunnel or corridor, a phenomenon known as backlayering.

1969

1969年：伦道夫·史密斯（Randolph Smith）和肯·豪斯（Ken House）发明了首款电池供电的烟雾探测器。

novation for fire protection. The proverbial parade of advancements is noteworthy: in 1800 Englishman John Carrey invented a crude automatic sprinkler; in 1821 Joseph Boyd patented the first rubber-lined cotton fire hose; in 1845 William Channing was credited with the invention of the first fire alarm telegraph; in 1852 a patent was issued for the first sprinkler perforated pipe system; also in 1852 the first Central Office (i.e., central station) and fire alarm boxes were installed in Boston; in 1853 the first practical motorized fire pumper was tested in Cincinnati; in 1860 Philip Pratt produced the first practical automatic sprinkler system; in 1863 Alanson Crane patented the first portable fire extinguisher; in 1864 Stewart Harrison produced the first practical sprinkler, significantly improved in 1874 by Henry Parmelee and again in 1880 by Frederick Grinnell. These inventions continued into the twentieth century with important technological innovations, such as the invention in 1940 of soy protein aerofoam by Percy Julian, the introduction of high-pressure water mist fog nozzles in 1942 by the U.S. Navy, and the invention in 1969 of the first battery-powered smoke detector by Randolph Smith and Ken House.[9]

Cote, A. E. (Ed.). (2008). Fire Protection Handbook (20th ed., Vol. I). National Fire Protection Association.

1973

THE UNIVERSITY of EDINBURGH

1973年，爱丁堡大学在工程科学学院（School of Engineering Science）内正式设立了消防工程系（Department of Fire Engineering），并设立了该学科的讲座教授席位。

该学科核心奠基人之一的戴维·拉什巴什（**Prof David Rasbash**）教授

Prof Dougal Drysdale

Prof Jose Torero

Post-World War II

Following the untimely death of Arnold in 1963, Leslie Jaeger was appointed fifth Regius Professor, from Magdalene College, Cambridge. Jaeger's tenure was brief, as he left after only four years to take up the Chair of Civil Engineering and Applied Mechanics at McGill University (a Chair, coincidentally, previously held by an earlier Regius Professor, George Armstrong). His tenure saw a further split into three separate departments: Civil Engineering, Electrical Engineering, and Mechanical Engineering. The Chair of Engineering itself was situated in the Department of Mechanical Engineering.

James King, former Chief Scientist in the Naval Construction Research Establishment at Rosyth, became the sixth Regius Professor in 1968. King oversaw a period of extensive structural change. First, in 1970, the Department of Civil Engineering was renamed the Department of Civil Engineering and Building Science (with C. B. Wilson appointed Professor of Building Science). Then, in 1972, the Departments of Electrical and Mechanical Engineering united with the hitherto independent Department of Chemical Engineering (founded as the Department of Chemical Technology in 1955) to form the School of Engineering Science. The Department of Civil Engineering and Building Science initially remained a discrete unit. In 1973, a Department of Fire Engineering (renamed Fire Safety Engineering, 1976) was created within the School of Engineering Science, and a Chair was instituted in the discipline. Finally, in 1979, the Department of Civil Engineering and Building Science was incorporated into the School of Engineering Science.

https://ourhistory.is.ed.ac.uk/index.php/Engineering

Many of those who are now leaders in the field came to Edinburgh to study and research under the supervision of the late Prof David Rasbash, one of the main pioneers of the discipline, and Prof Dougal Drysdale, author of the definitive text book on the subject, 'Introduction to Fire Dynamics' (Wiley, 3rd edition 2011).

In more recent years the group has been led by Prof Jose Torero, Prof Albert Simeoni, and Prof Grunde Jomaas, who held the BRE Chair in Fire Safety Engineering from 2004-12, 2013-15 and 2016-2021, respectively.

Teaching and research in fire safety continues at Edinburgh under the leadership of Prof Luke Bisby, the Chair of Fire and Structures.

The Edinburgh Fire Research Centre is part of the Institute for Infrastructure and Environment, School of Engineering at The University of Edinburgh.

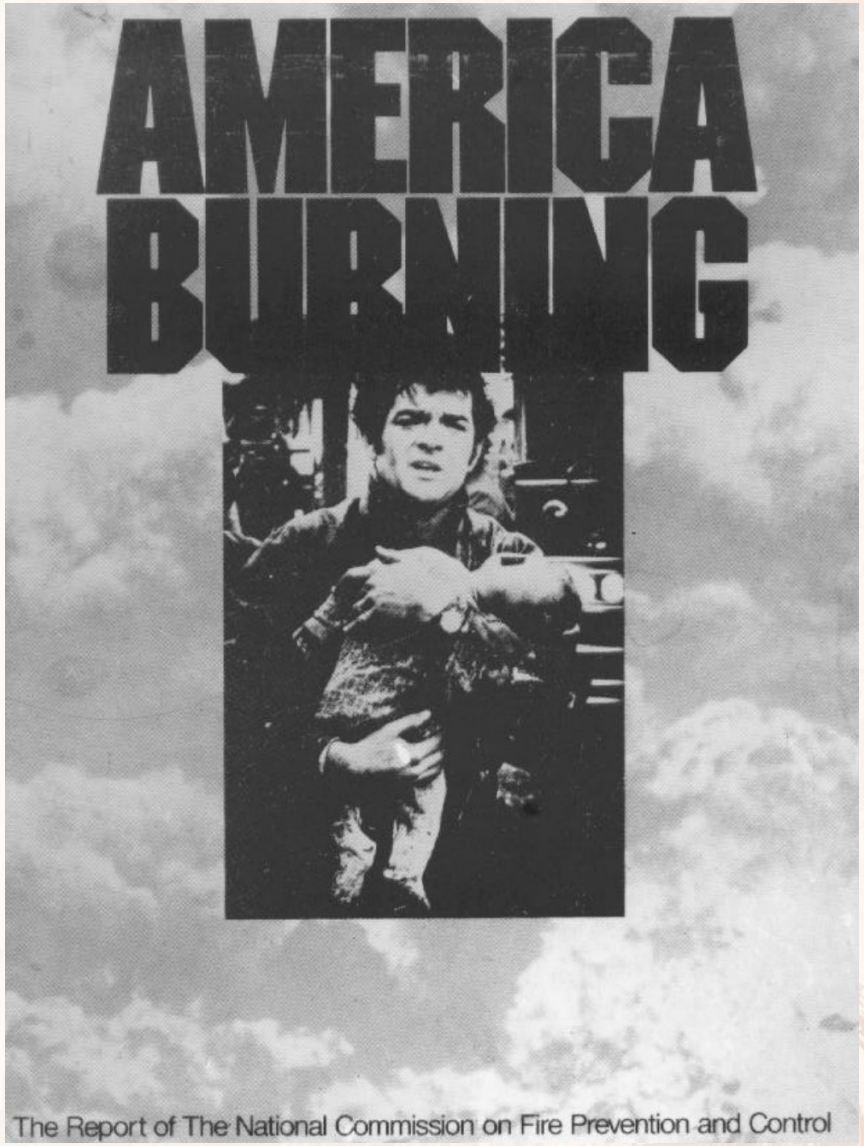
Fighting fire with ideas: how our fire engineers save lives. https://impact.ed.ac.uk/research/climate-environmental-crisis/fighting-fire-with-ideas-how-our-fire-engineers-save-lives/
Edinburgh Fire Research Centre: https://www.fire.eng.ed.ac.uk/history#:~:text=Many%20of%20those%20who%20are%20now%20leaders,to%20Fire%20Dynamics'%20(Wiley%2C%203rd%20edition%202011).

1973

1973 年发布的America Burning报告是消防史上最具深远影响力的文件之一。它不仅揭示了当时美国严峻的火灾问题，还直接促成了现代消防科学与预防体系的诞生。

The Commission on Fire Prevention and Control has made a good beginning, but it cannot do our work for us. Only people can prevent fires. We must become constantly alert to the threat of fires to ourselves, our children, and our homes. Fire is almost always the result of human carelessness. Each one of us must become aware—not for a single time, but for all the year—of what he or she can do to prevent fires.

—President Richard M. Nixon
September 7, 1972



1974

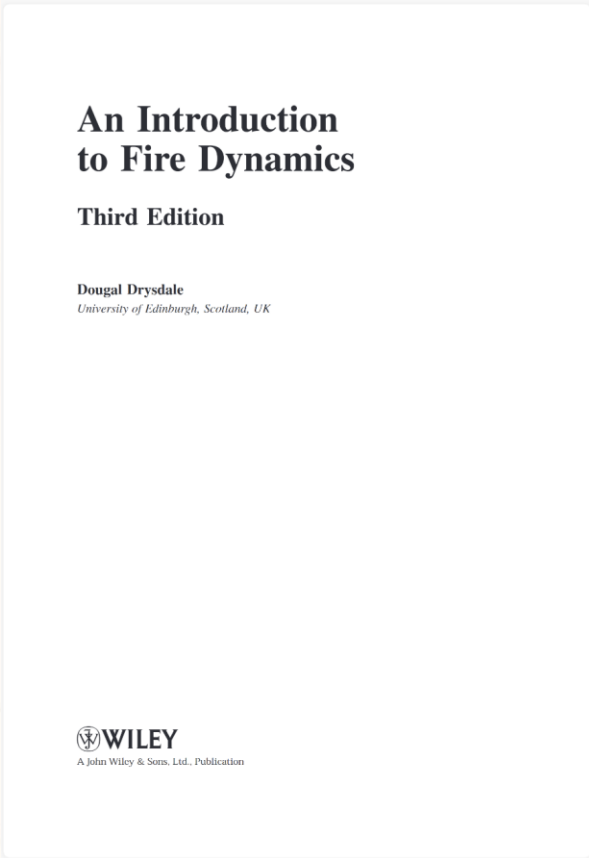
1971 年，美国有超过 12000 名普通民众及 250 名消防员因火灾丧生。为遏制这类惨痛伤亡，美国国会于 1974 年颁布《联邦火灾预防与控制法案》（Federal Fire Prevention and Control Act）。该法案设立了国家火灾预防与管控局（NFPCA，现美国消防管理局 USFA）以及国家消防学院（NFA）。

U.S. Fire Administration
Working for a fire-safe America

1974

全球第一个火灾工程领域的研究生培养项目于1974年在英国爱丁堡大学创立，由大卫·拉什巴什教授领导建立。这标志着火灾工程从一个以实践经验为主的领域，正式成为一个拥有系统高等教育和学位授予制度的独立工程学科。

Dougal Drysdale graduated with a degree in Chemistry from the University of Edinburgh in 1962. He gained a PhD in gas phase combustion from Cambridge University (UK) and after two years' postdoctoral work at the University of Toronto, moved to the University of Leeds to work with the gas kinetics group in the Department of Physical Chemistry. He joined the newly formed Department of Fire Engineering at the University of Edinburgh in 1974 and helped develop the first postgraduate degree programme in Fire Engineering under the leadership of Professor David Rasbash. He was invited to teach Fire Dynamics during the spring semester of 1982 at the Centre for Firesafety Studies, Worcester Polytechnic Institute, MA. The notes from this course formed the first draft of the first edition of *An Introduction to Fire Dynamics*, which was published in 1985.



1974

根据《联邦火灾预防与控制法案》（Federal Fire Prevention and Control Act of 1974）在当时的国家标准局（NBS，现为 NIST）内正式设立火灾研究中心（Center for Fire Research, CFR）。

1977

国际Fire Safety Journal创刊。

首任主编为I. N. EINHORN (Salt Lake City)，副主编为S.C.Israel (U.S.A.)和J.H.Petajan (U.S.A.)。

当前主编为英国学者Luke Bisby和比利时学者Bart Merci。

Luke Bisby

The University of Edinburgh, Edinburgh, United Kingdom

Bart Merci

Ghent University, Gent, Belgium

1979

1979年，美国伍斯特理工学院消防安全研究中心开设了全美第一个消防工程专业的硕士课程。该课程是在消防安全研究中心（Center for Fire Safety Studies）主任 David A. Lucht 的领导下建立的。In 1979, WPI established the first graduate degree program in fire protection engineering building on our early contributions to the fire protection engineering movement starting in the 19th century.

Professor David Lucht's career in the fire protection field spanned a period of over 45 years in business, government, and academia. In 1978, he became the first director of the Center for Firesafety Studies at WPI, where he oversaw the start-up of the Fire Protection Engineering graduate degree program.

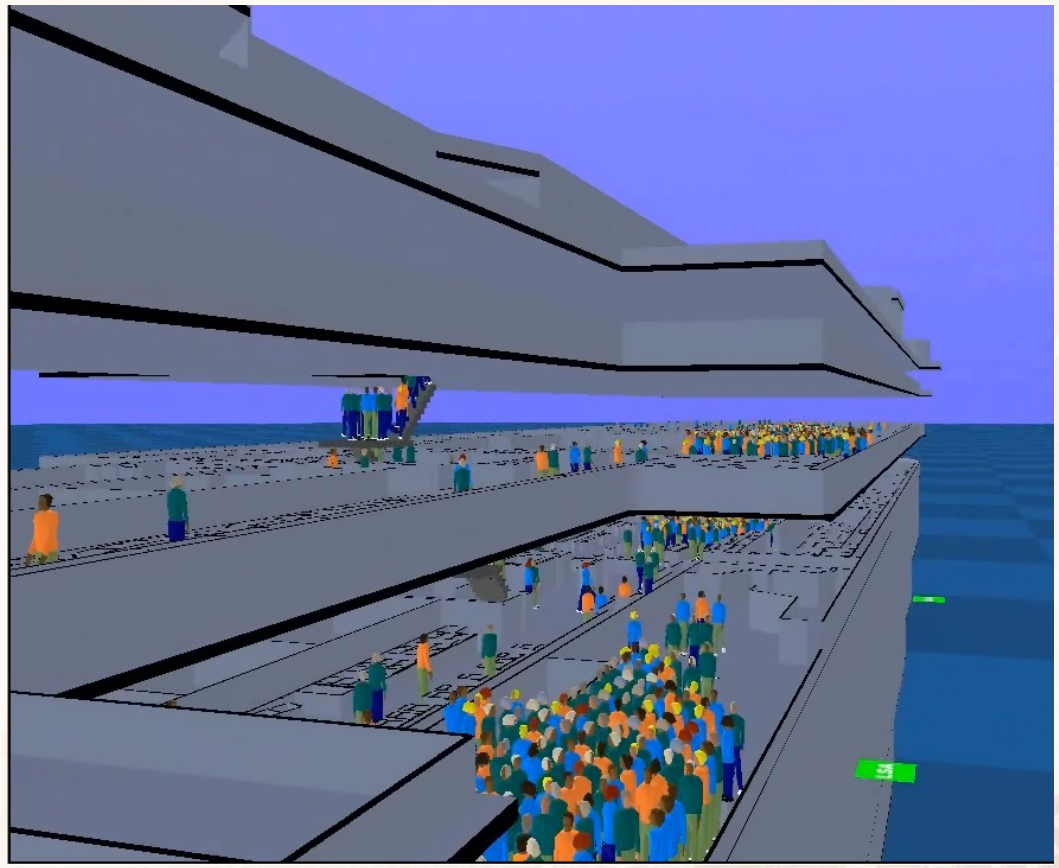
https://www.wpi.edu/academics/departments/fire-protection-engineering/resources/history#:~:text=In%201979%2C%20WPI%20established%20the%20first%20graduate,engineering%20movement%20starting%20in%20the%2019th%20century.

1970s

全球较早的安全疏散仿真软件。

EVACNET（1970s末）、FPETool（1990 年）和EXIT89（1980s）以及EXODUS（1989年），均是为响应对疏散时间进行精准评估的需求日益增长而开发的。

EXODUS 是一款用于模拟大型复杂空间中行为与移动的软件工具，其研发约始于 1989 年，自 1996 年起广泛可用，在约 23 个国家拥有用户，目前有四个版本，分别应用于建筑环境、航空、海事领域以及作为虚拟现实动画工具（Developed by the Fire Safety Engineering Group at the University of Greenwich, EXODUS comprises a suite of software packages, tailored to the building, maritime, rail and aircraft environments.）。



1970s

20世纪70年代：美国消防协会（NFPA）系统概念委员会开发了NFPA消防安全概念树，这是一种逻辑图，涵盖了所有已知和设想的提供消防安全的方法，至今仍适用于传统和创新建筑设计。

The most widely accepted systems approach to fire safety is the NFPA Fire Safety Concepts Tree, a logic diagram that covers all known and conceived means of providing fire safety. This approach was developed by the NFPA Committee on Systems Concepts in the 1970s and continues to be applicable to both traditional and innovative building design. A brief introduction to the "Tree" is published as a technical document, NFPA 550, *Guide to the Fire Safety Concepts Tree.*

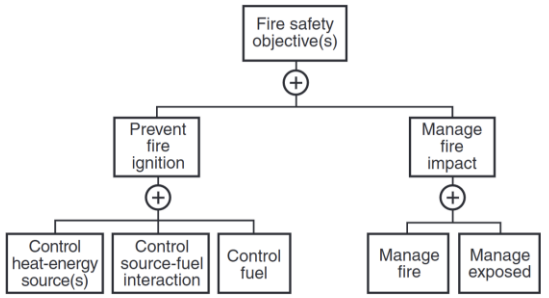
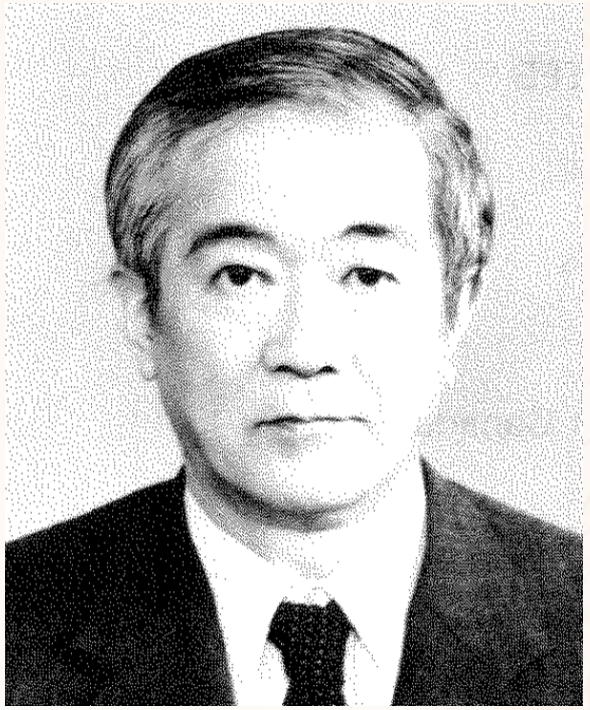


FIGURE 1.9.2 Principal Branches of the Fire Safety Concepts Tree

Cote, A. E. (Ed.). (2008). Fire Protection Handbook (20th ed., Vol. I). National Fire Protection Association.

1981

东京理科大学成为火灾科学研究中心成立（the Center for Fire Science and Technology of the Science University of Tokyo ）。同年创办了期刊International Journal for Fire Science and Technology。



Takashi Handa教授（1923–1985）

He became the first Director of the Center for Fire Science and Technology of the Science University of Tokyo in 1981.

火災科学研究所 Center for Fire Science and Technology – TUS. https://gcoe.tus-fire.com/en_journal/

1981

1981年4月24日，国家批准公安部在河北廊坊组建中国人民武装警察部队学院（简称廊坊武警学院，今中国人民警察大学），正式开设消防专业，招收在职干部，开办两年大专学历教育，培养连级以上管理指挥干部。

建校初期廊坊武警学院校门

资料来源：由中国人民警察大学李思成教授提供。

1982

《消防科学与技术》创刊于1982年，是由中华人民共和国应急管理部主管、应急管理部天津消防研究所主办的面向国内外发行的专业性学术期刊。本刊是我国创刊最早、最具权威性的学术性期刊之一，是国家消防救援科技领域唯一的中文核心期刊、中国科技核心期刊，也是成功入选国内外安全科学领域高质量科技期刊分级目录的消防学术性刊物。

1982

The cone calorimeter is the most important tool ever created in the field of fire safety science. Dr. Alexander Morgan, Center for Flame Retardant Materials Science, University of Dayton.

第一台锥形量热仪（Cone calorimeter）诞生！

1982 年，火灾研究中心的 Vytenis Babrauskas 及其同事研制出了第一台锥形量热仪（Cone calorimeter）。锥形量热仪很快便成为现代火灾安全测试的重要仪器，并于 1988 年荣获 R&D 100 奖。如今，锥形量热仪既可用于监管，也可用于研究。

维特尼斯·巴布拉斯卡斯（Vytenis Babrauskas）

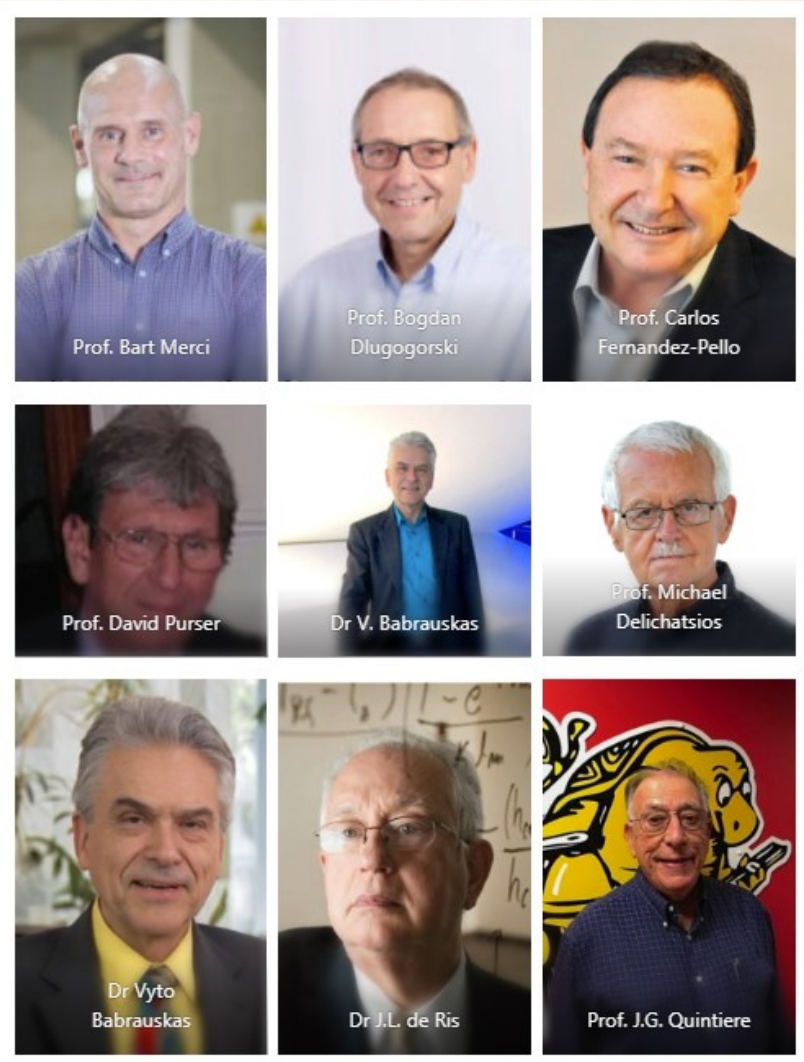
时间	作者	研究成果
1917 年	W. M. Thornston	首次发现有机液体和气体燃烧时，单位质量氧气消耗会释放恒定热量，提出相关方法
1977 年	William Parker	证实多种燃料燃烧时，单位氧气消耗的热量释放大致恒定；通过测氧耗可估算火灾释热，该方法现称“氧气消耗热量测定法”
1980 年	Clayton Huggett	在论文中提供严谨的概念验证，指出氧气消耗热量测定法估算释热的准确性显著高于以往方法

1983

国际火灾安全科学奖——埃蒙斯奖设立。

“国际火灾科学之父”的哈佛大学教授Howard W. Emmons (1912–1998)去世。

Howard Wilson Emmons (1912–1998) was an American professor in the department of Mechanical Engineering at Harvard University. During his career he conducted original research on fluid mechanics, combustion and fire safety. Today he is most widely known for his pioneering work in the field of fire safety engineering. He has been called "the father of modern fire science" for his contribution to the understanding of flame propagation and fire dynamics.



1983

元胞自动机 (CA) 作为一种抽象的数学模型，由约翰·冯·诺依曼在20世纪40年代末至50年代初提出。

火灾领域的首次应用：该模型被Green等人于1983年和1985年首次引入到火灾蔓延的建模中，成为该领域一类重要且高效的模拟方法（the cellular automata approach, which was first introduced by Green et al. (1983, 1985)）。

1984

中国消防协会（**China Fire Protection Association**）是1984年经公安部和中国科协批准，并经民政部依法登记成立的由消防科技工作者、消防专业工作者以及科研、教学、企业、中介服务机构等单位自愿结成的全国性、行业性社会团体，是非营利性社会组织。

1985

第一届国际火灾安全科学研讨会召开，并成立了国际火灾安全科学协会。

1984 年，由 P·H·托马斯博士、川越（K. Kawagoe）教授、秋田（K. Akita）教授、J·G·昆蒂埃博士、R·弗里德曼博士等人发起的讨论，促成了第一届国际火灾安全科学研讨会的筹备工作。举办该研讨会的宗旨是 “打造一个专门论坛，涵盖火灾研究的各个方面，以及这些研究在解决破坏性火灾所带来问题中的应用”。

第一届研讨会于 1985 年 10 月 7 日至 11 日召开，会上成立了一个新的国际组织 —— 国际火灾安全科学协会（IAFSS）。首届研讨会的注册参会者成为该协会的创始会员。


FIRE SAFETY SCIENCE
Proceedings of the First International Symposium

Editors

Cecile E. Grant
Civil Engineering Department
University of California, Berkeley, USA

Patrick J. Pagni
Mechanical Engineering Department
University of California, Berkeley, USA

INTERNATIONAL ASSOCIATION FOR FIRE SAFETY SCIENCE

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Grant, C. E., & Pagni, P. J. (Eds.). (1986). Fire safety science—Proceedings of the first international symposium. Hemisphere Publishing Corporation.

1985

中国建筑科学研究院建筑防火研究所（简称“防火所”）,成立于1985年，是由联合国开发计划署和中华人民共和国建设部联合投资组建的建筑防火研究机构，是中国建筑科学研究院（简称“中国建研院”）的二级单位，中国建研院隶属于国务院国有资产监督管理委员会，是全国建筑行业最大的综合性研究和开发机构之一。

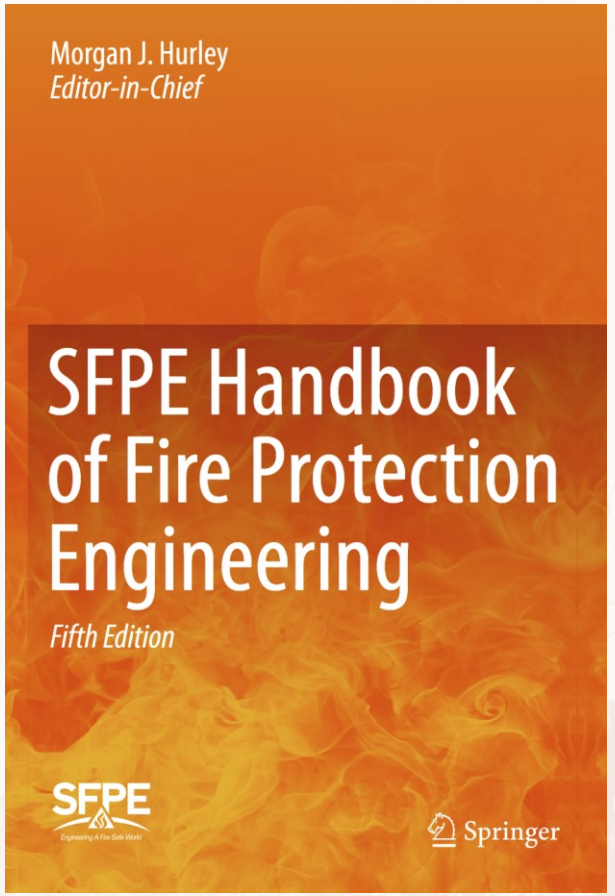
中国建筑科学研究院建筑防火研究所
Institute of Building Fire Research of China Academy of Building Research

李引擎
（建筑火灾专家）
组建了我国建筑业第一个
建筑防火研究所

1988

第一版《SFPE消防工程手册》于 1988年出版。Babrauskas 对此给予了高度评价。评价内容： 他认为该手册的出版是火灾安全工程领域 “最显著的积极成就”，并标志着该领域从此成为一个 “基于科学的专业”。

No other single event had as significant an impact on establishing the profession of fire protection engineering as the publication of this handbook. As Vyto Babrauskas said: "The field [of fire protection engineering] has made very gratifying progress in these last four decades. . . . The most remarkable positive achievement I think has been the SFPE Handbook, published first in 1988. . . . [W]ith the publication of the first edition of the SFPE Handbook in 1988, all of a sudden we could properly describe this as a science-based profession." [Babrauskas, V. "Some Neglected Areas in Fire Safety Engineering," Fire Science and Technology Vol. 32 No. 1 (2013) pp. 35–48.]



Hurley, M. J. (Ed.). (2016). SFPE handbook of fire protection engineering (5th ed.). Springer. https://doi.org/10.1007/978-1-4939-2565-0

1989

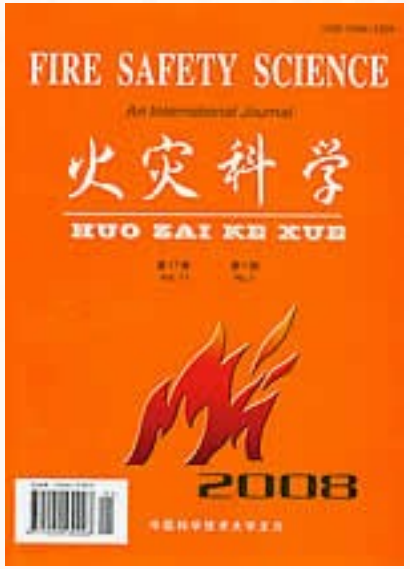
火灾安全全国重点实验室（原火灾科学国家重点实验室），简称“火灾实验室”，是利用世界银行贷款和国内配套投资兴建的我国火灾科学基础研究领域唯一的国家级研究机构。1989年通过立项论证，1992年获准边建设边对外开放，1995年通过国家验收。2023年国重重组方案获科技部审批通过。2025年实验室正式更名为“火灾安全全国重点实验室”。

火灾安全全国重点实验室
State Key Laboratory of Fire Science

范维澄
（中国火灾科学开拓者）
组建了火灾科学领域国家实验室

1992

《火灾科学》创刊于1992年，是由中国科学院主管、中国科学技术大学主办的亚澳火灾科学技术学会的会刊，是研究火灾发生、发展的机理与防治技术的科技期刊。



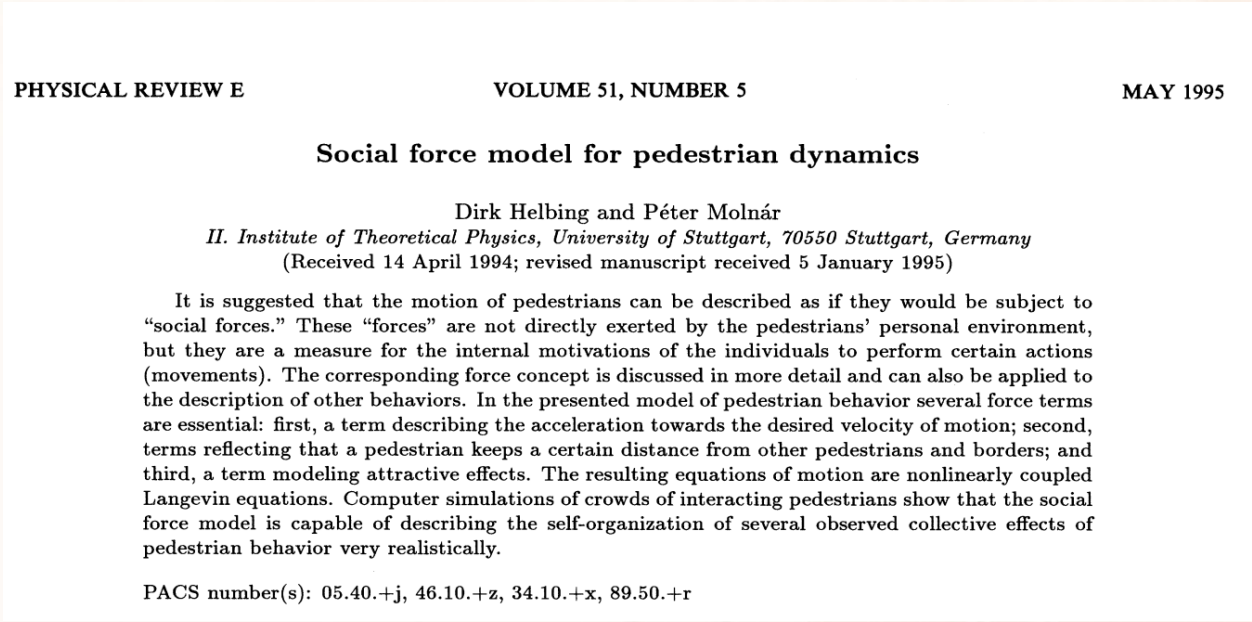
1992

亚澳火灾科学技术学会（Asia-Oceania Association for Fire Safety Science and Technology, AOAFST）是国际火灾安全科学学会（IAFSS）下属的重要地区性学术组织，成立于1992年。其宗旨是促进亚洲及大洋洲地区在火灾科学基础研究与技术应用领域的交流与进

1995

社会力模型 (Social Force Model) 是由 Dirk Helbing 和 Péter Molnár 于 1995 年提出的。

“The movement model implemented in the VISSIM is based on the Social Force Model developed by Helbing und Molnár.”



PHYSICAL REVIEW E VOLUME 51, NUMBER 5 MAY 1995

Social force model for pedestrian dynamics

Dirk Helbing and Péter Molnár
II. Institute of Theoretical Physics, University of Stuttgart, 70550 Stuttgart, Germany
(Received 14 April 1994; revised manuscript received 5 January 1995)

It is suggested that the motion of pedestrians can be described as if they would be subject to “social forces.” These “forces” are not directly exerted by the pedestrians’ personal environment, but they are a measure for the internal motivations of the individuals to perform certain actions (movements). The corresponding force concept is discussed in more detail and can also be applied to the description of other behaviors. In the presented model of pedestrian behavior several force terms are essential: first, a term describing the acceleration towards the desired velocity of motion; second, terms reflecting that a pedestrian keeps a certain distance from other pedestrians and borders; and third, a term modeling attractive effects. The resulting equations of motion are nonlinearly coupled Langevin equations. Computer simulations of crowds of interacting pedestrians show that the social force model is capable of describing the self-organization of several observed collective effects of pedestrian behavior very realistically.

PACS number(s): 05.40.+j, 46.10.+z, 34.10.+x, 89.50.+r

Helbing, D., and Molnár, P. (1995): Social force model for pedestrian dynamics. Physical Review E, 51(5), 4282-4286.

Helbing, D., Farkas, I., & Vicsek, T. (2000). Simulating dynamical features of escape panic. Nature, 407(6803), 487–490. doi.org

1996

专门针对疏散模拟以及行人动力学与通行流线分析的 building EXODUS 版本于 1996年10月正式推出。

EXODUS can be used for both evacuation simulation and pedestrian dynamics/circulation analysis. The software has been developed to meet the challenging demands of performance based safety codes. Based on a highly sophisticated set of sub models, it shatters the mould of traditional engineering analysis to produce realistic people-people, people-fire and people-structure interactions. As a result, the engineer can test more designs in less time to reach the optimal solution, free of the high cost and potential danger associated with human evacuation trials. Developed by the Fire Safety Engineering Group at the University of Greenwich, EXODUS comprises a suite of software packages, tailored to the building, maritime, rail and aircraft environments.

Fire Safety Engineering Group
safety in numbers

EXODUS
safety in numbers

1998

全球火灾监测中心创建。1998年， Johann Georg Goldammer在德国马克斯·普朗克化学研究所和弗莱堡大学的支持下创立了 GFMC。该中心是全球火灾信息的枢纽，为联合国等机构提供实时野火监测数据。

The Global Fire Monitoring Center (GFMC) was established in June 1998 in Freiburg, Germany. It was founded by Johann Georg Goldammer as a subdivision of the Max Planck Institute for Chemistry.

约翰·格奥尔格·戈尔达默
全球火灾监测中心主任

The Global Fire Monitoring Center (GFMC)

2000

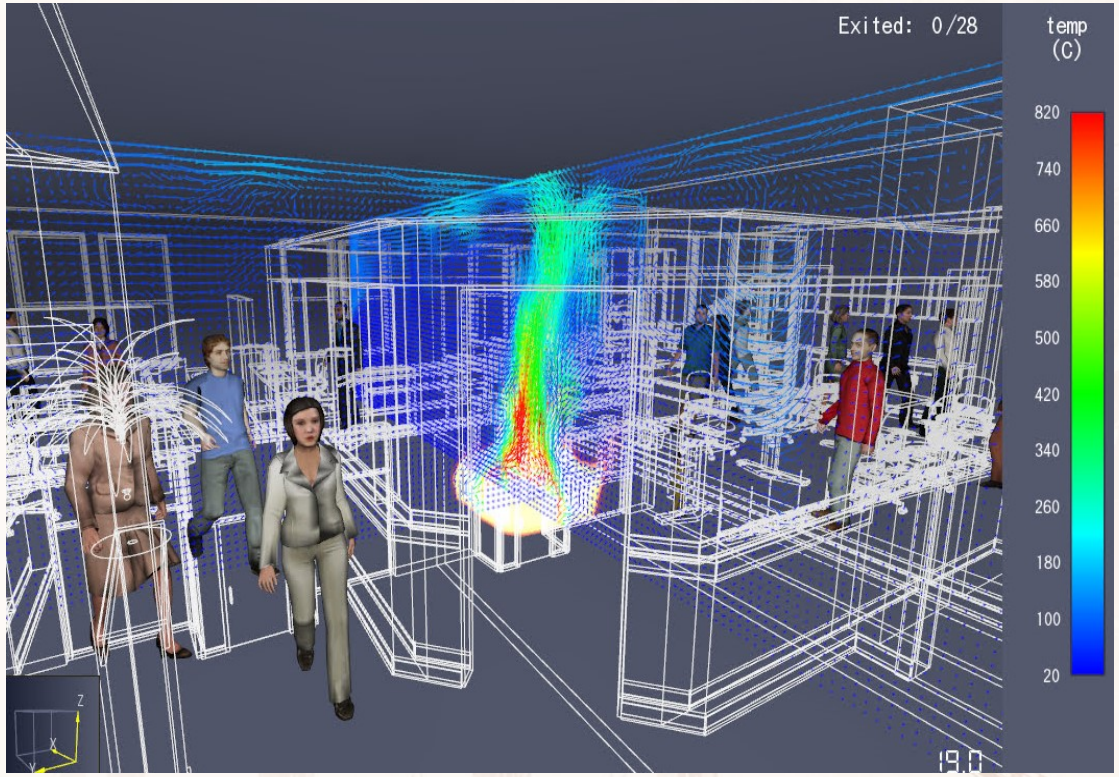
Fire Dynamics Simulator正式发布。

FDS的一个重要前身是 ALOFT（A Large Outdoor Fire Plume Trajectory）。这是一个基于物理的CFD模型，最初由NIST开发，用于评估海上燃烧石油泄漏产生的烟雾下风向扩散的危害。

目前，Fire Dynamics Simulator 是美国 NIST 联合芬兰 VTT 开发的免费软件，其配套可视化程序 Smokeview 可用于显示 FDS 的输出结果。首个版本于 2000 年 2 月发布，约半数应用于烟雾处理系统设计等正向场景、半数用于火灾重建，旨在解决实际火灾问题并助力基础研究，近期经同行评审的应用案例包括消防员死亡事件重建与锂电池储能容器火灾分析。

WFDS城市火灾动力学模拟器是由美国林务局开发的一款扩展程序，已整合到 FDS 中，可用于野火灾害建模。

商业版的FDS软件为PyroSim,是一款用于生成 FDS 输入文件的商业性质图形用户界面。



2001

性能化设计的工程框架：《BS 7974:2001 – Application of fire safety engineering principles to the design of buildings. Code of practice》，即《建筑物设计中的消防安全工程原则应用——操作规范》。

BS 7974 于 2001年 由英国标准协会（BSI）发布。

它的诞生是为了响应建筑设计和消防安全领域对性能化设计方法日益增长的需求，旨在为那些无法完全遵循规定性规范（如《批准文件B》）的建筑项目提供一套基于工程原理的替代合规路径。

BS 7974:2001 – application of fire safety engineering principles to the design of buildings. Code of practice

2018

应急管理部成立。

2018年3月根据第十三届全国人民代表大会第一次会议批准的国务院机构改革方案设立应急管理部。2025年3月13日，应急管理系统官方标识正式发布。

应急管理部的相关研究机构：

中国安全生产科学研究院

应急管理部国家安全科学与工程研究院（2020）

应急管理部研究中心

应急管理部国家自然灾害防治研究院（2019年成立）

应急管理部信息研究院

应急管理部危险化学品安全研究中心（2025年成立）

应急管理部消防研究所（天津、上海、四川、沈阳）

2018

中国消防救援学院是由原中国人民武装警察部队警种学院和原公安消防部队高等专科学校整合组建。2018年9月，根据中共中央深化跨军地改革决策部署，整合原武警警种学院与原公安消防高专力量和资源，以原武警警种学院为基础，组建中国消防救援学院，并于同年12月挂牌成立。学院的组建，标志着我国第一所专门的消防救援高等院校正式诞生，标志着消防救援教育事业站在新的历史起点，对于加快构建消防救援高等教育体系、培养造就高素质消防救援专业人才、推动新时代应急管理事业改革发展，具有重大而深远的意义。

2018

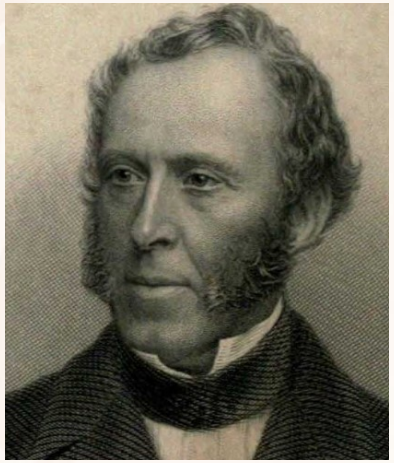
范维澄院士获埃蒙斯奖。

9月17日，由清华大学和美国伍斯特理工学院共同举办的第二届全球公共安全会议（Second Annual Global Public Safety Symposium）在美国波士顿伍斯特理工学院召开。会上，中国科学技术大学火灾科学国家重点实验室和清华大学公共安全研究院的创始人范维澄院士获埃蒙斯奖，并应邀作题为“中国火灾科学与公共安全技术研究的过去、现在和未来（Experience in Developing Fire Safety Science and Public Safety Technology in China: Past, Present, and Future）”的2018年度埃蒙斯奖演讲。

https://www.tsinghua.edu.cn/info/1181/37625.htm

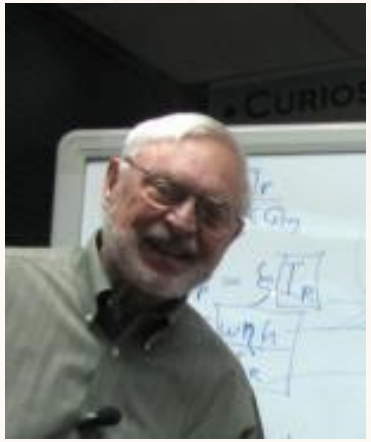
火灾安全科学
简史 附录

附录：火灾安全科学家（Fire Safety Science Scientist）



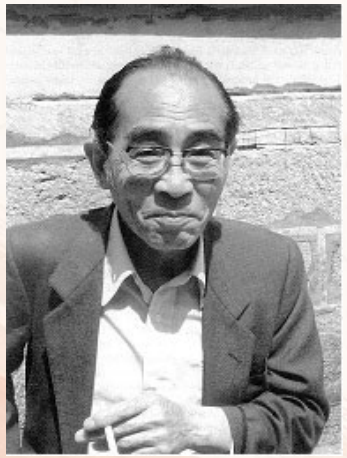
詹姆斯·布雷德伍德 (James Braidwood)
现代消防服务之父。

霍华德·艾蒙斯 (Howard Wilson Emmons) 现代火灾科学之父



理查德·罗瑟梅尔 (Richard C. Rothermel)
野外火灾行为建模先驱

詹姆斯·昆蒂尔 (James G. Quintiere
Principles of Fire Behavior



川越邦雄 (Kunio Kawagoe)
日本著名建筑火灾专家
提出了提出“通风因子”

约翰·布莱恩（John L. Bryan，1918–2003)
马里兰大学消防工程系（FPE）的创建人

范维澄
（中国火灾科学开拓者）
组建了火灾科学领域国家实验室

李引擎
（建筑火灾专家）
组建了我国建筑业第一个建筑防火研究所

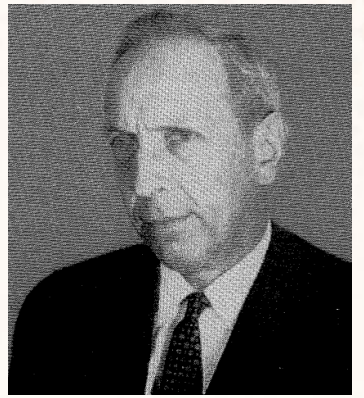
周允基
中国香港火灾科学知名学者
亚澳火灾科学技术学会主席

附录：火灾安全科学家（Fire Safety Science Scientist）

维托·巴布劳斯卡斯 (Vytenis Babrauskas)
美国首位开发室内火灾模拟计算机程序的科学家和锥形量热仪 (Cone Calorimeter)发明人

Professor Philip Thomas.
IAFSS创始人之一

Dougal Drysdale
Fire Safety Journal 前主编
IAFSS前主席
火灾动力学导论 作者

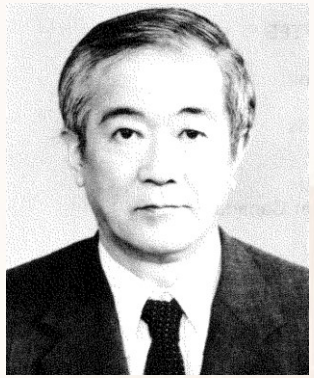


George M. Byram (乔治·拜拉姆) 1909-1 996
森林火灾领域知名学者

持续更新中.....
Updating continuously...

约翰·格奥尔格·戈尔达默
创建全球火灾监测中心 并担任主任

Edwin Galea 格林威治大学教授
人员疏散模拟领域的顶尖专家。是著名疏散模型 Building EXODUS 的主要开发者之一。
IAFSS前副主席



日本东京理科大学的Takashi Handa教授（1923–1985）
日本火灾科学先驱之一

英国爱丁堡大学火灾科学奠基人之一 David Rasbash

神忠久（Tadahisa Jin）
日本消防研究所 (FRI)
火灾烟气中人员行为与能见度研究的开创者

附录：国际火灾安全科学奖

埃蒙斯受邀大会讲座奖 (The Howard W. Emmons Invited Plenary Lectureship)

奖项、资格及待遇

“霍华德·W·埃蒙斯受邀大会讲座奖”是一项享有盛誉的荣誉，旨在表彰在火灾科学与工程领域做出卓越终身贡献及职业成就的人士。埃蒙斯讲座奖授予在火灾安全科学领域取得卓越终身成就的个人，而非针对单篇论文的奖项。

该奖项包括：受邀撰写一篇收录于大会论文集的论文，并在大会上进行相关的大会特邀报告（Plenary Lecture）。获奖者将免除大会注册费，并获得一笔用于支持差旅费用的津贴。

提名流程

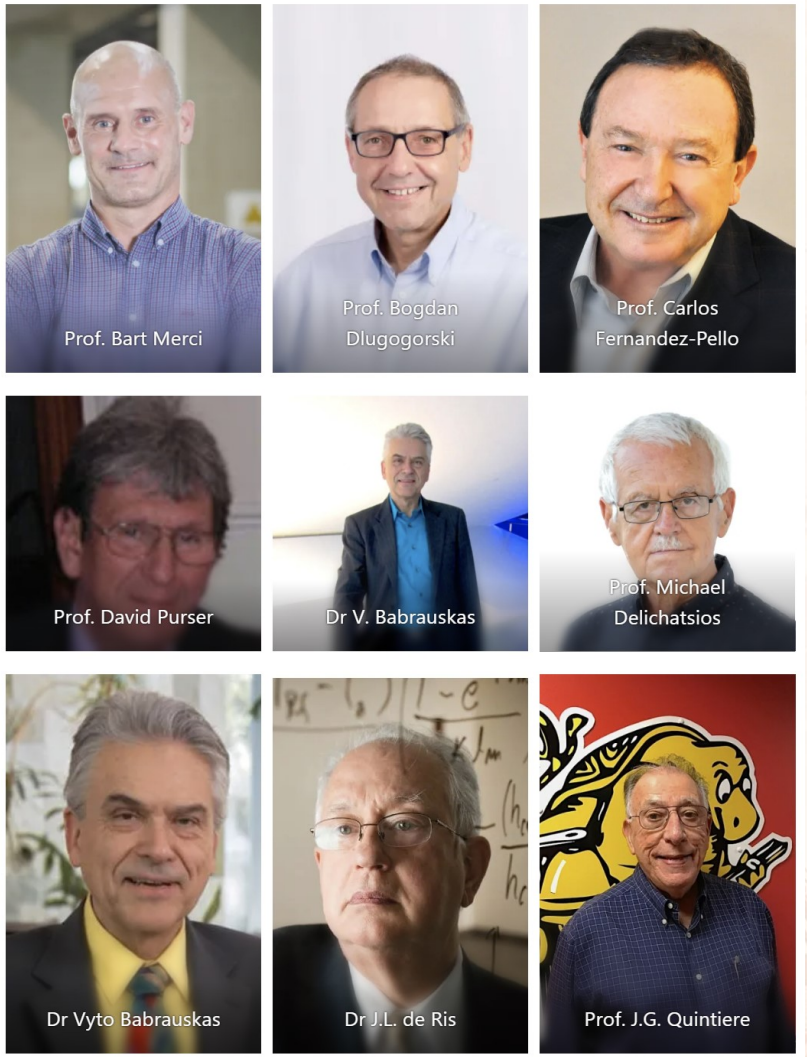
提名由国际火灾安全科学学会（IAFSS）会员提交。证明材料长度不得超过两页，应详细描述被提名人的成就及其重要性。不接受自我提名。被提名人可以不是 IAFSS 会员，但提名人必须是会员。提名过程严格保密，不应向被提名人透露。

评审考量

理想的讲座人选应能效仿该奖项命名者（霍华德·埃蒙斯）优秀的科研品质，以及对火灾科学做出的卓越贡献。特别是，评审委员会将寻找那些享有盛誉，并在研究课题的选择与执行中，将卓越的技术水平与实际应用及人道主义精神结合起来的学者。首要标准是：获奖者的贡献必须因其创新性和重要性而获得广泛认可。该奖项对火灾研究领域内的具体专业方向不设限制。

评选机构

获奖者将由大会奖项委员会（Symposium Awards Committee）选出。委员会将在大会召开前约一年选定讲座人选并通知本人。获奖者需及时提供讲座的文字版本，以便收录进论文集。

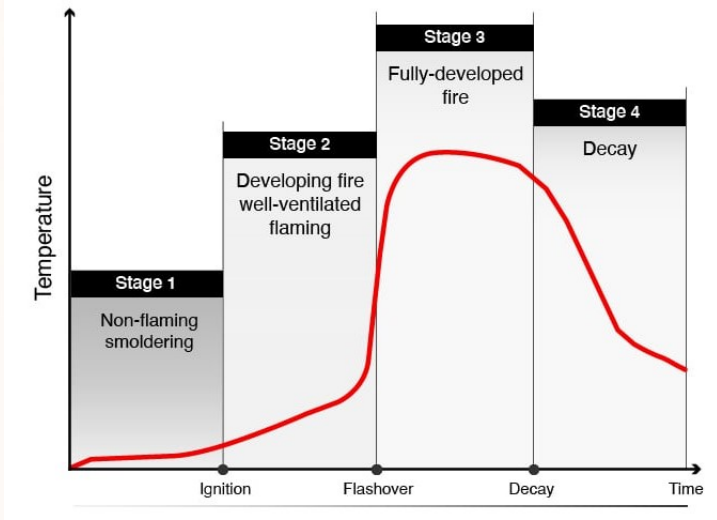


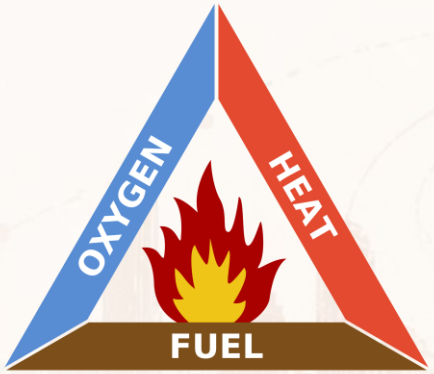
信息来源：https://iafss.org/awards/the-emmons-lectureship/

附录：火灾科学理论基础

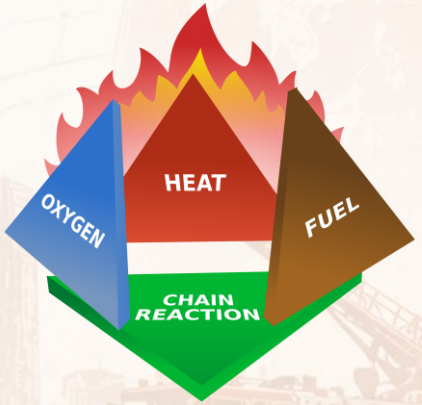
1. 牛顿第二运动定律（动量守恒）：约1650年，由艾萨克·牛顿提出。
2. 流体压力与速度关系：1737年，由丹尼尔·伯努利提出。
3. 热力学第一定律（能量守恒）：约1750年，由鲁道夫·克劳修斯提出。
4. 热传导方程（傅里叶定律）：1807年，由约瑟夫·傅里叶提出。
5. 流体运动的粘性方程（纳维-斯托克斯方程）：1827年（纳维）和1845年（斯托克斯）。
6. 蜡烛的化学史讲座：约1850年，由迈克尔·法拉第在皇家学会进行。
7. 质量扩散方程（菲克定律）：1855年，由A. 菲克提出。
8. 化学反应速率对温度的依赖关系（阿伦尼乌斯方程）：1884年，由斯万特·奥古斯特·阿伦尼乌斯提出。
9. 热辐射传热理论：约1900年，由马克斯·普朗克提出。
10. 管道内扩散火焰的求解：1928年，由Burke和Schumann完成。
11. 动力学燃烧方程：约1940年，由弗兰克-卡门涅茨基发展；约1930年，由谢苗诺夫发展；1950年，由泽尔多维奇等人发展。
12. 凝结相的对流燃烧解：约1950年，由H. 埃蒙斯和D. B. 斯波尔丁提出。
13. 火灾现象的解：约1960年，由P. H. 托马斯提出。

火灾发展曲线、燃烧三要素（Fire Triangle）以及燃烧四要素（Fire Tetrahedron），成果归属目前很难溯源。可以说是火灾科学学术共同体长期发展形成的成果。



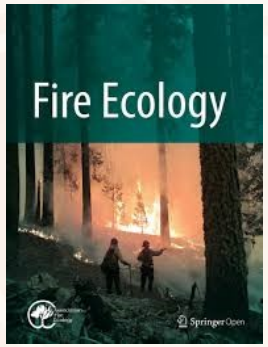


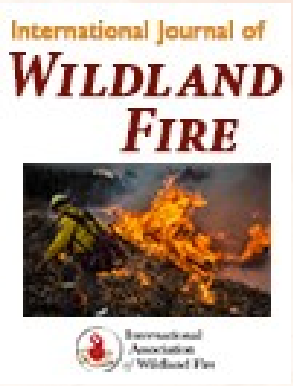
The concept of the Fire Triangle



The Fire Tetrahedron was first introduced in the early 1960s as an evolution of the traditional fire triangle.

附录：火灾安全科学重要期刊





期刊名称	出版社	ISSN	EISSN
Fire Ecology	SPRINGER	1933-9747	1933-9747
Fire Technology	SPRINGER	0015-2684	1572-8099
Fire-switzerland	MDPI	2571-6255	2571-6255
Fire and Materials	WILEY	0308-0501	1099-1018
Fire Safety Journal	ELSEVIER SCI LTD	0379-7112	1873-7226
Journal of Fire Sciences	SAGE PUBLICATIONS LTD	0734-9041	1530-8049
Journal of Structural Fire Engineering	EMERALD GROUP PUBLISHING LTD	2040-2317	2040-2317
International Journal of Wildland Fire	CSIRO PUBLISHING	1049-8001	1448-5516

期刊名称	单位	ISSN	CN	收录
消防科学与技术	应急管理部天津消防研究所	1009-0029	12-1311/TU	中文核心
火灾科学	中国科学技术大学	1004-5309	34-1115/X	北大核心

附录：推荐火灾安全科学图书

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4. Drysdale, D. (2011). An introduction to fire dynamics (3rd ed.). John Wiley & Sons.
5. Della-Giustina, D. E. (2014). Fire safety management handbook. Taylor & Francis Group.
6. Babrauskas, V. (2003). Ignition handbook: Principles and applications to fire safety engineering, fire investigation, risk management and forensic... Fire Science Publishers.
7. Harmathy, T. Z. (Ed.). (1985). Fire safety: Science and engineering (ASTM Special Technical Publication 882). American Society for Testing and Materials.
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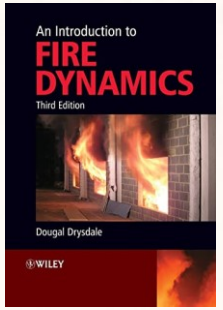
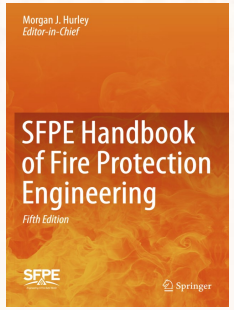
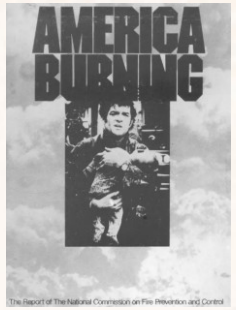
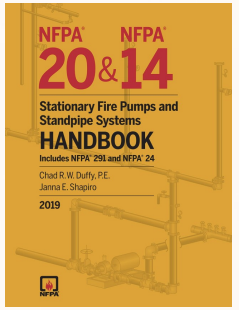
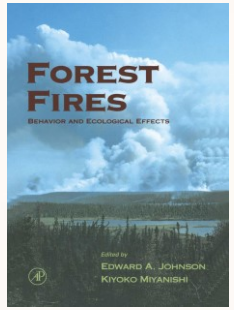
9. National Fire Protection Association. (2002). SFPE handbook of fire protection engineering (3rd ed.).
10. Purkiss, J. A. (2007). Fire safety engineering design of structures. Butterworth-Heinemann.

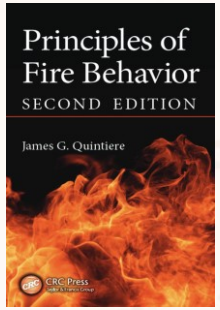


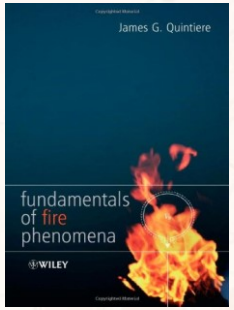


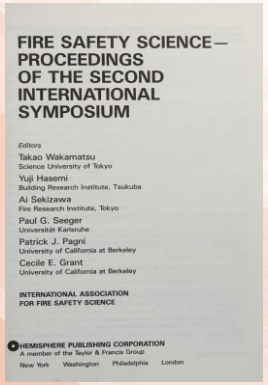


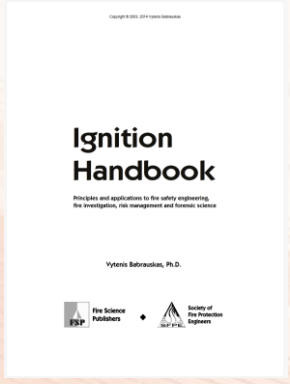


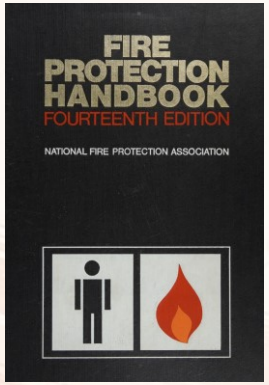


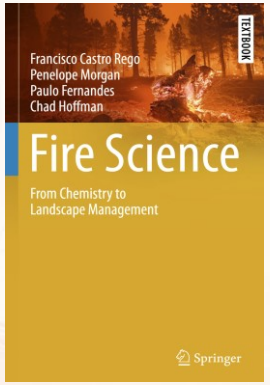


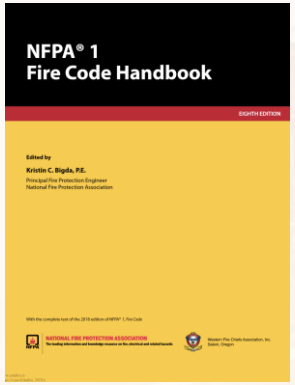


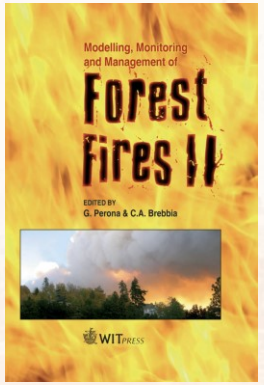


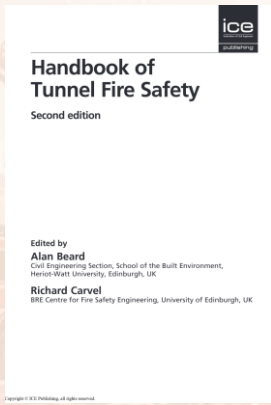




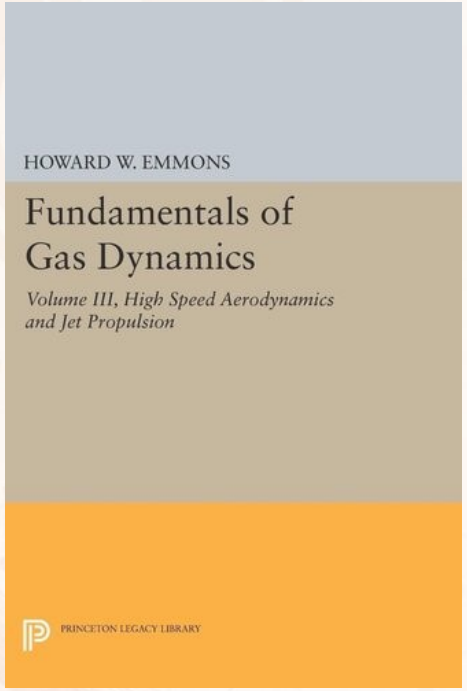








附录：推荐火灾安全科学图书



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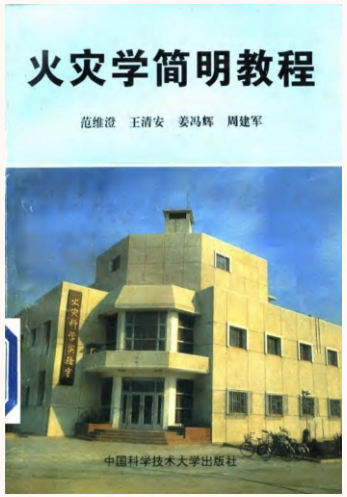

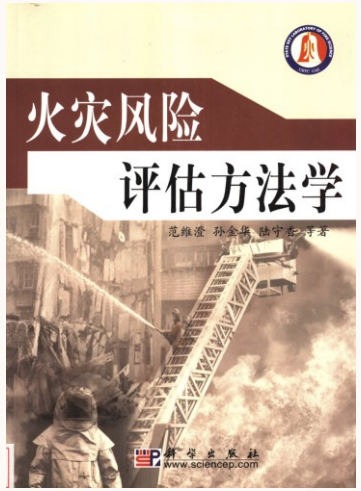

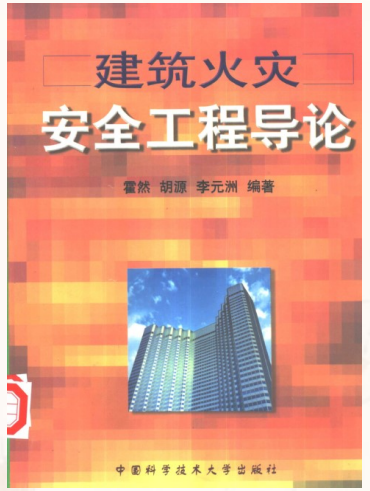

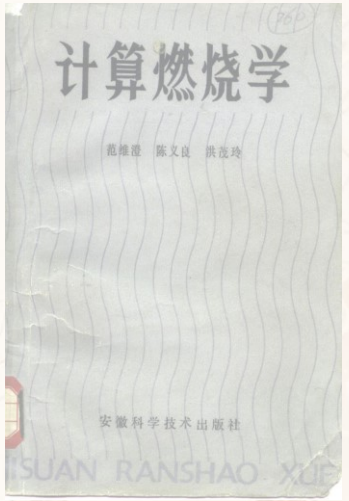

附录：火灾安全科学术语

一、 燃烧与火灾的基础条件与现象

- 火灾三角 (Fire Triangle)：描述燃烧所需的三个基本要素：燃料 (Fuel)、氧化剂 (Oxidizer，通常为氧气)、能量 (Energy，通常为热量)。移除其中任何一个即可阻止燃烧。火灾四面体 (Fire Tetrahedron) 增加了 “链式反应 (Chain Reaction)” 作为第四要素，更完整地解释了持续燃烧的条件。
- 闪点 (Flash Point)：在规定条件下，可燃液体表面蒸气遇点火源能发生闪燃的最低温度。是衡量液体火灾危险性的关键指标。
- 燃点/着火温度 (Ignition Temperature)：可燃物在外部热源作用下，能被点燃并持续燃烧的最低温度。
- 自燃 (Spontaneous Ignition / Self-Ignition)：可燃物在没有外部明火直接作用的情况下，由于自身缓慢氧化放热积聚，导致温度升高而引发的燃烧。
- 有焰燃烧 (Flammable Combustion)：燃烧过程中出现可见的明火焰，主要是可燃气体或蒸汽的燃烧形式。
- 阴燃/无焰燃烧 (Smoldering / Non-flame Combustion)：固体可燃物在不出现明火焰条件下的缓慢、发烟的燃烧过程。是引发火灾的常见原因。
- 爆炸 (Explosion)：物质状态急剧转变，瞬间释放大量能量的过程。分为物理爆炸（压力容器破裂）和化学爆炸（快速化学反应）。

二、 火灾发展过程与特殊现象

- 火灾发展阶段通用模型：常被划分为初期增长阶段 (Incipient/Growth Stage)、充分发展阶段 (Fully Developed Stage) 和衰减阶段 (Decay Stage)。初期增长模型：常用 t^2 火灾模型描述，即火灾热释放速率与时间的平方成正比（$\dot{Q} = \alpha t^2$），根据增长快慢分为慢速、中速、快速、超快速。
- 轰燃 (Flashover)：室内火灾中，所有可燃物表面几乎同时被引燃，火灾从局部燃烧瞬间转变为整个房间全面燃烧的现象。是火灾发展的重要转折点。
- 回燃 (Backdraft)：在缺氧条件下发生不完全燃烧的房间，突然引入新鲜空气时发生的剧烈爆燃现象。
- 火羽流 (Fire Plume)：火焰上方由浮力驱动的上升热气柱，是火灾中热量和烟气向上传输的主要形式。
- 顶棚射流 (Ceiling Jet)：火羽流撞击顶棚后，沿顶棚水平蔓延的热烟气层。
- 池火 (Pool Fire)：可燃液体在水平表面上形成的液池燃烧现象。

附录：火灾安全科学术语

三、 火灾特性与危害度量

- 热释放速率 (Heat Release Rate, HRR)：单位时间内火灾释放的热量。被认为是评价火灾危害最重要的单一变量，直接影响火灾发展、轰燃可能性及灭火难度。
- 火灾荷载 (Fire Load)：空间内所有可燃物完全燃烧所能释放的总热量，通常用等效木材质量表示。
- 火灾荷载密度 (Fire Load Density)：单位地板面积上的火灾荷载。
- 烟气 (Smoke)：火灾中产生的悬浮固态、液态颗粒和气态产物的混合物。主要危害包括毒性、减光性和高温。
- 毒性 (Toxicity)：火灾烟气对人体生理机能造成伤害的特性。一氧化碳 (CO) 是主要的致死毒性产物。

四、 材料与构件的火灾性能

- 可燃性/易燃性 (Flammability)：材料被点燃并维持燃烧的容易程度。
- 阻燃剂 (Flame Retardant) / 阻燃性 (Flame Retardancy)：添加到材料中以抑制或延缓其燃烧的化学物质或材料本身所具有的这种特性。
- 燃烧体、难燃烧体、非燃烧体 (Combustible, Difficult Combustible, Non-combustible Material)：根据建筑材料在火灾中反应进行的分类，分别对应起火即燃、难起火难蔓延、不起火不燃烧。
- 耐火极限 (Fire Resistance Limit)：建筑构件在标准火灾试验条件下，能保持其承载能力、完整性和隔热性的时间（以小时计）。是衡量构件抗火能力的关键指标。

五、 火灾类别与防治

- 火灾分类 (Classification of Fires)：A类火灾：固体物质火灾（如木材、纸张）。B类火灾：液体或可熔化固体火灾（如汽油、石蜡）。C类火灾：气体火灾（如煤气、天然气）。D类火灾：金属火灾（如钾、钠、镁）。（常补充）E类火灾：带电设备火灾。
- 灭火机理 (Theory of Fire Extinguishment)：冷却：降低温度至燃点以下。窒息：降低氧气浓度或隔绝空气。隔离：移除或隔离燃料。化学抑制：中断燃烧链式反应。

六、 火灾科学与工程方法论

- 火灾动力学 (Fire Dynamics)：研究火灾中流体流动、传热传质、化学反应及其相互作用的科学。
- 火灾模拟 (Fire Modeling)
- 区域模型 (Zone Model)：将房间分为上下两个均匀控制体（如热烟气层和冷空气层）进行模拟（如CFAST）。
- 场模型 (Field Model / CFD)：基于计算流体力学，对火灾过程进行三维、瞬态、详细的物理模拟（如FDS - Fire Dynamics Simulator）。
- 性能化防火设计 (Performance-Based Fire Safety Design)：基于工程分析和量化评估，以满足预设的安全目标和性能准则为导向的建筑防火设计方法。核心准则是 ASET > RSET（可用安全疏散时间 > 所需安全疏散时间）。
- 火灾风险评估 (Fire Risk Assessment)：系统地分析火灾发生的可能性及其后果严重程度，并对风险进行量化或定性评价的过程。
- 火灾安全工程学 (Fire Safety Engineering)：基于对火灾规律的认识，从系统安全的角度，研究如何实现建筑物总体安全的工程学科。它连接火灾科学基础研究与实际工程应用。

附录：安全疏散中的术语

- 分段/分区疏散 (Staged/Zoned Evacuation)：按照既定的优先级命令或管理疏散过程，使某些或所有居住者清空其区域并使用疏散路线。通常是为了让更危险的居住者先于危险较小区域的居住者撤离。
- 就地避难 (Shelter in Place)：一种保护行动，指示居住者留在建筑物内当前位置，而不是疏散。
- 封锁 (Lockdown)：一种保护程序，通常在面临外部暴力威胁时实施，限制人员在建筑物内的移动，并警告居住者隐蔽。
- 必需安全疏散时间 (Required Safe Egress Time, RSET)：居住者或一组居住者为到达建筑物内或外的安全地点所需花费的总时间。
- 可用安全疏散时间 (Available Safe Egress Time, ASET)：某种燃烧产物（如烟气）从起火点传播并在所选逃生路线上产生无法忍受状况所需的时间。

- 分段/分区疏散 (Staged/Zoned Evacuation)：按照既定的优先级命令或管理疏散过程，使某些或所有居住者清空其区域并使用疏散路线。通常是为了让更危险的居住者先于危险较小区域的居住者撤离。
- 就地避难 (Shelter in Place)：一种保护行动，指示居住者留在建筑物内当前位置，而不是疏散。
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附录：安全疏散中的术语

- 疏散安全准则： 必需安全疏散时间 (RSET) 必须小于可用安全疏散时间 (ASET)。即 RSET < ASET。
- 疏散通道 (Means of Egress)：从建筑物或结构内的任何点到公共道路的连续且无障碍的通行方式，由三个独立且不同的部分组成：(1) 出口通道，(2) 出口，(3) 出口疏散。
- 出口通道 (Exit Access)：疏散通道中通向出口的部分。
- 出口 (Exit)：疏散通道的一部分，通过建筑构造、位置或设备与其他所有空间分隔开，以提供通往出口疏散的受保护的通行路径。
- 水平出口 (Horizontal Exit) ：从一个建筑物到另一个建筑物大致同一层的避难区的通行方式，或穿过或绕过防火屏障到达同一建筑物内大致同一层的避难区的通行方式，该避难区可免受起火区域及其连通区域的火灾和烟雾影响。
- 出口疏散 (Exit Discharge)：疏散通道中介于出口终止点和公共道路之间的部分。
- 逃生方式 (Means of Escape)：不符合疏散通道严格定义但确实提供另一种出路的方式。
- 行程距离 (Travel Distance)：建筑物居住者必须行进到其最近出口的距离。
- 出口容量 (Exit Capacity)：建筑物的总出口容量必须超过建筑物的居住者负荷。特定占用类型的出口容量是通过将出口允许宽度（每人英寸）乘以出口宽度来确定的。
- 疏散通道数量 (Number of Means of Egress)：所有建筑物必须至少包含两个独立的疏散通道。每个疏散通道应尽可能远离另一个。居住者负荷为500–1000的建筑物必须有三个疏散通道，居住者负荷大于1000的建筑物需要至少四个疏散通道。
- 生命安全平面图 (Life Safety Floor Plans) ：应提供每个楼层的生命安全平面图，包括：(1) 居住者负荷、出口位置、疏散容量、主入口/出口、水平出口、行程距离和出口疏散；(2) 防火屏障、防烟屏障和防烟隔断；(3) 防烟保护的集会占用区域。

附录：火灾事故

- 1666：伦敦大火 (Great Fire of London)。直接促成了《伦敦重建法案》(1667 London Building Act) 的出台，这是英语世界首个全面的建筑规范。法律强制要求新建筑必须使用砖石而非木材，并加宽街道作为自然防火带。此外，它还催生了现代商业保险制度和早期的城市消防栓系统。
- 1904：巴尔的摩大火。促使美国国会授权国家标准局（NBS，现NIST）研究建筑结构防火安全。
- 1911：纽约三角内衣厂火灾 (Triangle Shirtwaist Factory Fire)：这场灾难是美国现代生命安全规范 (Life Safety Code) 的起点。它促使美国国家防火协会 (NFPA) 发布了首本关于逃生演习的指南，并直接推动了美国职业安全与健康管理局 (OSHA) 的最终成立。关键改进包括：强制安装自动喷淋系统、要求安全出口门必须向外开启且严禁上锁。
- 1942：波士顿椰林夜总会火灾 (Cocoanut Grove Fire)。不仅改变了公共娱乐场所的消防法规（如禁用旋转门作为主出口），还在急救医学和烧伤管理领域取得了突破性进展。它是首次对吸入性损伤进行系统性科学描述的契机，并推动了青霉素和血浆在民用烧伤救治中的应用。
- 1973 ：《火灾中的美国》报告 (America Burning Report)，虽非单一事故，但是基于长期火灾事故统计的转折点。该报告指出美国火灾损失惊人，导致了美国消防局 (USFA) 的成立，并推动了家用烟雾探测器的大规模普及和计算机火灾动力学模拟 (FDS) 的科研投入。
- 1974 ：英国弗利克斯伯勒工厂大爆炸 (Flixborough Disaster)。化工厂环己烷泄漏引发巨大蒸气云爆炸。它推动了对气相爆炸和超压模型的研究。此后，全球范围内开始系统建立化学工艺的安全评估标准（如HAZOP），并促成了英国《重大事故危险控制规定》（COMAH）的制定。
- 1985：英国布拉德福德球场火灾 (Bradford City Stadium Fire)。一个烟头掉入木质看台下的垃圾堆，火势在几分钟内横扫整个看台。科学家通过此案例深入研究了火灾在倾斜表面上的非线性蔓延规律。它直接导致英国立法禁止在体育场馆使用木质看台，并推动了体育场疏散模拟软件的开发。

附录：火灾事故

- 1987 ：大兴安岭“5·6”特大森林火灾。中国现代消防史上极其重要的转折点，它直接推动了中国火灾科学国家重点实验室的创建，实现了中国消防从“经验救火”向“科学防火”的跨越。
- 1987：伦敦国王十字车站火灾 (King ‘s Cross Fire)。木质扶梯起火，火焰在向上蔓延时突然呈现“喷气式”加速。计算机流体力学（CFD）在调查中立了大功，科学家发现了沟槽效应：火焰在狭窄倾斜的槽内会贴着表面流动并迅速加热上方材料。这改变了全球对地下空间、隧道通风与材料选择的科学认知。
- 1996 ：杜塞尔多夫机场火灾 (Düsseldorf Airport Fire)。电焊引发火灾，烟气通过天花板缝隙进入航站楼。研究重点转向了非晶态保温材料（如聚苯乙烯）燃烧产生的毒性烟气规律。促使现代机场开始大规模应用吸气式烟雾探测系统（VESDA）和更精密的排烟控制逻辑。
- 2001 ：世界贸易中心倒塌 (9/11 WTC Collapse)。飞机撞击后的航空煤油火灾导致大楼钢结构强度丧失。这是火灾科学进入“结构防火”时代的标志。研究从单纯的“材料防火”转向了“结构系统防火”——即研究在极端高温下，整个框架结构如何避免连锁性坍塌，并直接修改了全球摩天大楼的耐火时限标准。
- 2019 ：巴黎圣母院火灾 (Notre-Dame Cathedral Fire)。阁楼起火，木质塔尖倒塌。推动了火灾机器人、无人机热成像协同灭火以及古建筑三维建模在火灾预防中的科学应用。

FIRMS
Fire Information for Resource Management System

Fire Information for Resource Management System

火灾数据库

The Fire Information for Resource Management System (FIRMS) distributes Near Real-Time (NRT) active fire data from the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard the Aqua and Terra satellites, and the Visible Infrared Imaging Radiometer Suite (VIIRS) aboard S-NPP, NOAA 20 and NOAA 21 (formally known as JPSS-1 and JPSS-2). Globally these data are available within 3 hours of satellite observation, but for the US and Canada active fire detections are available in real-time.

信息扩展

安全科学学习平台

https://smartdata.las.ac.cn/safetyhub/

Safety Science Hub　主页　历史　典藏　术语　工具　图谱　期刊　展望　探索　友情链接　EN 中文

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SAFETY SCIENCE LEARNING PLATFORM

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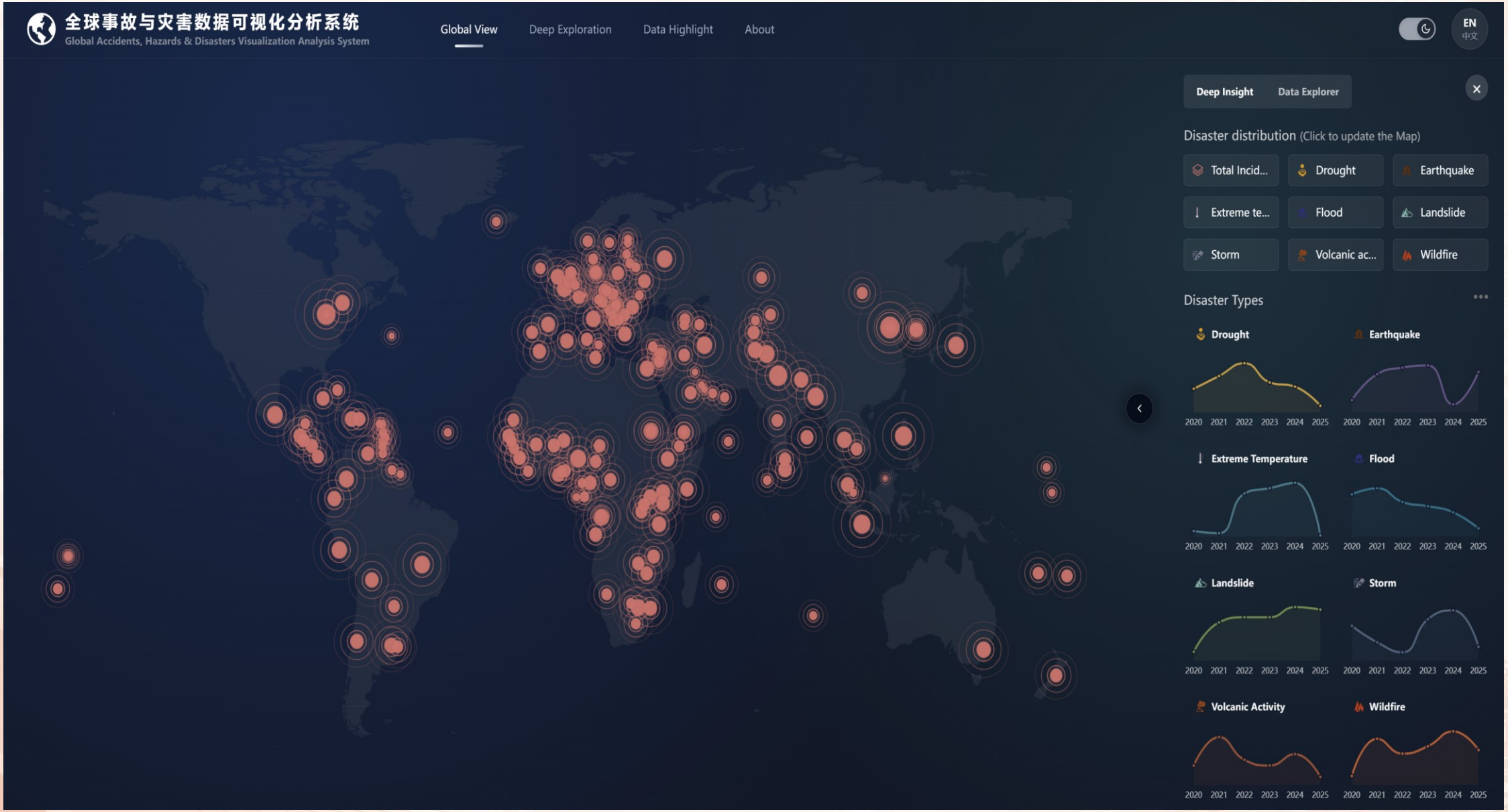
Open Safety Science: Of the community, by the community, for the community.

安全与安全科学：安全是指人的身心免受外界因素危害的存在状态及其保障条件。安全科学是一门专门研究安全的本质及其运动、转化规律与保障条件的科学（刘潜，1992）。安全科学研究人及技术和环境之间的关系，以建立这三者的平衡共生态为目的（Geysen, 1991）。安全是指构成系统的各要素在特定关联模式下，持续维持其预设功能的状态。事故是指因系统内部要素自身或要素间关联关系发生破坏，最终引发系统整体功能丧失的异常状态，其结果具体表现为系统要素的损失或伤害及系统功能的失效等。安全科学是以保障系统的要素构成、要素关联及系统结构稳定性为研究对象的学科，旨在将系统维持在安全态。安全科学是人类对群体可持续发展的探索、认识和反思，是人类对安全问题经验和规律的提炼与总结，是体系化的安全知识（李杰，2025）。

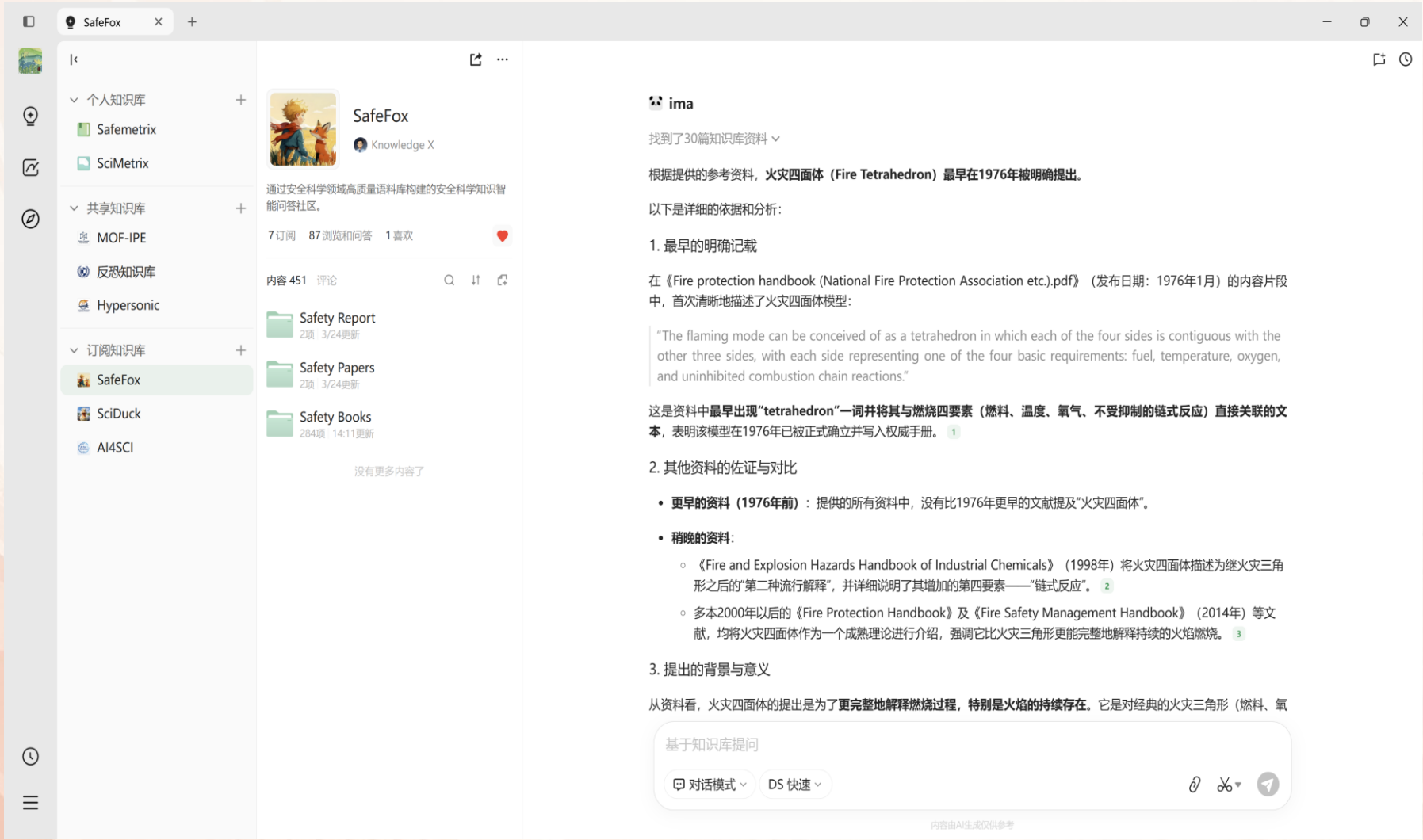
公众号　视频号

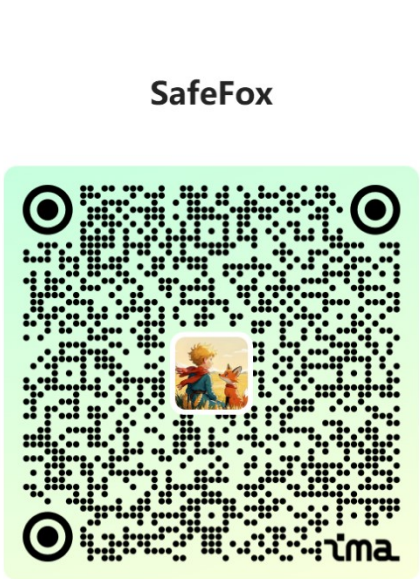
Safemetrix：全球事故与灾害数据可视化分析系统



AcciGraph 事故防控知识智能问答与知识图谱系统

SafeFox：安全科学智能问答





附录：团队在安全科学领域的相关工作

SciExplorer开放科学计量学数据可视化分析平台
https://smartdata.las.ac.cn/SciExplorer/?lang=CN

CiteInsight科学引文网络智能分析平台
https://smartdata.las.ac.cn/citeinsight/zh

火灾安全科学简史

A Brief History of Fire Safety Science

重要事件持续收集和完善中.....