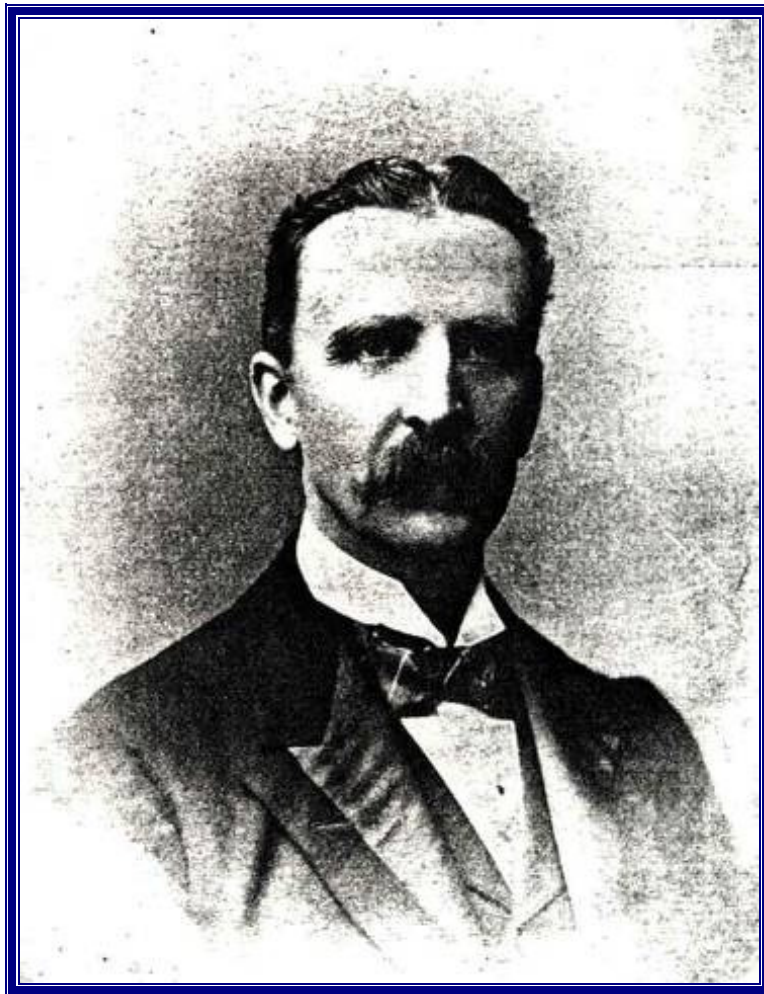




Sir SAMUEL CLELAND DAVIDSON
1846-1921



Inventor of the "Sirocco" Fan

[68] Samuel Cleland DAVIDSON

Belfast fan manufacturer. Patented his *Sirocco* multiblade centrifugal (BP 4609: 1898), but its "large open eye" seems to have been anticipated in the earlier patents of Henry Aland of Wandsworth (1883) and George Greig of Scotland (BP 12,611: 1884). Davidson tried to block the later fan designs of Keith [70] but eventually failed. However, there is no doubt that the Davidson fan was extremely successful: "It has enjoyed a success unrivalled by any other design and has been manufactured in greater numbers than any other form of flow machine. Apart from its compactness, it is remarkably silent in operation. There is no other fan which operates as silently at comparable pressures" (from a 1973 assessment of the Sirocco fan by the German fan engineer, Bruno Eck). The Davidson fan was later marketed in the USA by the American Blower Co. (from 1908) after the Sirocco Eng. Co. of New York went out of business. Davidson was also involved in the designing, installation, and maintenance of the Royal Victoria Hospital, Belfast (1903), where the environmental engineering design was carried out by Lea [208], who was believed to have been influenced by Key [98].

(Mini-biography from "The Comfort Makers," Brian Roberts, ASHRAE, 2000)

The culmination of all of the best of the ideas of the fan designers of the 19th century is represented in the Davidson patent ("Sirocco" fan) of 1900. In the original Davidson design, the blades are narrower radially and more closely spaced than in fans previously built (the blades were three times as long as the radial dimension, and the blade spacing was about two-thirds of the depth of the blade). The patent also gave special prominence to the unobstructed design of the inlet chamber, and to the blade design, where the tip of the blade is advanced behind the heel. Both these features were embodied in the earlier Ser design, though in the Davidson fans the blades projected their entire depth within the inlet circle.

It is interesting to quote Bruno Eck's assessment of this original "Sirocco" fan many years later (1973):⁽¹⁸⁾

"The original design of the Sirocco fan had the following dimensions:

$$d_1/d_2 = 0.875 \text{ (inside/outside impeller diameter)}$$

$$b = 3/5d_2 \text{ (blade width)}$$

$$\beta_1 = 64^\circ \text{ (angle of blade to tangent of circumference at point of entry)}$$

$$\beta_2 = 22^\circ \text{ (corresponding angle at point of discharge)}$$

$$Z = 54 \text{ (number of blades)}$$

The blades were formed precisely as circular arcs.

This design received no attention in the field of research. Although the circular arc was blamed for the poor efficiency ($\eta = 50\%$), it has enjoyed a success unrivalled by any other design and has been manufactured in greater numbers than any other form of flow machine. Apart from its compactness it is remarkably silent in operation. There is no other fan which operates as silently at comparable pressures."

(From "Building Services Engineering," Neville S Billington & Brian M Roberts, 1882)

1911.

THE
ORIGIN AND PROGRESS
OF MULTIBLADE FANS

Some up-to-date Vital Facts in Fan History—
Object Lessons in the working of the British
Patent Laws—Imperative call for reform.

By a Technical Expert.



A REPLY.

*A brochure by James Keith detailing his patent disputes with Davidson
(CIBSE Heritage Group Collection)*

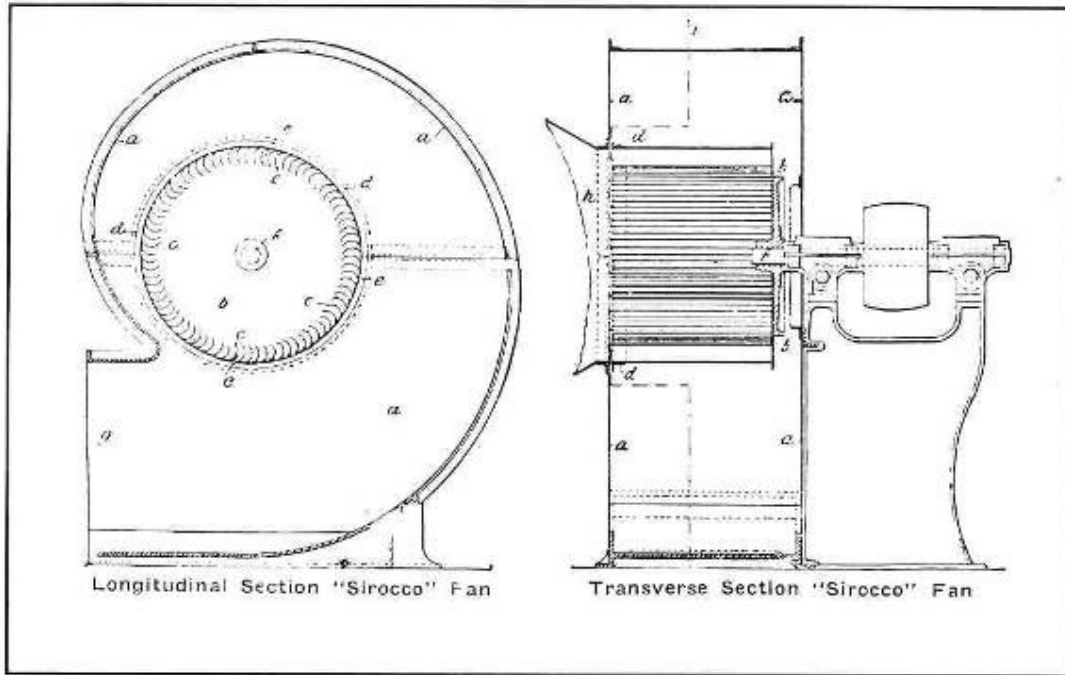


Figure 7-72 "Sirocco" fan with multiblade vane wheels with shallow blades and wide configuration (from *Engineering Review*, May 1908).

Sirocco Engineering Company

The Sirocco Engineering Company of New York marketed a low-pressure multivane curved-blade fan patented by Samuel Davidson in 1900. This centrifugal fan had narrow, closely spaced radial blades that were three times longer than typical designs (Figures 7-72 and 7-73).

During the first decade of the twentieth century, the Sirocco fan went through numerous modifications, includ-

ing changes to the blade design and single- or double-inlet design. In 1908, the Sirocco rights were sold to the American Blower Co.

*(Extract from "Heat & Cold: Mastering the Great Indoors,"
Barry Donaldson & Bernard Nagengast, ASHRAE, 1994)*

FANS

DESIGN AND OPERATION OF CENTRIFUGAL, AXIAL-FLOW
AND CROSS-FLOW FANS

BY
Dr.-Ing. BRUNO ECK

First English Edition
Translated and Edited by
Dr. RAM S. AZAD
and
Dr. DAVID R. SCOTT



PERGAMON PRESS
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SYDNEY BRAUNSCHWEIG

54. DESIGN OF THE MULTIVANE IMPELLER (SIROCCO RUNNER)

In many applications a choice of fan is governed by the space available for its installation and the permissible noise level. One requires a design giving a minimal value for the coefficient δ . This problem was solved by the design of the multivane impeller. It is some 60 years old and is widely known. Its main features are its large diameter ratio, large relative width, and number of blades which are of the forward-curve design, thus forming a "drum". The original design of the Sirocco fan had the following dimensions:

$$d_1/d_2 = 0.875; \quad b = \frac{3}{4} d_2; \quad \beta_1 = 64^\circ; \quad \beta_2 = 22^\circ; \quad z = 54.$$

The blades were formed precisely as circular arcs.

This design received no attention in the field of research. Although the circular arc was blamed for the poor efficiency ($\eta = 50\%$), it has enjoyed a success unrivalled by any other design and has been manufactured in greater numbers than any other form of flow machine. Apart from its compactness it is remarkably silent in operation. There is no other fan which operates as silently at comparable pressures. One will find quiet operation a criterion in many applications even if it is at the expense of efficiency. In this aspect the multivane impeller fulfils uncontested an important operational problem that is no less important today than it was in previous years.

This impeller differs quite considerably from others, and there is a lack of fundamental knowledge of the design and calculations.

(Extract from "Fans," Bruno Eck, 1973: CIBSE Heritage Group Collection)

SABC

Tough on the Coal Dealer,
but a boon to the man behind the pocket-book. With the price of fuel climbing higher and higher it is going to require "stratagem" to keep down expenses this winter.

The "A B C" Fan System of Heating
will not only heat but it will actually pay for itself in a season in its saving of fuel.

The most satisfactory system for the user—hence the most profitable for the contractor to advocate.
A complete line of Heaters, Fans and Blowers for all purposes.
Send for Catalogues.

AMERICAN BLOWER CO.,
DETROIT, MICH.

NEW YORK, 141 Broadway. CHICAGO, Marquette Bldg. LONDON, 70 Gracechurch St.

Figure 7-70 Advertisement, American Blower Company (from Engineering Review, vol. 12, November 1902).

Heating—Cooling
Mechanical Draft
for Boilers

Davidson's Patent
SIROCCO
Centrifugal Fans

Sirocco Engineering Co.
22 Thames Street, New York

Figure 7-73 Sirocco Engineering Co., mechanical draft for boilers (from Engineering Review, September 1906, p. xxxvii).

S. C. DAVIDSON, M. I. M. E.

Of more than passing interest because of the recently announced consolidation of the Sirocco Engineering Company with the American Blower Company is the subject of this sketch.

Samuel Cleland Davidson is an Irishman by birth, but of Scotch descent. His ancestors, who hailed from Ayrshire, settled in Ulster about 1628. Mr. Davidson was the youngest member of a family of eight and was born in County Down in 1846, son of the late James Davidson.

He was educated at the Royal Academical Institution, Belfast. His tastes from early childhood ran in mechanical lines, and on leaving school at the age of fifteen, he entered the office of William Hastings, a Belfast civil engineer, where he remained until the summer of 1864, and acquired a good knowledge of surveying, architecture and engineering.

During 1864 his father purchased an interest in a tea estate in India, and believing his son would have better prospects of advancement in life as a tea grower (this industry being in its infancy), sent him to India in the autumn of that year. The estate was 300 miles northeast of Calcutta. Upon arrival he acted as assistant manager for two years and then became manager. After his father's death in 1869 he bought out the co-partners and became sole proprietor.

Mr. Davidson had not been long on the tea estate before he recognized the possibility of improvement in the existing primitive and by no means cleanly systems, which had been copied from methods employed in China for centuries, and turned his mind to the invention of mechanical means for the manufacture of the leaf. It was a matter of much difficulty and required continued perseverance to overcome the conservative prejudice of the planting community generally against the use of anything mechanical to replace the hand and foot methods which had been established by the Chinese experience of centuries.

As the teas from the Davidson estate brought best market prices, the prejudice gradually gave way, and in 1874 Mr. Davidson sold his property, returned to Belfast, and for some years superintended the manufacture by Messrs. Comb, Barbour & Comb of his patented tea machinery.

In 1881 he started the "Sirocco" Engineering Works at Belfast, Ireland, where at present there are engaged about 500 hands in the production of "Sirocco" tea machinery and "Sirocco" centrifugal blowers and exhaust fans.



The business was converted into a private limited liability company in 1898 under the name of Davidson & Company, Ltd., of which the subject of our sketch is chairman and managing director.

The "Sirocco" works at Belfast are unique in the respect that nothing else is manufactured but the personal inventions of Mr. Davidson.

Although Mr. Davidson's name is a household word in connection with the tea industry (being one of the first to introduce and establish agencies for the sale of Indian teas in America and the Continent of Europe), his reputation as an inventor is even wider. As many of our readers are aware, he has within

recent years invented, and successfully placed on the markets of nearly every country of the world the "Sirocco" centrifugal fans.

Originally his experiments in the constructing of fans were undertaken with a view to improve the ordinary type of centrifugal fan, which he employed in connection with his "Sirocco" tea dryers, and his investigations resulted in the production of a new type of fan.

Mr. Davidson was granted patents in the United States covering broadly the principle and construction of his "Sirocco" blowers in 1900. In 1903 they were introduced on the American market by the Sirocco Engineering Company, of New York, in which Mr. Davidson interested himself, and a factory was started shortly afterward in Troy, N. Y. By the recent

consolidation and incorporating the American Blower Company under the laws of the State of New York, Mr. Davidson became financially interested in the American Blower Company, now a leading interest in the blower business of the world.

During his sojourn in Carchar, India, Mr. Davidson was a leading polo player. He was also a keen sportsman, a good rifle shot, having won the first championship cup of the Northeastern Frontier of India Rifle Association in 1873. As a foot racer he held an unbeaten record for 100 yards ($10 \frac{2}{5}$ seconds) in Eastern Bengal from 1865 to 1871.

In Mr. Davidson is found a rare combination of inventive genius and good business capacity. He is full of enthusiastic energy, a genial companion and considerate employer. He is a member of the Institute of Mechanical Engineers and of the Society of Arts.

(Text from "S C Davidson MIME," Engineering Review, May 1909)

NOTES ON FAN
ENGINEERING



Publication
Ref. No. SF337

Price 7/6 Nett

Published by
DAVIDSON & CO. LIMITED
Sirocco Engineering Works, Belfast
NORTHERN IRELAND

Davidson book from 1956 (CIBSE Heritage Group Collection)

**"The First Air Conditioned Building
in the World?"**



**Royal Victoria Hospital,
Belfast.**

*(Booklet by the Hospital Engineering Department, c.2000
CIBSE Heritage Group Collection)*

The degree of control designed by Davidson into the air-supply system was rigorous by standards of the time (1903) and made ingenious use of the comparatively crude technology available. Air, on entering through window-type openings in the ends of the engine-house, was pulled through hanging curtains of coconut fibre robes kept moist by sprinklers in the roof of the filter-chamber (this water could be warmed in winter to prevent freezing). Cleaned of soot, smuts and other impurities for which the Belfast atmosphere was notorious, the air then passed through batteries of heating-coils before entering the fans and being propelled up the duct. In order to prevent excessive temperature drop during its relatively leisurely journey to the far end of the duct, the air received extra heat in winter from a booster pipe running its full length and from further coils of pipe in the entrance to each distributor.

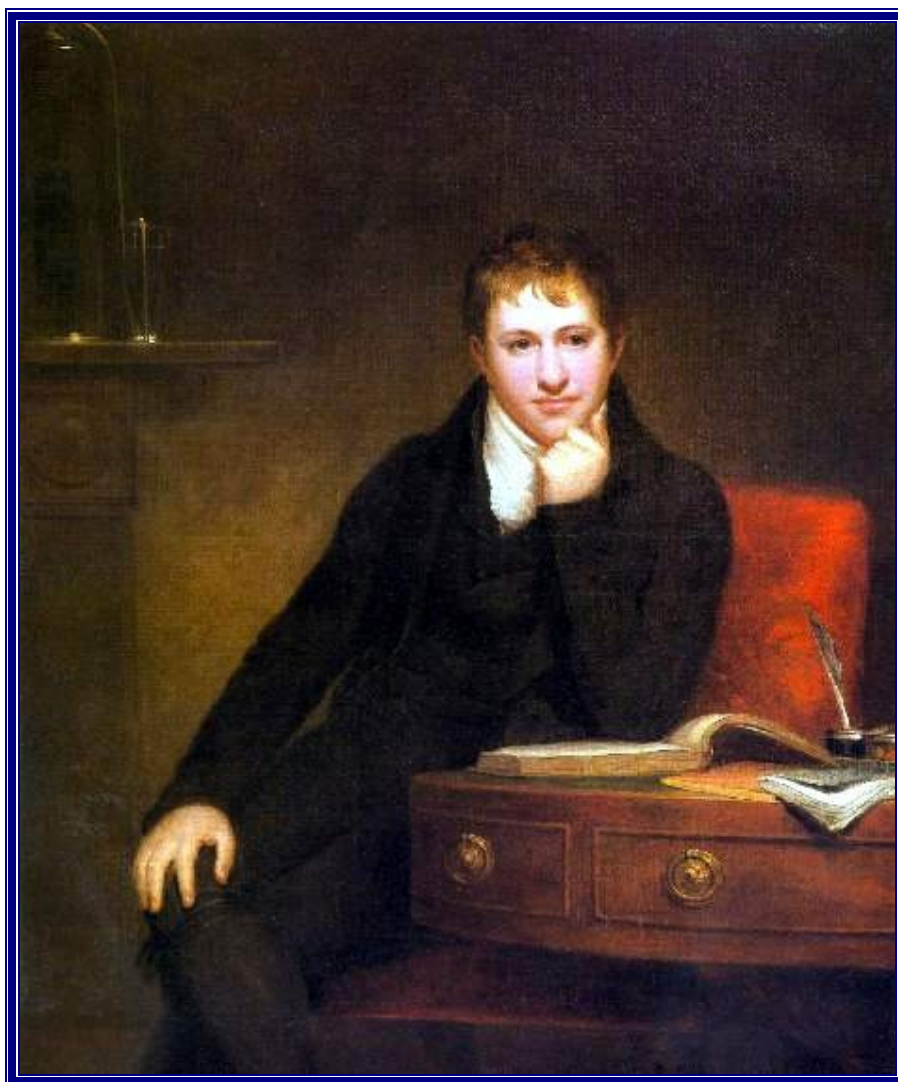
This system, intended first to provide warmed and cleaned air to all the medical and surgical areas of the hospital, brought with it an additional benefit. Because the outside air was dirtiest in winter, that was also the season when the sprinkler system to moisten the filters was most used. But the winter was also the time when there was the biggest difference in external and internal air temperatures – air entering the system below freezing would leave it at a temperature in the sixties Fahrenheit – and thus the greatest reduction in relative humidity, in any system that did not make good the deficiency in the water vapour content of the air. But this deficiency was, crudely, made good by the sprinkler system, more or less in direct ratio to need, because the colder the day, the more soot would be pumped into the Belfast atmosphere, and the more water would be run through the sprinklers and taken up by the air that passed through the ropes.

Had this topping-up of the relative humidity of the atmosphere been left to happy accident, there would be no point in enquiring whether the Royal Victoria Hospital has a place among pioneer air conditioning systems, but it was never left entirely to accident.

Description from above booklet



Sir HUMPHRY DAVY
1778-1829



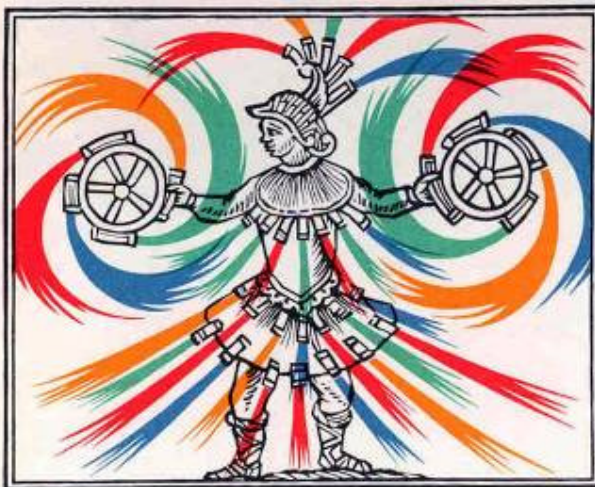
Demonstrated an Arc Lamp in 1808

[153] Sir Humphry DAVY

1778-1829

English chemist. Influenced by the writings of Lavoisier [148] but disagreed with his caloric theory, believing instead that heat was a form of motion. Discovered nitrous oxide (1800). Appointed by Rumford [15] lecturer at the Royal Institution, London (1801). Famous for his electrical experiments, demonstrated his arc lamp (1808) and invented the miners' safety lamp, or Davy Lamp (1815). Took responsibility for improving the ventilation of the House of Lords (1811), providing numerous holes in the floor for air distribution, combined with ceiling screens and heated metal tubes to accelerate the upward air movement. As recounted, "For boring twenty-thousand holes/ The Lords gave nothing. Damn their souls." Some consider Davy's most far-sighted decision was the appointment of the young Faraday [158] as his assistant (1813).

(Mini-biography from "The Comfort Makers," Brian Roberts, ASHRAE, 2000)



a history of electricity

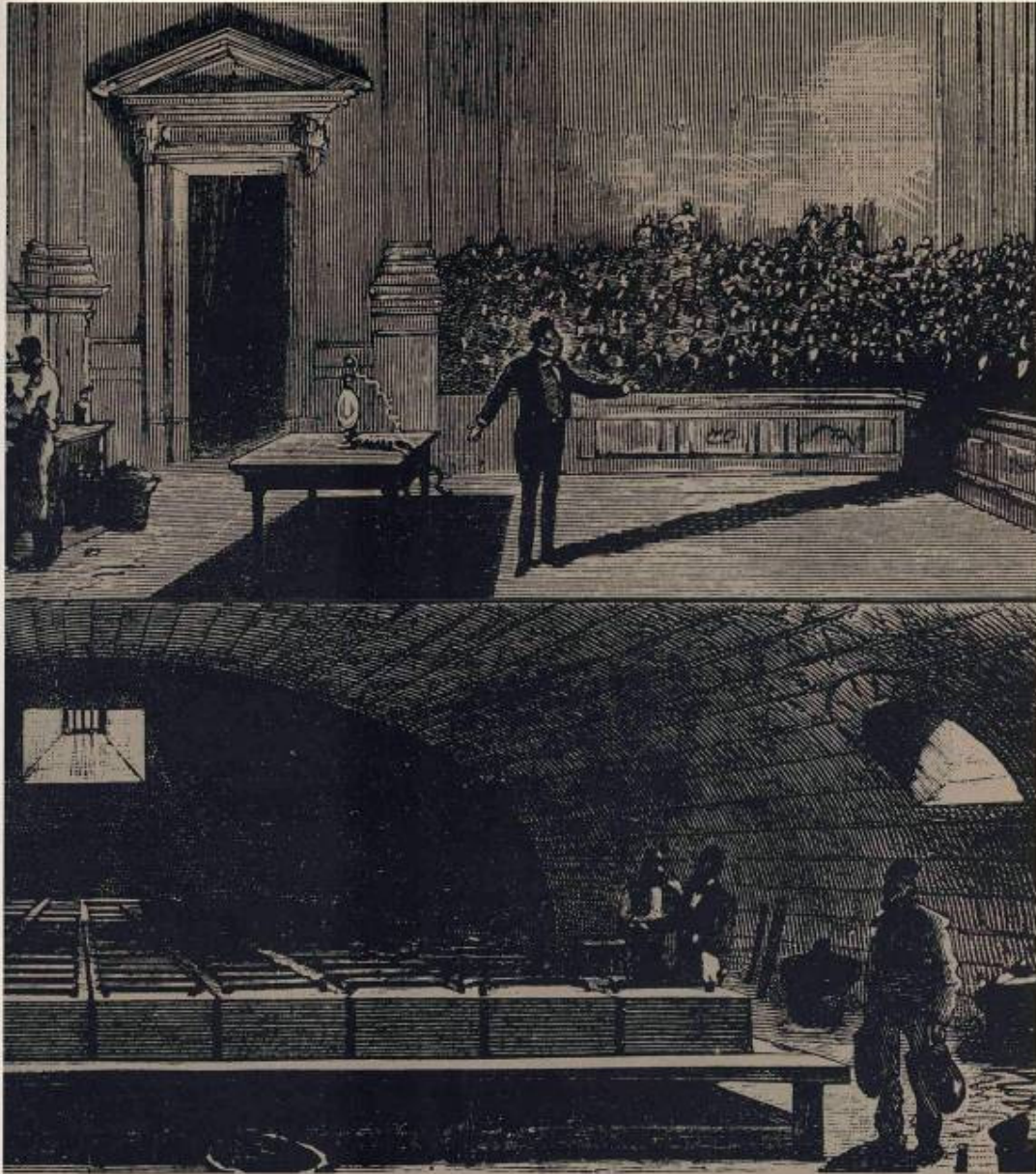
EDWARD TATNALL CANBY

Undated (CIBSE Heritage Group Collection)

It was a more famous man who is mainly noted in this field. Sir Humphrey Davy, brilliant lecturer and youthful director of the Royal Society at 23, devised a powerful "battery" of some 200 zinc and copper plate couplings, an enormous "crown of cups," with which he performed revealing experiments. The arc came first. He found that the spark that jumps when a current is interrupted can be maintained, a brilliant bit of continuous "lightning." Studying this, Davy found that charcoal (carbon) contacts made a dazzling arc, with intense heat. (The "arc" is the upward bow of the spark due to rising hot air.) In later forms the carbon arc became a practical electric light and also led to the electric furnace. In the arc, which produced the highest known man-made temperatures until the nuclear explosion, all metals melt and stones are vaporized.

Davy went on to the decomposition of compounds by the forced passage of current—"electrolysis" as Faraday later called it. He worked out, at last, an accurate measure of electrical *quantity*, by the amount of hydrogen and oxygen released in the decomposition of water; then he turned to solids that might be melted so as to pass the electric current. In 1807 he made a remarkable discovery. Potash and soda were common substances, thought to be elements. Might they be compounds—of unknown metals? Would electricity free the metal itself? Davy melted potash in a platinum

spoon, applied his battery, and was rewarded by small globules of silvery metal in the molten mass, some of which immediately caught fire. The weird new metal was potassium, never before seen in elemental form, and Davy produced another, sodium, from his melted soda. Both metals "burn" furiously in water, decomposing it by their violent affinity for its elements. In succession, Davy went on to liberate a series of unheard-of metals—calcium, strontium, barium, magnesium.



With a massive battery of 2000 voltaic cells, British scientist Humphry Davy demonstrated the first electric arc light before the Royal Society in 1808. It was the birth of the search for a practical electric light.