sum then than now—which enabled him to send his son to school. He invented a miner's safety-lamp, which he perfected about the same time as Sir Humphrey Davy produced his. There was considerable doubt as to which of the two was the first in the field, and after Davy had been presented with a service of plate, Stephenson's friends gave their candidate a testimonial of £1,000. Meanwhile Stephenson's position permitted him to experiment with the construction and operation of steam-engines.

It was then the practice in such places as Killingworth Colliery to lay wooden or iron plates as tracks for the wheels of horse-drawn coal-trucks to run on. Why not use steam instead of horses to pull the trucks? The idea, in fact, was "in the air," and, after seeing experiments of the kind, Stephenson persuaded his employer to back such a project.

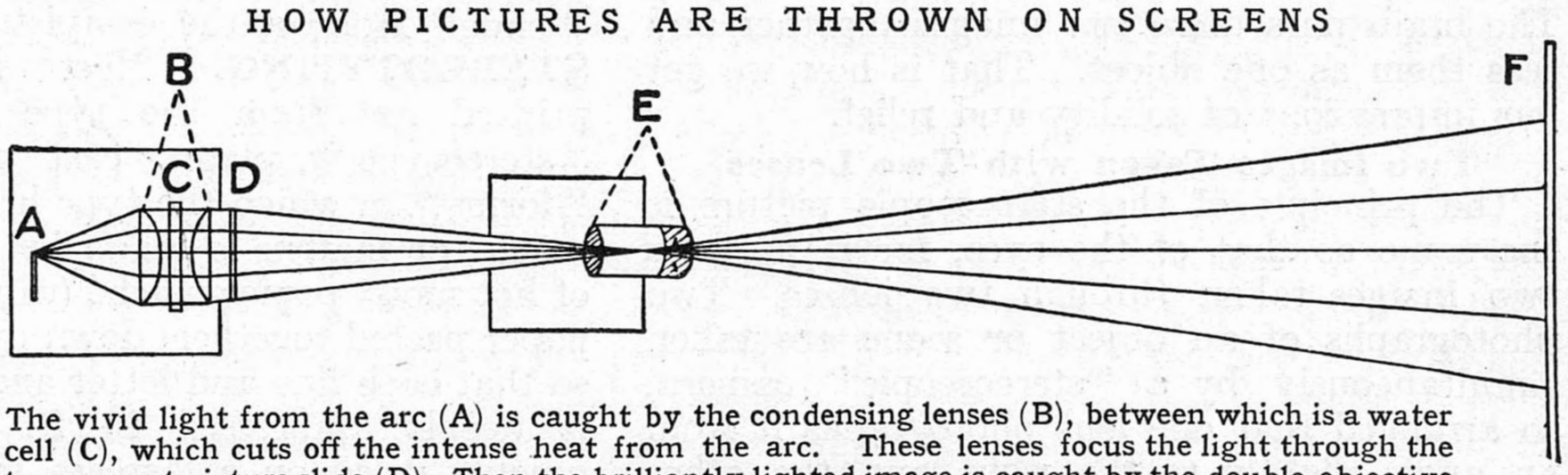
Success of His Engines

His first engine, completed in 1814, ran successfully; in his second he improved Watt's engine by turning the exhaust steam into the chimney. His engine, "Locomotion," run over the Stockton and Darlington Railway at its opening in 1825, was the first ever used to draw goods and passengers. His "Rocket" in 1829 won the £500 prize offered by the Liverpool and Manchester Railway for the best locomotive engine. (*See* Locomotive.)

Stephenson was now a made man, and henceforward, until he retired to live the life of a country gentleman, was the great railway builder and consulting engineer not only of England but of all Europe.

His son Robert (1803–59) inherited his father's abilities. He became a noted international engineer, among his works being many railways and famous bridges in various parts of the world. He helped to develop his father's locomotive factory, and later made the firm of Robert Stephenson and Company the leading locomotive manufacturers in the world.

HOW PICTURES ARE THROWN ON SCREENS



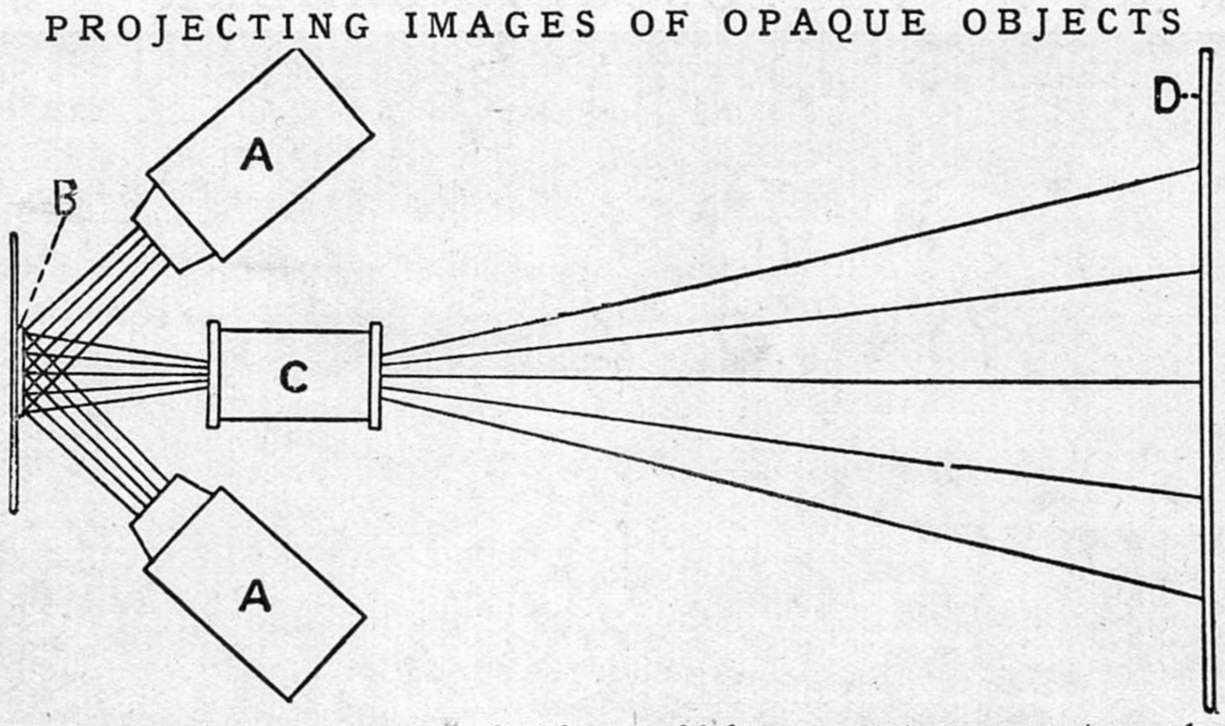
The vivid light from the arc (A) is caught by the condensing lenses (B), between which is a water cell (C), which cuts off the intense heat from the arc. These lenses focus the light through the transparent picture slide (D). Then the brilliantly lighted image is caught by the double-objective lens (E) and focused on the screen (F). The whole device works like a giant camera, in which the lens "photographs" the image of the slide upon the back of the camera, the room or theatre in this instance playing the part of the camera box.

STEREOP'TICON. In the 17th century a certain learned Dane showed in Lyons, France, illuminated pictures projected on the wall by a marvellous lantern. Yet that old "magic lantern" was comparatively a simple toy.

The principle is the same in all "projection apparatus." The light passes through a set of large condensing lenses, which gather up the rays and distribute them equally over the transparent image on the slide. After passing through the slide, the beam of light, which is now carrying the image, concentrates upon the smaller objective lenses. These focus the image and project it upon the white screen, where it becomes visible. (*See* Lens; Light.)

The slide consists of a piece of glass on which may be lettering, or images painted in transparent colours, or (more often) plain or coloured photographs, which are exactly like the ordinary photograph except that the gelatine film is supported on glass instead of on paper. To protect the slide or film from the intense heat generated by the light, a water cell is usually placed between the condensing lenses. The light, placed in a box known as the lamp house, must be brilliant and steady.

PROJECTING IMAGES OF OPAQUE OBJECTS



Here we see how pictures of objects which are not transparent can be thrown on the screen. The two arc-lamps (A) concentrate intense light upon the object (B), and the reflected light from the object is focused by the large objective lens (C) upon the screen (D).

Other Optical Lanterns

There are several types of instruments for projecting on a screen images of non-transparent or opaque objects. In one of the simplest of these, the "balopticon," the opaque object is intensely illuminated by two lights,