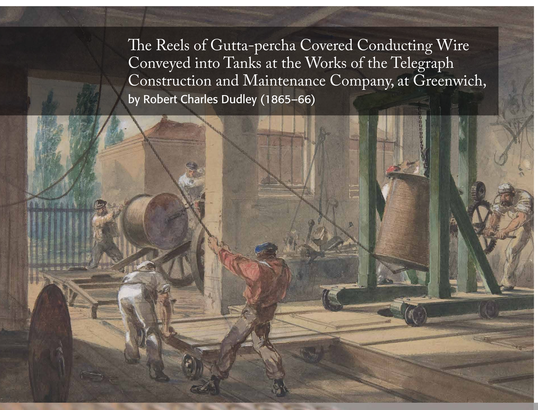
IEEE Global MUSEUM
Presented by IEEE History Center

IEEE

UNDER THE WAVES
Insulating Transatlantic Communications

From the telegraph to the telephone, the development of our global undersea communications network depended critically on natural, and then synthetic, insulating materials.



The Reels of Gutta-percha Covered Conducting Wire Conveyed into Tanks at the Works of the Telegraph Construction and Maintenance Company, at Greenwich, by Robert Charles Dudley (1865–66)

Gutta-percha

Gutta-percha is a natural latex derived from the *Palaquium gutta* tree native to Malaya, a British Imperial colony throughout the telegraphic age. Its thermoplastic versatility gave rise to a thriving European goods trade—from bottle stoppers to golf balls—that ultimately proved ecologically unsustainable. After Michael Faraday promoted its suitability as an electrical insulator in 1848, gutta-percha rapidly replaced tarred or varnished cotton. British cable companies revived their plans to connect distant cities via long underground lines. By 1851, the Submarine Telegraph Company had succeeded in linking London and Paris, which stoked ambitions to cross the Atlantic. Control of gutta-percha supplies undoubtedly contributed to the British monopoly over global telegraphic communications.

The failure of the first transatlantic telegraph cable, laid in 1858 (above left), was blamed partly on a lack of electrical standards and testing procedures, particularly for resistance. This was put right for the successful cable of 1866 (above right). It consisted of seven strands of gutta-percha insulated copper wire, and was protected by twisted steel, embedded in preserved hemp. The cable was then covered with an outer layer of manila yarn.

Polyethylene

The commercial development of the synthetic polymer polyethylene in the late 1930s had a similar impact on submarine communications to gutta-percha. It was created, partly by accident, by Eric Fawcett and Reginald Gibson at the Imperial Chemical Industries (ICI) works in Northwich, England. Its low electric permittivity and dielectric losses, particularly at radio frequencies, made it ideal for submarine telephony. Moreover, existing extruders for applying gutta-percha to telegraph cables could easily be adapted. The fifteen years to 1960 saw over 40,000 miles of polyethylene-insulated submarine telegraph and telephone cables laid—five times the diameter of the Earth.

TAT-1

The first transatlantic telephone cable, TAT-1 (for "transatlantic"), connected London with New York and Montreal in 1956. AT&T Bell Labs designed the main undersea link, two one-way coaxial cables almost 1100 miles long. Each cable was equipped with 51 vacuum-tube repeaters to compensate for signal attenuation. Between 1959 and 1978 six further coaxial links of increasing capacity were laid before AT&T Bell Labs launched TAT-8 in 1988: the first transatlantic fiber optic cable. Modern Atlantic fiber optic cables are still insulated with polyethylene. Their capacity is equivalent to about four million of the 36 voice channels initially carried on TAT-1.