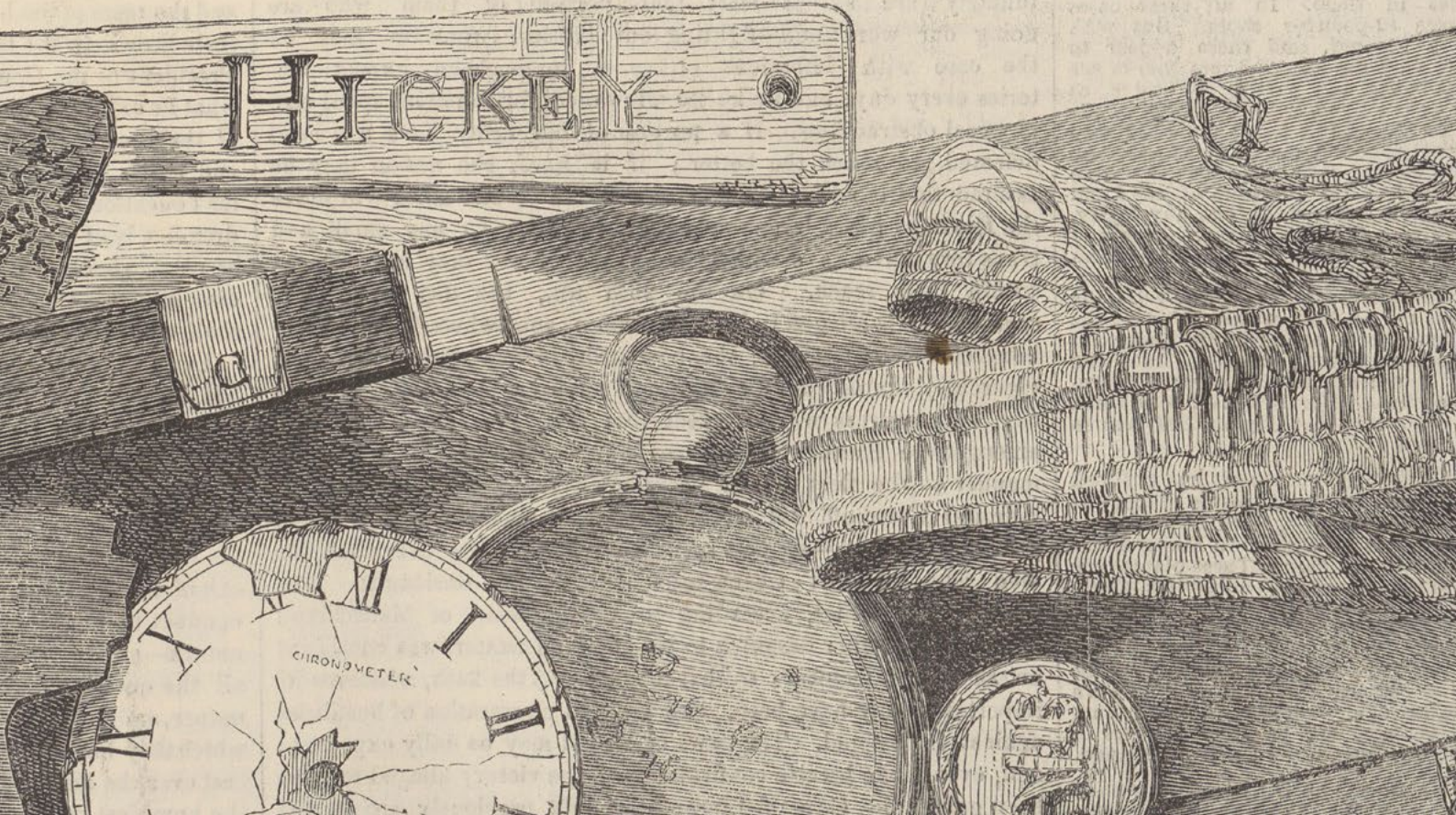
RESISTANCE

HIRT. PIECE OF PLATE. PART OF COMPASS. CERTIFICATE CASE. BUTTONS,



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BACK AND FRONT COVER:
James Tissot, *The Last Evening*, 1873 (details), The Guildhall Art Gallery, Corporation of London.

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RESISTANCE

CASSIE NEWLAND

GUTTA-PERCHA

Gutta-percha is a natural plastic that was employed by telegraph cable manufacturers to insulate the copper core of the cable. It is a tree sap, which when heated becomes plastic and workable into almost any shape. Importantly, gutta-percha retains this new shape as it cools and hardens to a consistency like thick leather. It is thought that the cabinet of curiosities collected by John Tradescant in 1656 contained a sample of gutta-percha described as 'mazer wood' and that 'being warmed in water [it], will work to any form'.[1] From Tradescant's Cabinet to the mid nineteenth century gutta-percha remained nothing more than a little-known curiosity.

Michael Faraday first published observations on the electrical properties (or rather the lack of them) of gutta-percha in a letter to the *Philosophical Magazine* dated 1 March 1848. He finds gutta-percha to be an excellent insulator and suggests multiple uses for it in the manufacture of electrical equipment and the undertaking of electrical experiments.[2] The idea of insulating copper wires with it appears to have been made by William Henry Hatcher, Civil Engineer and Secretary of the Electric Telegraph Company who in 1846 had suggested its possibilities for insulating cable to Charles Vincent Walker, Electrician to the South Eastern Railway company.[3] In 1847 Walker, along with J. & T. Forster and Co., patented a machine which sandwiched copper wire between two fillets of gutta-percha.[4] Walker is also credited with mentioning gutta-perhca's insulating potential to Charles Hancock of the Gutta Percha Company who in 1848 designed a superior machine for covering wires seamlessly through a process of extrusion.[5] Other early adopters were Werner von Siemens, who is credited with insulating an experimental wire with gutta-percha in 1847.[6] These early insulated cables were so effective that gutta-percha became a very sought-after material.

The tree is described as 'a tree of large size, attaining a diameter of 4 to 5 feet, and a height of between 100 and 200 feet… It has large thin buttresses around its base'.[7] It is slow-growing and gutta-percha cannot be harvested until the tree is around 30 years old.[8] Gutta-percha is traditionally harvested by felling the entire tree, rather than tapping as is commonly practiced with other sap-producing trees, such as rubber. The tree is felled several feet from the ground using a *biliong* or axe. The bark of the trunk was then ringed at intervals of approximately 15 to 30cms to allow the latex to run out and the crown removed to encourage the flow. Coconut shells, leaves or a hole in the ground were used to collect the dripping sap. Each tree produced very little (gutta-percha coagulates very quickly on exposure to the air) and the vast majority of the gutta-percha remained undrained inside the trees. Tully estimates that as little as 11 ounces (312g) of latex could be gathered on average from any one tree.[9]

As Collins estimates British imports for 1877 alone as 1.34 million kilograms (approximately 4 million trees)[10] and Sérullas gives the figure for 1891 at a staggering 1.8

million kilograms (5.5 million trees), the traditional method of gathering quickly became unsustainable.[11] Scarcity drove prices through the roof. In 1844, before its discovery by the telegraph industry, gutta-percha was 8 Spanish Dollars per *picul* (60 kilos).[12] By 1848, shortly after its debut as an insulator, it had risen to 13 Spanish Dollars per *picul*. By 1853, after the successes of the first gutta-percha insulated cables the price rocketed to 60 Spanish Dollars per *picul*.[13] The extraordinarily high price that the material commanded meant that every gutta-percha tree was effectively subject to a bounty. Collection soared and the tree was soon facing threats of extinction.

Gutta-percha was extinct on Singapore island by 1847,[14] from Malacca and Selangor by no later than 1875 and from Perak region by 1884.[15] When supplies were exhausted from British territories, the telegraph industry turned to imports from Borneo and Sumatra. In 1879 alone five million trees were cut down for their gutta on the island of Borneo.[16]

But cables were changing the world. Demand continued to soar. The British government, one of the greatest beneficiaries of the submarine cables, found itself increasingly addicted to a product over which it had little influence. Worries were voiced constantly and from the inception of the export industry about the unsustainable nature of the local collecting industry, the lack of foresight and the unmanaged and unmanageable forest system. Future supply problems were predicted 'if some more provident means be not adopted in its collection than that at present in use'.[17] The boom in the cable industry in the 1870s exacerbated the situation leading to calls to action from many writers including Collins,[18] Brannt[19] and telegraph engineer Séligmann-Lui.[20]

The powerhouse of economic botany, Kew, was mobilised into action to search for new sources of the rapidly disappearing plant. It quickly established that gutta-percha trees will only grow, on a narrow strip of land encompassing The Malay peninsular, Sumatra and what was the island of Borneo (today comprising Sabah, Sarawak, Brunei and the various Kalimantans). Once this extremely limited ecological band in which gutta trees grew naturally became known waves of panic spread throughout the telegraph industry.[21] Faced with a finite and rapidly shrinking natural resource the scientists at Kew turned to other, more imaginative means of continuing supply.

Kew requested – and were sent – thousands of specimins of gutta sapplings, leaves and seeds from all over the world. These were then sorted, identified, catalogued and named by William Hooker, Director of the Royal Botanic Gardens, Kew.[22] This allowed the collation and dissemination of information about exactly which species of gutta-producing trees were suitable for use as a telegraph insulator. It also reduced the amount of inferior gums accidentally entering the export market, allowing for identification and assessment of imported gutta samples in terms of their purity and likely properties. The impact

of identifying the correct tree for gutta-collection brought with it more selective felling, further impacting the *Palaquium gutta*.

The network of botanical and experimental Gardens was galvanized into action as Kew sought further regions in which *Palaquium gutta* would grow to increase supply. Seeds of the *Palaquium Gutta* were packed into tins and envelopes and sent out to the far reaches of the Empire. To no avail, in the *List of Economic Plants Native to or Suitable for Cultivation in the British Empire* gutta-percha is still listed as suitable for growing only in the British territory of Malaya and the foreign territories of Sumatra and Java.[23] Kew then attempted to find a suitable substitute tree that *could* be grown in British territories, trying *Bassia parkii* in British Africa, *Mimusops balata* in the Guianas (Royal Botanic Gardens, Kew, 1891) and *Dichopsis elliptica* in India.[24] The Kew Bulletin notes that without exception the gum from these plants failed as potential electrical insulators.[25]

With no good news from Kew, the British Government knew their only hope to maintain supply was to increase British presence in the growing region and create gutta-percha plantations. When gutta-percha first appeared on the market Britain held three, relatively small, trading colonies on the Malay peninsula: Penang Island, Province Wellesley, and Malacca and Singapore; an area of approximately 1276 square miles. Sarawak, on the north-west coast of the island of Borneo was also nominally under British 'White Raja' rule. In 1846 the Sultan of Brunei was persuaded to cede Labuan island off the Sabah coast to the British. In 1874 Pangkor island, the Dindings and Province Wellesley on the Malay peninsula were also ceded to the British. Finally, in 1881 the British North Borneo Company was formed with lands of 30 000 square miles encompassing the present day area of Sabah.

Even with territory established in the growing region, gutta-percha plantations were not easily encouraged. The unsuitability of the tree to less invasive 'tapping' methods and the slow growing nature of the plant ensured that any gutta-percha plantation would not realise any profit on the initial investment until the trees were mature; a delay of at least 30 years. Investors were understandably slow to appear while there existed an exploitable supply in the wild.[26] When prices finally went through the roof, around 1895, plantations became an economically viable prospect for first time. The first was set up by the Dutch in Java in 1895, which produced gutta from 1908.[27] The British followed in 1915 with production coming online in the late 1920s. Plantations were never to become even remotely successful at meeting demand; a case of too little too late.

Running in parallel to this typically imperial government enterprise was a stream of research being carried out in the laboratories of the cable manufacturers. Sérullas, for example, patented a process to recover gutta by macerating fallen leaves and twigs

then treated them with acid to recover the gum.[28] Attempts were also made to replace gutta-percha as an insulation material entirely. Thomas Christy, for example patented a 'bandage of animal glue and glycerine'[29] which could be used to cover cables, while Purcell Taylor invented 'Purcellite', the artificial gutta-percha.[30] Both these substitutes sank without a trace.

The most promising developments came at the turn of the nineteenth century in places such as TELCON. A nascent chemical industry emerged.[31] This industry worked with lower quality (read cheaper and more abundant) guttas. The individual chemical compounds comprising true gutta were slowly identified to provide an ideal recipe of resins, gums and plasticisers. Engineers could then use this recipe to manipulate lower quality guttas, removing unwanted elements and substituting the missing ingredients with ones derived from petrochemicals. More sophisticated understandings of the properties of materials rapidly developed and it was a short journey from manipulating existing materials to the synthesis of entirely new ones. In 1898 the first man-made plastic, polyethylene, was created. It would go on to replace gutta-percha as an electrical insulator. The Malaysian and Indonesian rainforests, having been selectively plundered began a slow decline. The days of gutta-percha were over, a victim of the telegraph engineer's success.

1. Tradescant quoted in T. Oxley, 'Gutta Percha', *Journal of the Indian Archipelago and East Asia* (1847), p. 29.

2. M. Faraday, 'On the use of gutta-percha in electrical insulation', *Philosophical Magazine*, Series 3, vol. 32, no. 214 (1848), p. 165.

3. In the nineteenth century the position of Secretary was the equivalent to our CEO.

4. S. Roberts, *Distant Writing: A History of the Telegraph Companies in Britain between 1838 and 1868* (2006), p.108, http://tinyurl.com/z6syctd (consulted 11 September 2016).

5. S. Roberts, *Distant Writing...* (2006), http://tinyurl.com/jk4fmj8 (consulted 11 September 2016).

6. W. Feldenkirchen, *Werner von Siemens: Inventor and International Enterpreneur* (Columbus Ohio: The Ohio State University Press, 1994), p. 46.

7. J. S. Gamble, 'Gutta Percha Trees of the Malay Peninsula', *Bulletin of Miscellaneous Information, Royal Gardens, Kew*, vol. 4 (1907), pp.113-114.

8. J. Tully, 'A Victorian Ecological Disaster: Imperialism, the Telegraph, and Gutta-Percha', *Journal of World History*, vol. 20, no. 4 (2009), p. 575.

9. Ibid., p. 571.

10. J. Collins, *Report on the Gutta Percha of Commerce* (London: George Allen,1878).

11. E. Sérullas, 'On Gutta Percha', *India Rubber Journal*, vol. 7, no. 6 (1891), p. 162.

12. At the time the Spanish Dollar was the most widely accepted coinage in the region. It remained so until the introduction of the British Trade Dollar in 1895.

13. C. B. Buckley, *An Anecdotal History of Old Times in Singapore* (Singapore: Fraser & Neave, 1902), pp. 405-406.

14. Sérullas, 'On Gutta Percha' (1891), p. 163.

15. Ibid.

16. Ibid.

17. Oxley,'Gutta Percha' (1847), p. 24.

18. Collins, *Report* (1878).

19. W. T. Brannt, *India Rubber, Gutta Percha and Balata* (London: Sampson Low, Marston, 1900), pp. 233-235.

20. Seligman-Lui et al, 'Le gutta-percha au point de vue de la telegraphie sous-marine', *Traite de telegraphie sous-marine* (1888), pp. 69-70.

21. H. L. Terry, *India Rubber and Its Manufacture, with Chapters on Gutta-Percha and Balata* (London: Archibald Constable & Co., 1907), p. 272.

22. Royal Botanic Gardens, Kew, 'Rediscovery of gutta percha tree at Singapore', *Bulletin of Miscellaneous Information CCXIII*, vol. 57 (1891), p. 231.

23. Royal Botanic Gardens, Kew, 'A List of Economic Plants Native or Suitable for Cultivation in the British Empire', *Bulletin of Miscellaneous Information*, vol. 7, no. 8 (1917), p. 263.

24. Royal Botanic Gardens, Kew, 'Indian Gutta Percha', *Bulletin of Miscellaneous Information CCLXXXIV*, vol. 72 (1892), pp. 296-7.

25. Royal Botanic Gardens, Kew, 'Rediscovery of gutta percha tree at Singapore', *Bulletin of Miscellaneous Information CCXIII*, vol. 57 (1891), p. 230.

26. Terry, *India Rubber* (1907), p. 273.

27. Tully, 'Ecological Disaster' (2009), p. 578.

28. Anon., 'Notes on Gutta Percha', *The Engineer* (6 May 1898), p.417.

29. T. Christy, 'A New Material', *India Rubber Journal*, vol. 5, no. 2 (1891), p. 107.

30. P. Taylor, 'Artificial Gutta Percha', *India Rubber Journal*, vol. 6, no. 10 (1890), p. 260.

31. D. Headrick, 'Gutta-percha: A Case of Resource Depletion and International Rivalry', *IEEE Technology and Society Magazine* (1987).