# Historical Uses of Gutta-Percha

## Gutta-Percha

From The Columbia Encyclopedia, Sixth Edition. 2001

Natural latex obtained from Palaquium gutta and several other evergreen trees of East Asia. The latex, collected by felling or girdling the tree, is allowed to coagulate and is then washed, purified, and molded into bricks for shipping. Like caoutchouc, gutta-percha is a polyterpene, i.e., a polymer of isoprene, but, unlike caoutchouc, it is not very elastic; the reason for the difference is that the polymer molecules in gutta-percha have a trans structure, whereas those of caoutchouc have a cis structure (isomer). Gutta-percha is an excellent nonconductor and is often employed in insulating marine and underground cables. It is also used for golf-ball coverings, surgical appliances, and adhesives.

# Gutta-Percha

**by Harvey Wickes Felter, M.D., and John Uri Lloyd, Phr. M., Ph. D.:**

From King's American Dispensatory

The concrete juice of *Isonandra Gutta*, Hooker (*Dichopsis Gutta*, Bentley), and other species of the same order.

*Nat. Ord.*—Sapotaceae.

COMMON NAMES: *Gutta-percha, Gutta-taban, Gutta-percha depurata, Gummi-plasticum*. ILLUSTRATION: Bentley and Trimen, *Med. Plants,* 167.

**Botanical Source.**—This is the concrete milky juice of a tall tree, a native of the Malayan Archipelago, especially of Singapore, where it is now becoming rapidly extinguished through ruthlessness in collecting gutta-percha. It has a straight and lofty trunk, about 3 feet in diameter at the base, with numerous ascending branches; the terminal buds are white from exuding gutta. The wood is hard; the leaves crowded at the extremity of the branches, alternate, petiolate, oblong, with a small point at the apex, base tapering, 4 or 6 inches long, 2 inches broad, upper surface bright-green, feather-nerved, under surface brownish-red, from dense pubescence; the midrib and petiole the same; the petiole 1 inch long, channeled, not articulated with the stem. Stipules none. The flowers are axillary, sessile, 4 together, disposed in a quadrangular manner, small and white. Bracts none. Calyx persistent, 6 sepals, brownish-red, in a double series, the outer largest; aestivation valvate. The corolla is monopetalous, 6-cleft, the lobes 1/4 of an inch long, tubes 1/2 an inch and deciduous; aestivation twisted. Stamens 12, in a single series, equal, similar, and inserted in the mouth of the tube. The filaments are equal in length to the lobes of the corolla; the anthers sagittate, extrorse, and affixed by their base to the filaments; the pollen scanty. The ovary is superior, conical, sessile, seated on a disk, 6-celled, each cell containing a single ovule Suspended from a central axis; the funiculus is conspicuous. Style longer than the stamens and persistent; stigmas undivided (E. White).

## Isonandra Gutta tree

The foliage, flower and fruit of the Isonandra Gutta tree.

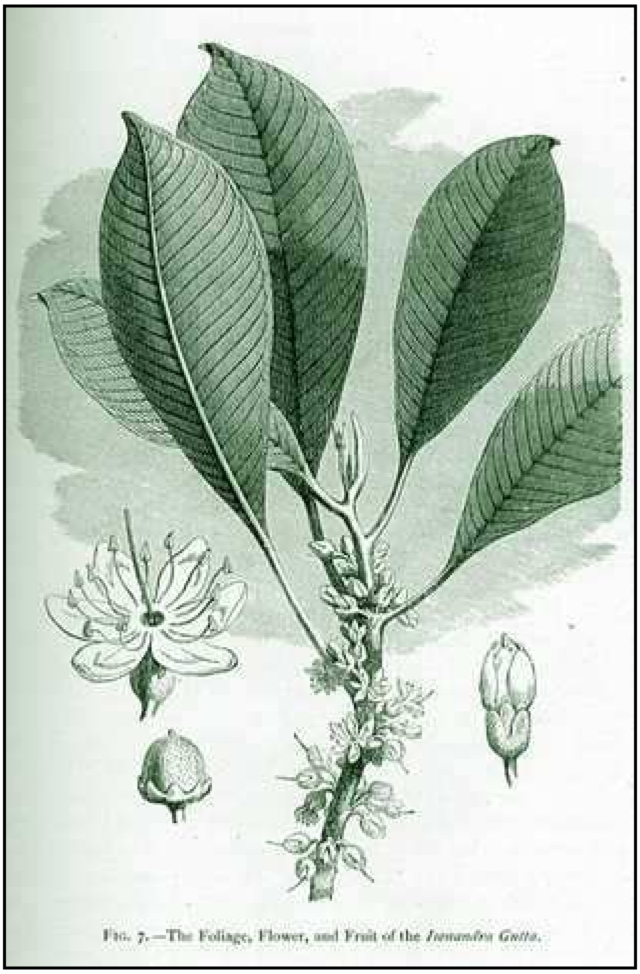


FIG. 7.—The Foliage, Flower, and Fruit of the *Isonandra Gutta*.

**History and Description.**—This substance was introduced in 1842 to the profession, by Dr. William Montgomerie, a surgeon in the British army in the Indies. The natives cut down the tree, remove its bark, and collect the milky juice in conic receptacles made from the spathe of the Areca palm. The juice soon concretes upon exposure to the air. The product is then put into a pot with water warmed to 70° C. (158° F.) and kneaded, which removes particles of wood and bark, this process being repeated several times until a uniform mass is obtained. It has been stated that the yield from one tree is 20 to 30 pounds, but according to data given by Prof. Tschirch (*Indische Heil und Nutzpflanzen*, 1892, p. 203) this must be an exaggeration. Dr. Burck, in Buitenzorg (Java), has shown that by making incisions in living trees 1400 grammes of gutta may be obtained annually, and that this yield may be maintained during a period of 3 or 4 years. As imported it contains various foreign matters from which it should be freed before using it. It is a white or dirty pinkish opaque solid, having a faint odor, no taste, and hardens at 15.5° C. (60° F.). Water, alcohol, alkaline solutions, hydrochloric and acetic acids, and fixed oils have no action on it. It is soluble in coal naphtha, oil of turpentine, benzol, chloroform, boiling ether, and bisulphide of carbon. Hot water softens it, and a heat of 71.1° C. (1601 F.) renders it adhesive and pliable; when soft it may be easily cut or molded into various shapes—a temperature of 65° to 60° C. (120° to 128° F.) being the most favorable for this purpose. It resembles caoutchouc, and like this substance, has the property of combining with sulphur, and is thus capable of being vulcanized for use in the arts (see *Elastica*). Its specific gravity is 0.979. Gutta-percha, when in contact with air for some time, oxidizes and undergoes a peculiar change, becoming brittle and ultimately losing all coherence. In this process formic acid is liberated. The oxidized substance is soluble in cold alcohol. This change does not take place when gutta-percha is kept under water. It is a better insulator for electric wires and cables than caoutchouc, and is employed for insulating purposes in large quantities.

**Chemical Composition.**—When gutta-percha, according to Payen (1852), is purified by kneading in warm water, dried, and treated with hot absolute alcohol a hydrocarbon, *gutta* (75 to 82 per cent) remains. From the hot solution an oxygen compound, *alban* (14 to 16 per cent), falls out upon cooling, while another oxygen compound, *fluavil* (4 to 6 per cent), remains in solution. To these constituents Otto Oesterle, in Prof. Tschirch's laboratory (*Archiv der Pharm.*, 1892, p. 641), added *guttane*, an unstable, thread-like body resembling gutta. Crude gutta-percha of commerce also contains tannin, salts and saccharine substances. No volatile oil could be identified.

*Gutta* determines the elasticity of gutta-percha, and its plasticity at elevated temperatures. It is a white, amorphous hydrocarbon of the formula $(C_{10}H_{16})_n$ (Oesterle); $C_{20}H_{32}$ (Oudemans, Baumhauer); $(C_4H_7)_n$ (Payen), etc., insoluble in alcohol and cold ether, little soluble in benzol and oil of turpentine, easily soluble in carbon disulphide and chloroform. It melts at 53° C. (127.4° F.) (Oesterle) and absorbs oxygen rapidly, whereby formic acid is liberated (Payen). Exposed to air and light pure gutta becomes yellow, friable, and partly soluble in alcohol, caustic potash and benzol.

*Alban* is a light powder, riot dissolved by water, diluted acids or alkalies, dissolves in boiling, but not in cold, absolute alcohol; readily soluble in ether, chloroform, carbon disulphide, benzol, and oil of turpentine. It has the composition $C_{40}H_{64}O_2$ (Oesterle), yielding a hydrocarbon, *alben*, by heating with alcoholic potassa. It melts at 195° C. (383° F.). The presence of alban does not seem to have any harmful effect upon the technical properties of gutta-percha.

*Fluavil* is a lemon-yellow, amorphous body, having the composition $(C_{10}H_{16}O)_n$ (Oesterle), melting between 82° and 85° C. (179.6° and 185° F. but becoming soft at a much lower temperature. When it occurs in gutta in larger quantities it renders this article brittle. Fluavil is more soluble in the solvents mentioned than the other constituents. Whether alban and fluavil are decomposition products of gutta, was not determined.

**Action, Medical Uses, and Dosage.**—Gutta-percha serves several useful ends in medicine, surgery, and pharmacy, and is likewise used for ornamental and various other purposes. Splints, etc., have been made of it, and employed in cases of *fractures, diseased joints*, and other cases where it is desired to keep the parts in a permanent position, and it is also formed into bougies, injection pipes, catheters, pessaries, specula, forceps, handles, etc. Its pliability after having been immersed into hot water renders it especially adapted for the preparation of splints, and such splints are preferable to carved wooden splints. The solution in bisulphide of carbon has been employed by M. Vogel in *wounds* effected by cutting instruments—the fluid evaporates with great rapidity, and leaves a thin layer which protects the wound from atmospheric action, at the same time keeping its edges in close contact. The following compound is recommended for the *hemorrhage* supervening the extraction of teeth: Take of gutta-percha, 1 ounce; best tar, 1 1/2 ounces; creosote, 1 drachm; shellac, 1 ounce. Boil these in a crucible, stirring or beating them well, until they are blended into a stiff, homogeneous mass. The compound is readily softened between the fingers, and is easily introduced into the bleeding socket. It must be pressed in, and the hemorrhage will be speedily checked. For dental purposes solution of gutta-percha is purified by agitating it with calcium sulphate. Mixed with silica, powdered glass, zinc oxide, and similar mineral substances, to give hardness and the proper consistence, it is largely used by dentists to fill the cavities of *carious teeth*. Mr. Aiton recommends the following preparation, applied to the skin in the same manner as collodion, as a protection against poisonous or deleterious vapors or fluids: Add 30 grains of gutta-percha to 1/2 an ounce of benzene, and expose to a moderate heat; when the gutta-percha is dissolved, add to it a solution of 5 grains of caoutchouc dissolved in 1/2 ounce of benzene (benzol). A clear *solution of gutta-percha* may be made by adding to the solution a mixture of 2/3 of a part of finely powdered carbonate of lead in 2 parts of chloroform; agitating the whole 2 or 3 times, and then allowing the mixture to stand 10 or 12 days. The carbonate of lead, in becoming deposited, carries with it coloring and insoluble matters; the clear solution should then be decanted and placed in 1/2 fluid ounce vials, with closely-fitting glass stoppers. This will be found very valuable as a local application to *irritated* and *abraded surfaces, chaps, small wounds*, etc., as it forms a kind of cuticle over the parts.

Dr. Maunoury recommends mixing 2 parts of chloride of zinc with 1 part of powdered gutta-percha, in a tube or porcelain dish, and gently beating the mixture over a lamp. The gutta-percha softens, the particles cohere in a spongy mass, which retains the chloride of zinc, and may be made into any convenient shape, which it retains on cooling. This he recommends as a manageable caustic, as it retains its consistence and flexibility, and can be easily inserted into the urethra, nostrils, fistulous or other passages, and, by its porosity, permits the exudation of the caustic, and thus opens a free passage for the result of the action of the caustic on the tissues. Other caustics or agents may be applied in the same way. Chrysarobin is well applied with solution of gutta-percha.

It has been extolled by dermatologists as an efficient application in certain *skin affections,* to prevent access of air and the formation of crusts, to lessen the quantity of secretions, and to limit the action of the medicaments employed. It has thus been employed in *smallpox* (to prevent pitting), in *erysipelas, psoriasis, herpes tonsurans, prurigo,* and certain *eczemas*.

Prof. J. M. Maisch proposed the following solution as preferable to collodion, in having no gloss or contractile power, and in its close resemblance to the skin: Take 1 part of the best commercial gutta-percha, cut it into small pieces, and, by agitation, dissolve it in 12 parts of chloroform; on standing for a day, all the coloring matter rises like a scum to the surface, leaving the solution clear; this may then be easily drawn off to the last drop. A wide glass tube, narrower at the bottom, and so arranged that both ends may be closed by corks, is the only instrument necessary; after the separation is complete, the upper cork must be removed, and the lower one loosened so as to allow the liquid to run out slowly. Gutta-percha is acted upon by the strong mineral acids, but not by sea water, alkalies, vegetable acids, or weak mineral acids, hence gutta-percha vessels are highly valuable.

**Related Products and Preparation.**—Several guttas, some of which are closely allied to caoutchouc, are used to adulterate gutta-percha, among which may be mentioned the following: *Gutta-soo-soo*—two kinds—one from Perek, the other, a caoutchouc, from Borneo, *Gutta-singgarip*, *Gutta-rambong*, and *Gutta-sundek* (*Gutta-putih*).

BALATA (GUM CHICLE).—This is a milky exudate, known in tropical America as *Chicle*, or *Tuno-gum*, derived from the Bully tree (*Mimusops globoso*, Gaertner), which grows along the Amazon and Orinoco rivers of South America. It is very much like gutta-percha, and is employed sometimes in plasters. Within recent years the demand for this substance has increased enormously in the United States, where the bulk is employed in making *chewing gum*.

GUTTA-PERCHA CEMENTS.—An improved cement for uniting the parts of boots and shoes, and in the manufacture of articles of dress in which cement is required, is made of 64 parts, by weight, of gutta-percha, 16 parts of caoutchouc, 8 parts of pitch, 4 parts of shellac, and 8 parts of oil. The ingredients are melted together, the caoutchouc having been previously dissolved. A cement for uniting sheet gutta-percha to silk or other fabrics, is composed of gutta-percha, 40 pounds; caoutchouc, 3 pounds; shellac, 3 pounds; Canada balsam, 14 pounds; liquid styrax, 35 pounds; gum mastic, 4 pounds; and oxide of lead, 1 pound. Another for uniting it to leather, as soles of shoes, etc., consists of gutta-percha, 50 pounds; Venice turpentine, 40 pounds; shellac, 4 pounds; caoutchouc, 1 pound; and liquid styrax, 5 pounds. A cement for repairing or patching shoes and boots has been in vogue among shoemakers. It is made by dissolving 1 ounce of raw gutta-percha in 1 pound of bisulphide of carbon, and then adding a piece of resin. The leather must be well buffed to make the cement adhere.

## Insulator for underwater telegraph cables

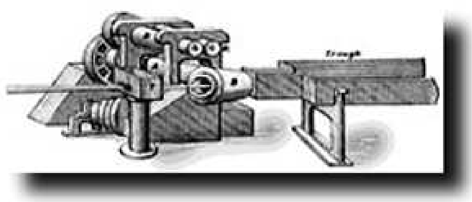
This material, found just a few years earlier in Malaya, was presented to Cyrus Field by Samuel Canning who would come to be a member of the first transatlantic cable expedition. From Samuel Canning, Mr. Field learned of the difficulties of keeping the copper wires in the cable insulated because of the conductive medium from the ocean that surrounded the wire. Gutta-percha seemed to have the required properties for this task.

Gutta-percha was produced by evaporating the milky fluid of the gutta-percha tree and coagulating the latex from which an inelastic firm insulator resulted. This material softened in hot water. It had a distinct advantage over India rubber that had been used in earlier cables because, on cooling, it became hard without becoming brittle. It was ideally suited for underwater use where the cold and pressure improved its insulating qualities. Submersion also kept the cable away from sunlight which had a deteriorating effect on the cable. The crossing of the Atlantic Ocean by cable was viewed by the scientists involved in the gutta-percha work as the ultimate test of the material.

Locally made items of this material were brought to Europe from the Malay Peninsula and specimens were exhibited at the Royal Society of Arts in London in 1843. It was subsequently imported and used for various applications, including jewellery making.

The discovery of a form of rubber called gutta-percha in 1843 led to the manufacture of a suitable insulation by 1847.

In 1845, the S. W. Silver & Co. of Stratford, East London, invented a means of extruding gutta-percha to cover wire (see picture below). Gutta-percha was the best cable insulation



available and it was used to insulate the telegraph lines along the Great Western Railroad in 1843. The lines consisted of five copper conductor wires, covered with gutta-percha and supported in wooden blocks.

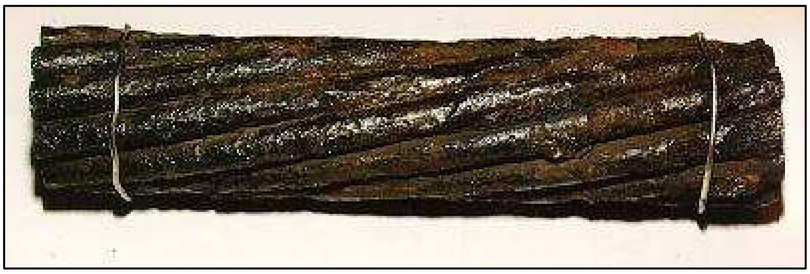
The real beginnings of global submarine cable telegraphy began with a wealthy English merchant family named Brett, who financed a cable crossing the English Channel to France in 1850. That cable failed after only a few messages had been exchanged, and was finally replaced with an engineered design that could withstand the currents at the bottom of the Channel in September 1851.

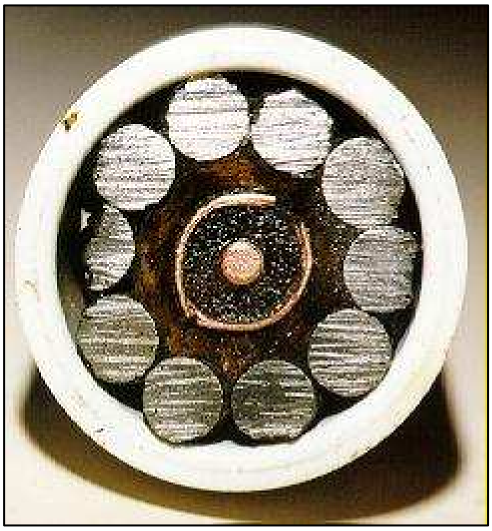
A waterproof insulating material was needed for the outdoor cable. Gutta-percha, a resin from the Isonandra Gutta tree, was imported from the Malay Peninsula and tested for wire insulation. This material was a good insulator; it provided an inelastic, firm insulation. It softened in warm water and was hard but not brittle when cooled. The only problem with gutta-percha was that it deteriorated in direct sunlight.

## UNDERWATER TELEGRAPH CABLE DETAILS
## W1TP TELEGRAPH AND SCIENTIFIC INSTRUMENT MUSEUMS:

**Tom Perera - W1TP**

This very early telegraph cable connected Havana, Cuba and the United States in the late 19th Century. It was recovered from the Atlantic Ocean by Tom Perera in January of 1997. It was conserved in an electrolytic bath for 4 months and then cut into smaller pieces and carefully dissected to reveal its inner construction.





The various layers of the cable are shown and described below:

**OVERVIEW OF THE CABLE AND ITS LAYERS:**

This view shows all of the various layers of the cable. Each of these layers is described below. Some erosion of the outermost layer is apparent due to its submersion for over 100 years in salt water.

**OUTER LAYER - 1: STEEL WIRES:**

The outer layer consists of a total of 10 strands of steel wire. Each strand had an outside diameter of 3/8-inch. This layer was designed to provide great strength and resistance to abraision from coral and rocks.

**LAYER 2 - TAR-IMPREGNATED HEMP:**

This layer was designed to provide a waterproof seal. It was wound in the opposite direction from the outer layer in an attempt to reduce torsional twisting of the cable.

**LAYER 3 - SPIRAL-WOUND COPPER SHEET:**

This copper sheet layer was included to prevent the Torado worms from working their way into the Gutta Percha insulation and allowing salt water to short out the inner conductor. Although it looks like the shield in a modern coaxial cable, it actually had no electrical function.

**LAYER 4 - SPIRAL-WOUND COPPER SHEET:**

A second layer of copper sheeting was wound just under layer 3. It was also designed to further deter the Torado worms.

**LAYER 5 - GUTTA PERCHA INSULATION:**

Gutta Percha is a rubber-like Malayan gum obtained from trees which is liquid when heated and solid when cool. It is an excellent insulator and was used as the main cable insulation.

**LAYER 6 - SPIRAL-WOUND STEEL WIRE:**

A continuous wrapping of .020-inch. diameter steel wire provided inductive loading to partially cancel out the large values of capacitance generated in such a long cable. Cancelling out some of the the capacitance reduced the time-constant of the cable and increased the speed that It could carry information.

**LAYER 7 - SPIRAL-WOUND COPPER SHEETS wound around the LAYER 8 - SOLID COPPER INNER CONDUCTOR:**

The 5/32-inch outside diameter layer of spiral wound copper sheets decoupled and isolated the steel wire from the 1/8-inch outside diameter solid copper inner conductor which carried the positive and negative voltages of the telegraph signals.

In the future, I plan to add information about the electrical characteristics of this cable. I will also update these pages as I try to recover all six of the underwater cables. They will provide samples of the technological improvements in cables from 1866 to the 1900's and allow me to analyze how well they have survived over 100 years under the ocean.

# THE DISCOVERY OF GUTTA-PERCHA

Gutta-percha was obtained from a variety of guttiferous trees throughout the Pacific Rim although different varieties produce materials of differing quality. The differences generally reflect the quantity of resin in the product with that from Pahang having the lowest resin content. Balata has one of the highest resin contents and was obtained from trees in the tropical regions of South America.

There is much confusion in the literature, and amongst collectors, as to “what gutta-percha is”. In practical terms, and when addressing collectors’ items, the material is probably the whole residue from the latex, dried after collection from whichever tree was its source. This material tends to range from dark yellow through red to black. It is possible that it has undergone some degree of purification but, given the variations in initial composition, it would be extremely difficult to confirm this, even by detailed chemical analysis.

In the same way that commercially available natural rubber is some 95% cis polyisoprene, the crude gutta-percha was often 30% to 50% trans polyisoprene. That is it has the same chemical “building block” as natural rubber (C5H8)n but with a different spacial configuration. Isolation of the pure trans polyisoprene gives a white/very pale cream “cheesy” material which looks and feels not unlike a block of high density polythene (m.p. about 135℃) or polypropylene (m.p. 168℃). The hard gutta-percha softens at relatively low temperatures (>71℃) and could then easily be moulded or extruded (the screw extruder was invented in 1845). At slightly lower temperatures, around 60℃, it can easily be cut whilst at room temperature it reverts to a hard material.

It is generally believed that a British surgeon, Dr William Montgomerie, was the first person to introduce the Western world to gutta-percha in 1843. However, that honour actually belongs to John Tradescant who had returned from his travels in the Far East with this material in 1656. He called it “mazer wood” but it then was regarded as only one of many plant curiosities and it was left to Dr Montgomerie to appreciate its potential. He originally saw the material in Singapore, in 1822, and learned its Malay name – gutta-percha - but he forgot about it when he transferred to the Bengal Residency. When he returned to Singapore he remembered the material and how the workers had made handles for their machetes with it. It struck him that there was potential for its use both as knife handles and for various medical devices. After some experimentation he referred his work (in 1843) to the Medical Board of Calcutta and copied the documents to The Royal Society of Arts in London through his brother-in-law. The Society realised the potential of the material and promptly awarded Montgomerie its gold medal. At about the same time, Dr Hosé d’Almeida submitted similar studies to the Royal Asiatic Society together with some samples of gutta-percha. Early experiments in England with the gutta-were not very successful but in Paris, using Montgomerie’s data, several medical instruments were manufactured.

Once the technology was understood, things moved rapidly and later that year Hancock& Bewley formed The Gutta-Percha Company in the UK. In 1845 Lagrénée returned to France from China and brought with him some gutta-percha which he too had found in Singapore. His named the material “gum plastic”. In the following year we can record the first gutta-percha patent - taken out by Alexander, Cabriol & Duclos for a laminate consisting of three layers: gutta-fabric-gutta. Unfortunately they considered gutta to be akin to rubber and overlooked the fact that its plastic qualities were quite different from the elastic properties of the latter. As with the early days of rubber, it looked as though gutta-percha was not going to be of much use.

However, Gutta-percha had properties which could be exploited and three of these, together with its softening at easily attainable temperatures, provided its three main areas of use until each was superseded by advances in synthetic plastic materials.

The three properties were its hard “plasticity”, its electrical insulating properties and its extremely low coefficient of thermal expansion/contraction. These were exploited in quite different ways; the first in the manufacture of golf balls, the second in the manufacture of telegraph cables and the third in the making of moulds, dies and castings where the final (cold) product was dimensionally identical to the moulded (hot) one. This last area was of considerable importance because of the extreme delicacy and detail which could be included in the mould and then copied by the new “electro-metallurgical” process.

The first gutta-percha golf ball, known as a “gutty” was hand moulded by J Patterson in Scotland in 1845 and was just a smooth ball. Previous balls had been made of wood, then leather stuffed with feathers and these took a couple of hours or so to make. The rapid introduction of metal moulds meant that one person could turn out 10 or more per hour which drastically reduced their cost and was a significant factor in the expansion of the game’s popularity. In the 1860’s it was discovered that cutting groves in the ball improved its flight. Again, this was originally done by hand but by the 1890’s the pattern was built into the moulds. Early in the 1900’s a new ball was introduced which had a core of stretched natural rubber thread and the era of the gutty was over. In 1845 W Siemans suggested gutta-percha as telegraph wire insulant and two years later WH Barlow & T Forster took out a UK Patent for the making of telegraph cables with gutta - percha. In the same year JJ Craven, working in the UK, insulated undersea cables with gutta-percha and in 1849 R & J Dick gave us the first recorded use of gutta-percha as a telegraph cable insulant (in London). The following year they founded R & J Dick Ltd. Gutta -ercha and Balata Manufacturers.

At the same time, J and JW Brett were preparing to lay the first gutta-percha insulated cable from Dover to Calais. In 1850 they made their first attempt, which failed, as did their second the following year. However, they were able to repair this and so began a new era of communication. In 1858 CW Field used the ship “The Faraday” to lay the first transatlantic telegraph cable. This was both insulated and coated with gutta - percha.

Gutta-percha is very stable underwater and the cables lasted many years - it would not surprise me if some still existed today although modern ones are plastic insulated and coated. Indeed, Gutta-percha is very difficult to find today in anything other than antiques. A recent television programme about the history of golf found its researchers scouring the country to find some virgin material. One small sealed tin was eventually found in Hertfordshire and, when opened, it revealed a slab of pale cream pure gutta-percha which had not seen the light of day for many decades. After filming the tin was re-sealed for posterity.

# Gutta-Percha and Golf Balls

Golf balls have changed over the ages as the equipment itself has changed. In fact, the single biggest factor in the change of golf equipment was directly related to the change of the golf ball. When early Scottish players changed from the featherie ball in 1850's to the gutta percha ball. it caused the graceful narrow heads of the long noses to thicken to take the brunt of the rock hard gutta percha balls. The gutta percha ball also increased the popularity of iron clubs. This section features gutta perchas, brambles, square mesh balls, and dimple balls.

# THE GUTTA PERCHA BALL PERIOD

From the Evolution & History Of The Golf Ball (Part 3)

by Leo M. Kelly, Jr.

By the early 1850s Gutta Percha golf balls had made Featheries a collectors' item. The gutta percha golf ball period lasted from around 1848 well into the 1900s. Gutta Percha is a rubber-like material that comes from the dried sap of sapodilla trees of East Asia. The earliest solid gutta balls were formed from pieces of gutta percha heated in water and softened. These first gutty balls were made by rounding the heated material into a ball by hand.

After a few years, metal molds were used. A skilled ball maker could produce six dozen or more gutty balls a day, 25 times what the feather ball maker could turn out. This volume of production caused the price of balls to drop to a cost that middle and lower income golfers could afford. Thus the game of golf was able to attract many new players who had previously been excluded by the high cost of equipment.

Rev. James Paterson of Dundee is acknowledged to have made the first gutty golf ball in 1845. Having done missionary work in Asia, he shipped back to his home in Scotland a statue in a crate containing chunks of rubbery gutta percha used as packing material. Idly fiddling with the elastic substance encouraged him to attempt different methods of fashioning golf balls. When the gutty ball was first introduced it was known at the time as the "Pateron's Patent" and was made to look like a feather golf ball. It had a smooth surface and was engraved with lines to look like the seams seen on a feathery.

Shortly, there were several people perfecting balls made from gutta percha. By 1850, a debate on the relative merits of the gutty over the feathery had caused a rift between the two camps of golf players. In short order, the gutty won and became the standard equipment of play.

Now that there was widespread demand for the balls made from gutta percha, two-piece metal molds were used to fashion the perfectly round spheres. At first, only smooth balls were produced but soon players noticed their shots became more predictable as the surface of the ball roughened from play. This led to the addition of the first surface markings on gutty balls for greater aerodynamic stability.

Robert Forgan, the St. Andrews club and ball maker, is attributed to selling the first balls with surface patterns. Forgan simply held the smooth gutty ball in a mount and indented the surface with the claw end of a hammer. Thus simulating cuts made by an iron golf club. This became the standard marking on golf balls for 20 years and balls from this period are referred to as hand hammered.

By the 1880s, markings were being applied right in the mold. The earliest ball patterns were circular marks radiating from the poles of the ball. These intersecting marks, today are referred to as the fishnet or raised mesh pattern. In the 1890s, dozens of more exotic patterns were devised, including the bramble, a sort of hob nail design, that would remain the most popular pattern even into the early rubber core period.

The number of unique pattern designs numbered into the hundreds. This aspect of variety in gutty ball patterns makes them the sought after collectibles they are today. Circles, triangles, letters, commas, and other geometric shapes, incised or in relief, were all used as marking patterns for gutty balls. Three of the most unusual patterns were Willie Dunn's "Stars & Stripes" flag pattern ball, Alexander Henry's ball with its' spiral rifle grooves, and the "Map of the World" ball with its' relief map of the planet earth resembling a mini-globe.

Producing feather balls was difficult and strenuous, a vocation adopted by only a few men. The ease with which gutta percha could be heated and molded quickly bridged the distance between club makers and ball makers. Now, the average club making professional at a golf club could buy a mold or two and become both club and ball maker, substantially increasing his income. All the important club making professionals had their own brand of ball. By the 1890s there were hundreds of names on the market creating intense competition for sales.

The weight of gutta percha golf balls ranged in pennyweight (troy system) from the lightest of 26 to 31 with a 31 pennyweight ball being the heaviest. These weights approximately convert to today's avoirdupois ounces of about 1.426 to 1.70 (conversion based on 18.23 pennyweight troy equals 1 ounce avoirdupois).

The driving distance for a typical player using a gutty was between 170 and 190 yards with the average being about 180 or a good 30 yards further than a feathery. At the 1899 United States Open Championship, played over the course at Baltimore Country Club, a driving contest was held for the professional competitors. The competition was won by Willie Hoare, who hit his gutty ball 269 yards, 7 feet 6 inches. In 1893 the famous Scottish amateur Freddie Tait drove a gutty at St. Andrews 342 yards. Reportedly Tait's drive was aided by frozen hard ground, but not by the wind. An amateur long driving contest using gutty balls took place in 1898 at the Glenville links, Cleveland, Ohio. The best drive was executed by Mr. Sterling Beckwith, who sent the ball 184 yards and 2 inches.

The hardness of gutta percha balls did not allow them to be cut easily by iron clubs. Graceful, long-headed wooden clubs of the feather ball period could not withstand repeated hits of the hard gutta percha balls. The profile of heads for wooden clubs quickly changed from a thin, delicate neck and shallow face to a thicker, more substantial neck and deeper face. Ultimately, the long-nose was replaced by the bulger with its' shorter, stouter head. These design alterations came about mostly from the change in dynamics required to strike the harder ball.

Gutta Percha balls, when hit, make a clicking sound somewhat like the sound of billiard balls at impact. One way to tell if a golf ball is made of gutta percha is to tap it gently against an iron club head. If it sounds (clicks) like a billiard ball does, it may be a solid gutty. Another way of telling is by its' color; aged gutta percha is a dark brown sometimes almost a blackish brown. A clicking sound or dark color by itself is not enough to tell if a ball is a solid gutty. It could be an early rubber core ball that has a gutta percha cover, so do not depend only on those tests. The most reliable means to verify the construction of a ball suspected of being a solid gutty is to examine it under an x-ray. A solid ball can easily be distinguished from a rubber core ball. A dentist's office is the most practical place to use an x-ray.

Like featheries, gutty balls had several liabilities. Their hardness often did damage to wooden faced golf clubs and made necessary the use of leather, and later fiber, inserts in the club face. The harshness of sound and feel was detested by players resisting change from feather ball play. In very cold weather gutta percha balls became brittle and had a tendency to break up. The problem of the gutty ball breaking up during play brought a rule change to cover this circumstance. The player was allowed to drop another ball next to the biggest piece of his broken ball. In extremely hot weather a gutta percha ball could become soft and would not fly as far as in cooler temperatures. But none of these problems diminished the popularity of gutty balls.

Gutta percha, when molded and cured, was dark brown in color. Gutty balls were painted with ball paint when they were ready to use and after repeated play would require repainting. Having been knocked around a bit, a gutty might have major blemishes, chips or gouges, or even be out of round. When reheated, a gutty ball could be remolded and this attribute created a whole separate industry: ball remaking. Old balls purchased from golfers were remade, repainted and resold for less cost than a new ball. Many of these balls were marked as remakes. Collectors today can find remade balls and also balls showing several layers of paint where a player used his touch-up enamel. This does not diminish from their collectibility but a mint or scarcely played ball with most of its' original paint intact is still the ultimate prize for collectors.

The gutty replaced the feathery because of less cost and better quality. When the rubber core golf ball replaced the gutty it was due to superior driving and playing qualities even though it cost more than twice as much when first introduced.

Rare Circa: 1848-50 Smooth
Gutta Percha Ball

# History of the Atlantic Cable & Submarine Telegraphy

## *The Gutta Percha Company*

by Bill Burns

**Introduction**: In 1950 the Telegraph Construction and Maintenance Company (Telcon) created an exhibition of items made from gutta percha, the material which helped make the company's fortune. Thanks to George Oliver and Jim Jones for supplying these photographs from the 1950 exhibition.

Introduced to Britain in 1843, gutta percha is the gum of a tree native to the Malay Peninsula and Malaysia. At that time there was no application for the material as cable insulation; this would come later. Unlike india rubber, which must be vulcanised to be useful as an insulator, gutta percha is thermoplastic, softening at elevated temperatures and returning to its solid form as it cools. This made it easy to mould gutta percha into many decorative and functional objects, either by pressing the heated material into cold moulds, or by extrusion.

The Gutta Percha Company was established in 1845, and made chessmen, mirror surrounds, tea trays, commemorative plaques, animal figures, inkstands, and even a full-size sideboard, among many other decorative items. Industrial products included machinery belts, acid-tank linings, and tubes. The extrusion machinery used to make the tubes, modelled it is said on Italian pasta machines, was soon adapted for use in wire covering. This technique was used first to insulate landline cables, and later for submarine cables.

After the failure of their first cable in 1850, the brothers John and Jacob Brett laid a successful submarine cable from Dover to Calais in 1851. This used two layers of gutta percha insulation and an armoured outer layer. Gutta percha proved to be an ideal insulator for submarine cables, and as a further benefit for cable use it was found that gutta percha's insulating properties improved under the pressure and temperature conditions of the ocean bed. Gutta percha remained the prime material for submarine cable insulation for over 80 years.

Previous attempts to use gutta percha as cable insulation involved compressing two sheets of gutta percha around the wire, but this left two seams in the insulation. The Gutta Percha Company's tubes were seamless, and proved their value in insulating the 1850 and 1851 cross-channel cables, although the covering process had not yet been perfected. The conductors of the 1851 cable had an irregular coating of gutta percha, which had to be shaved away in places, and suffered from air holes and voids. Nonetheless, the cable was a success, and much additional business followed. Producing cable core became the company's main operation, consuming a significant proportion of the output of gutta percha, imports of which exceeded a thousand tons a year by 1861.

The Gutta Percha Company had few competitors during the 1850s, and supplied the bulk of the cable core in the early years of the industry, including that for the 1857 and 1858 Atlantic cables. By the time of the 1865 Atlantic cable, the company had supplied over 14,000 miles of core for 64 cables, and production of reliable and consistent cable core was routine. One of their major customers was cable manufacturer Glass, Elliot & Company, formed in 1854, which had made many cables, including the 1857 and 1858 Atlantic cables. To meet the financial and engineering demands of the 1865 cable, the Gutta Percha Company amalgamated with Glass, Elliot to form the Telegraph Construction and Maintenance Company. Known as Telcon, this was the first company to be involved in every phase of cable making, from insulating the core to laying the completed cable.

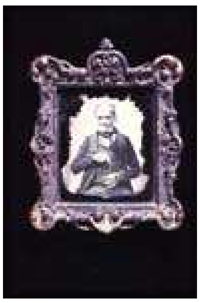
## The Plastics Museum

### Natural Materials

# Gutta Percha

Gutta Percha (GP) was extracted from trees growing in the Pacific Rim countries and was one of the first of the natural plastics to be exploited by man. It is chemically the same as that other tree extract, rubber, but the shape of the molecule gives it different properties.
GP was introduced to the Western World in 1843 by Dr William Montgomerie who sent samples from Singapore to the Royal Society of Arts in London. There it was demonstrated that the material could be moulded after heating in hot water and that it retained its tough state on cooling. Michael Faraday discovered that GP was an excellent electrical insulator and when Bewley invented the screw extruder for GP, insulated wires and cables became a technical and commercial possibility. In 1850 the first submarine telegraph cables were laid and by the end of the nineteenth century over 250,000 miles of GP insulated telegraph cable was in use. This application was to continue for 100 years until replaced by polyethylene.
This entirely new material was soon exploited by a vigorous innovative society. By the time of the Great International Exhibition in 1851 a host of different applications had been found covering so many aspects of Victorian life that contemporary cartoonists made fun of the claims.

A revolution of a different kind resulted from the introduction of GP balls for golf in 1848. Until then feathers encased in leather were used which was very expensive and quickly became unplayable in wet weather. Balls made of solid GP had no such disadvantages and their cheapness and reliable performance was a major influence in the vast expansion of the game in subsequent years.
Although GP is hardly known today, it still is used by dentists to make temporary fillings and together with the almost identical Balata resin, is used in rubber conveyor belting. Its unusual property of not shrinking whilst cooling down exploited by medal die sinkers to test the dies before making metal medals. These GP 'medals' are frequently seen in antique fairs.
In the USA and elsewhere the name Gutta Percha is used to describe any dark coloured Victorian moulding material, from horn to shellac and Bois Durci to genuine gutta percha.



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# Is It Curtains For *Gutta-percha*?

Through a fog of nitrous oxide, I asked the endodontist about the toothpick-like thing he was about to put in my mouth. "That's a ***gutta-percha*** point," replied the doc. "We use them to fill up the root canals after ***Gutta-percha*** we get the bad stuff out of there."

***Gutta-percha***! Images of pith-helmeted British adventurers slashing their way through unexplored jungles in pursuit of vast natural riches filled my humming brain. But...what is this stuff that I will be carrying around in my skull forever? Does it involve some sort of odious guts? Perhaps the guts of birds that perch somewhere?

Not at all. It is a tree sap. Isonandra ***gutta***, a handsome tree native to Borneo, Java, and Sumatra, is tapped to release a milky, rubbery sap that is concentrated to form the wondrous material known as ***gutta-percha***. Here, I thought, was an old material that was still hanging on to a niche market. But I needed to know more, so I poked around a bit. My new permanent lodger has, I am proud to report, a glorious past.

***Gutta-percha*** was a hero of the communications revolution that changed the world when the telegraph was invented. Telegraphy pioneers attempting to link nations via undersea cables were at first stymied by the lack of a suitable electrical-insulating material. Then, in 1843, one Robert Montgomerie sent samples of dark-brown ***gutta-percha*** gathered on the Malay Peninsula to London, where they were exhibited at the Royal Society of Arts.(The name comes from the Malay words for the gum of the ***percha*** tree, according to the Oxford English Dictionary.) Just two years later S.W. Silver & Co. of Stratford developed an extruding machine to coat the stuff onto copper wires. The insulator worked so well that the firm renamed itself the India Rubber, ***Gutta*** Percha & Telegraphy Works Co. and began producing miles of insulated cable. A successful cable was laid across the English Channel in 1851, and other, longer undersea cables soon followed.

At the same time that ***gutta-percha*** was helping to shrink the world through light-speed communications, it was also transforming the sport of golf. In the late 1840s the first ***gutta-percha*** golf balls went into production. They flew farther and cost much less than their feather-stuffed, leather-jacketed predecessors, helping make golf an affordable pastime for more players. Dinged-up "gutties," as they were known, could even be repaired by softening them in boiling water, then squeezing them in a hand press to restore their spherical shape. Gutties put the makers of "featheries" out of business and totally ruled until 1898, when B.F. Goodrich Co. introduced an even better ball made from a rubber thread wrapped under tension around a rubber core, then coated with a rubber skin.

***Gutta***-percha made its appearance in dentistry in the mid-1800s, when it was first used for filling cavities. In their classic endodontics book, Pathways of the Pulp, Stephen Cohen and Richard J. Burns report that in 1887, S.S. White Manufacturing Co. began producing "points" of rolled ***gutta-percha*** for stuffing root canals. The material was valued for its plasticity when heated, which permits it to be stuffed into the odd nooks and crannies that remain after infected tissue is removed by the dentist. And that's how they still do it today, with a material derived from the sap of a tropical tree. The annual market for ***gutta-percha*** in the U.S. is estimated to be $30 million to $40 million, and most of it comes from Brazil, where tappers harvest sap from trees growing in the rain forest. To make points for filling root canals, it is mixed with various waxes, resins, and a zinc-oxide filler.

Having this splendid substance embedded in my head, sealed with a special cement, protecting my once-troubled canals from bacterial assault, made me proud. I felt personally connected to the vast sweep of history and invention. I began to think of ***gutta-percha*** as being in a class with other unimprovable materials like mahogany or granite, stuff that is eternally top-drawer.

That is, until I called up Dr. Gerald Glickman, chairman of the endodontics department at Baylor College of Dentistry in Dallas. "We all want to get rid of ***gutta-percha***," he proclaimed. "Even though it is the closest thing we have to an ideal root-canal filling material, it is hard to work with, and sometimes it still leaks. Developing a better material is what's on the horizon in our specialty." Indeed, the big dental-supply firm Denstply International, based in York, Pa., is working on a synthetic replacement for ***gutta-percha*** that it hopes to introduce in the near future, and so are its competitors.

Say it isn't so, Doc! The final retirement of a storied material with a magnificent name seems too sad to contemplate. Well, it turns out that there is still hope for ***gutta-percha***, thanks to the "hickory hackers," golfing's equivalent of Civil War reenactors. "There's a whole subculture of people in America who play golf with 19th-century equipment," reports Rand Jerris, director of the museum and archive at the United States Golf Association in Far Hills, N.J. "Almost every weekend, someplace in this country, you can find tournaments where people play with hickory-shaft clubs and ***gutta-percha*** balls."

Let's say you wanted to take up hickory hacking. Where could you find some authentic gutties? GlenCall International Golf Ltd. in--of course--Scotland offers balls made in original old-time molds from solid ***gutta-percha*** for £85 sterling per dozen. Damn good. I think I'll have another hit of that nitrous oxide.