

INVENTION

# Vulcanization of Rubber

## "A Classic Invention"

The Inventor, Charles Goodyear, Tells How He Made  
"Gum-Elastic" Into a Material of Thousands of Uses

*GUM-ELASTIC and its varieties, with a detailed account of its applications and uses, and of the Discovery of Vulcanization. By Charles Goodyear. New Haven: Published for the Author. 1853. (A few copies of this book, designed for public libraries, were printed on thin sheets of rubber, and bound in a beautiful, heavily carved binding of the same substance. The U. S. National Museum collection of Goodyeariana contains a copy of this edition. But the inventor in this case was over-enthusiastic for his material, and except in one or two places the pages are hopelessly stuck together.)*

1834

**T**HE INVENTOR commenced his experiments in a small dwelling, mixing the gum by hand, and spreading it upon a marble slab with a rolling-pin. He here also commenced the art of embossing on glazed cambrics. It was now supposed by himself as well as others, that his success in the treatment of gum-elastic warranted his attempts to manufacture the goods.

By the disinterested and timely aid which was gratuitously offered him by a gentleman of New Haven (Ralph B. Steele, Esq.), he was enabled to commence the manufacture on a small scale, pulling and kneading the gum by hand, and spreading it with an iron pin upon a marble slab, as above stated. With the aid of a few hands, he succeeded, among other things, in the manufacture of a few hundred pairs of shoes from the embossed goods, which would even now be considered beautiful.

Being impressed with the idea that the difficulties which were met with in the manufacture of the gum, were attributable to the solvents which were used, he considered himself fortunate at this time to find in the market some forty or fifty barrels of India rubber sap, among which were a number of casks in which the gum had not coagulated. It was said to be kept in that state by mixing a portion of alcohol

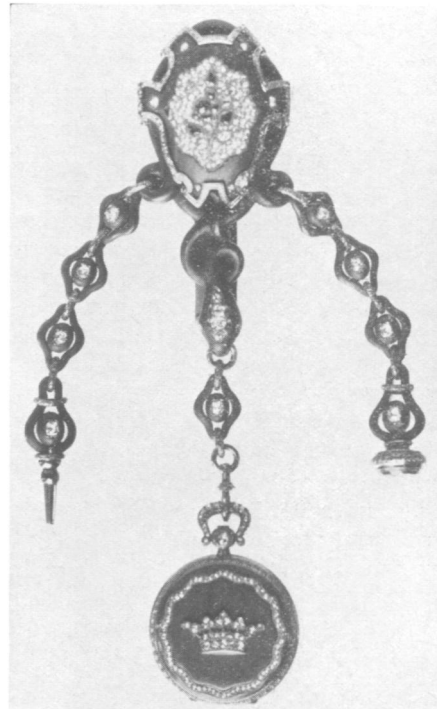
with it, before it was exported from Para. The inventor now hoped to surmount all difficulties by using the sap in this liquid state, if he failed to succeed with other experiments.

A son of Erin, who had been employed to work at the gum, had imbibed the same idea from his employer, and was beforehand in putting it in practice. On the arrival of the barrels containing the sap, he opened one at night, and on meeting his employer at the shop in the morning, Jerry good humoredly signified to him that he had supplanted him, and that a Yankee was not so quick at inventing as an Irishman, at the same time pointing to the trowsers he had on, which he had dipped in the barrel of sap. The job was so completely done, that at first the impression was produced that the improvements were completed, and that experiments with gum-elastic were nearly at an end. Jerry sat down to his labor of mixing gum before the fire, as usual, and on attempting to get up again a few minutes after, he found that he was not only cemented to his seat, but that his legs were cemented together. On being extricated from his improved trowsers, to the no small merriment of the bystanders, he subsequently manifested no further inclination for invention.

This experiment was a convincing proof that adhesiveness was a property which belonged to the gum, and was not the consequence of imperfect manufacture. . .

1838

In the summer of 1838 [the inventor] became acquainted with Mr. Nathaniel Hayward, of Woburn, Mass., who had been employed as the foreman of the Eagle Company at Woburn, where he had made use of sulphur by impregnating the solvent with it. It was through him that the writer received the first knowledge of the use of sulphur as a drier of gum-elastic. Mr. Hayward was left in possession of the factory, which was abandoned by the Eagle Company.



### DIAMONDS SET IN RUBBER

*Goodyear tried using rubber for almost every imaginable purpose, although he doubted that "a material can be adopted for ornaments which is not 'dear bought and far fetched.'" This beautiful watch and necklace are part of a collection exhibited by Goodyear in Paris, and now in possession of the U. S. National Museum.*

Soon after this it was occupied by the writer, who employed him for the purpose of manufacturing life-preservers and other articles, by the acid gas and solarizing processes. About this time the writer purchased the claim of combining sulphur with India rubber, of Mr. Hayward, for which a patent was taken out February 24, 1839. It should be remarked that this claim was for the use of sulphur, and not for the heating or vulcanizing process, subsequently discovered by the writer. . .

1839

At this time, as well as on many former occasions, if the improvement sought for had been one connected with machinery, or one, the prosecution of which depended upon the art of any human being, or upon any amount of capital beyond a few six pences at a

time, necessity would have compelled him to yield; but so long as these could be obtained or hoped for, experiment could be continued, and the discovery made, at it was, in the most humble sphere.

The inventor now applied himself alone, with unabated ardor and diligence, to detect the cause of his misfortune, and, if possible, to retrieve the lost reputation of his invention; and, as had happened on former occasions, he had hardly time enough to realize the extent of his embarrassment, before he became intently engaged with another experiment, and his mind buoyant with new hopes and expectations; which, as it afterwards proved, were to be, for this time at least, more than realized.

While on one of the visits above alluded to, at the factory at Woburn, and at the dwelling where he stopped whenever he visited the manufactory at Woburn, the inventor made some experiments to ascertain the effect of heat upon the same compound that had decomposed in the mail-bags and other articles. He was surprised to find that the specimen, being carelessly brought in contact with a hot stove, charred like leather. He endeavored to call the attention of his brother, as well as some other individuals who were present, and who were acquainted with the manufacture of gum-elastic, to this effect, as remarkable, and unlike any before known, since gum-elastic always melted when exposed to a high degree of heat. The occurrence did not at the time appear to them to be worthy of notice; it was considered as one of the frequent appeals that he was in the habit of making, in behalf of some new experiment.

He however directly inferred that if the process of charring would be stopped at the right point, it might divest the gum of its native adhesiveness throughout, which would make it better than the native gum. Upon further trial with heat, he was further convinced of the correctness of this infer-

ence by finding that India rubber could not be melted in boiling sulphur at any heat ever so great, but always charred.

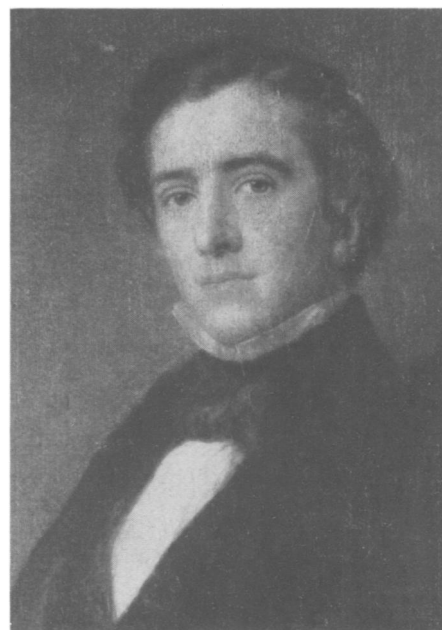
He made another trial of heating a similar fabric, before an open fire. The same effect, that of charring the gum, followed; but there were further and very satisfactory indications of ultimate success, in producing the desired result, as upon the edge of the charred portions of the fabric, there appeared a line, or border, that was not charred, but perfectly cured.

He now removed with his family to Lynn, in order that he might have access to the steam power of Messrs. Baldwin & Haskins, for the purpose of trying experiments in vulcanizing by steam.

A few weeks after, he removed from Lynn to Woburn, where he now pursued his inquiries and experiments for some months quite alone, until the desired result was obtained. On ascertaining to a certainty that he had found the object of his search, and much more, and that the new substance was proof against cold, and the solvents of native gum, he felt himself amply repaid for the past, and quite indifferent as to the trials of the future. . .

#### Nature of the Discovery

The change wrought in the native gum by this process may with propriety be compared to that which is wrought in a perishable skin or hide, by the process of tanning, which converts it into a beautiful kid, or substantial leather; or to that by which the crude ore is changed, by the process of smelting, into valuable iron for man's use; or to that by which iron is changed by the well known process of baking with carbon, into steel. This latter comparison holds good, not only as to the results, but also as to the method, except that instead of carbon, sulphur is used in the baking process, treated of for vulcanizing the gum, which is penetrated by sulphur after it has taken the form of a gas, a high degree of heat being used in both cases. One remarkable fact is exhibited by this improvement, which is an apparent anomaly in chemistry. An article is obtained which is not dissolved without great difficulty, by the best known solvents of gum-elastic, which yet possesses all the valuable properties of the native gum, and many others that the native gum does not possess. It will be readily perceived, that the effect of this process is not simply the improvement of a substance; but it amounts, in fact, to the production of a *new material*. The dur-



CHARLES GOODYEAR

*The man "who has on an India rubber cap, stock, coat, vest, and shoes, with an India rubber money purse, without a cent of money in it," according to the testimony of one of his friends. This portrait of the inventor, painted on a panel of hard rubber, is in the U. S. National Museum.*

ability imparted to gum-elastic by the heating or vulcanizing process, not only improves it for its own peculiar and legitimate uses, but also renders it a fit substitute for a variety of other substances where its use had not before been contemplated. It may, at first thought, appear absurd to compare the durability of an article like gum-elastic, with that of metal or wood, yet it will be found upon investigation, that in consequence of its resistance of corrosion and decay, it is, for certain purposes, far more durable than either of these, as has been found by actual trial. . . . It has now been proved, by several years' experience in its use, that by this discovery, a substance is produced, possessing all the valuable properties of gum-elastic in the highest degree of perfection, without the imperfections pertaining to the native gum, which must have prevented gum-elastic ever being applied to many purposes of great utility, for which, by the removal of its objectionable qualities, it is now made available.

When a new material is in any way made available to the arts and manufactures, it is impossible to set bounds to its application, or to the extent of the benefits to be derived from it.

*Science News Letter, March 7, 1931*

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## ALUMINUM

A Scientific Curiosity

## BORON

The Metal from Borax

Are the Subjects of

NEXT WEEK'S CLASSIC OF SCIENCE

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