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### Amber

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## AMBER.

By PROFESSOR T. M'KENNY HUGHES, M.A., F.R.S., F.S.A., F.G.S.

There are few natural objects that can compare with amber for beauty, for historic associations, and for scientific interest. There are not many things so restfully responsive, so peacefully brilliant, as a collection of polished amber gleaming in the sun, here gathering its light into glowing centres, here reflecting it from small surfaces within, or there transmitting it on to surrounding objects.

The difficulties that hung round its mode of occurrence and the obscurity that enveloped the country where it was found; the fabulous accounts of its origin, and the superstitious beliefs in its virtues; its known electric properties, and the remains of what were once living creatures so strangely enclosed within it—all united to throw a mystery and an additional charm around this beautiful substance.

We can understand why a Roman lady would love to carry a piece of amber about with her to play with. Men throughout eastern Europe now carry a small string of beads, often made of amber, to fiddle with, and, as some have assured me, to assist them in resisting the excessive longing for smoke, which, like sipping sherry or breaking up one's bread at dinner, often originates in the desire to be employed on some mechanical task from a feeling of unrest or fidgets.

The Roman lady, wishing for an excuse to avert her eyes, may have looked down at the play of light in the beautiful object she carried in her hand, may have changed the subject by calling attention to it, and in many ways have found it useful. She cannot have carried it about as scent, for it gives off none at ordinary temperatures, though it forms an important ingredient in incense burning, as, for instance, before the shrine of Mahomet at Mecca, and in the temples of China, where

large quantities of it are consumed. She may have liked the velvety feel of the amber, but it is curious, when one comes to think of it, how few things there are, except articles of dress, that are ever carried about to please the sense of touch, as compared with the number that are kept about one for the gratification of the other senses. In the hot summer of Italy she would perhaps have received more pleasure from the cool relief of holding a piece of rock crystal or carnelian in her hand.

The ancients regarded with interest the strange inclusion of what once were living things in this transparent substance, and attached great value to good specimens of amber with insects in it. But their mythology shows that the derivation of amber from the resin of trees was understood and also its common occurrence in the alluvial deposits of certain rivers. Milton embodies this legend in the lines that tell—

“Of the half parched Eridanus, where weep  
Even now the sister trees their amber tears  
O'er Phaëthon untimely dead.”

But Pope expressed the popular view when he wrote—

“Pretty! in amber to observe the forms  
Of hairs or straws, or dirt, or grub, or worms!  
The things we know are neither rich nor rare,  
But wonder how the devil they got there!”

Bacon<sup>1</sup> more thoughtfully had written, “The Spider Flye and Ant being tender, dissippable substances, falling into Amber are therein buried, finding therein both a Death and Tombe, preserving them better from Corruption than a Royall Monument.”

Lizards are sometimes seen in amber. In the Bath Museum many years ago there was, and there is now in the South Kensington Museum, a piece containing a fish. It is easy to see how the exuding resin, to which insects would so easily stick, would flow round them and the leaves and twigs of the trees. And it is of course possible that the resin may have dropped on to and enveloped a dead fish thrown up at the base of the tree.

<sup>1</sup> *The History of Life and Death*, 283.

Various analyses of amber have been given. According to Schrotter it consists of—

Carbon	..	..	..	78.94
Hydrogen	..	..	..	10.53
Oxygen	..	..	..	10.53
				100.00

As the result of another analysis its composition was found to be—

Carbon	..	..	..	80.99
Hydrogen	..	..	..	7.31
Oxygen	..	..	..	6.73
Calcium	..	..	..	1.54
Alumina	..	..	..	1.10
Silica ..	..	..	..	0.63
				98.30

At 287° it melts and is decomposed, yielding water, an organic oil, and succinic acid. By cooking it for forty hours in an iron vessel covered with sand or boiling it for twenty hours in rape oil, amber will become transparent and pieces can be moulded and stuck together. By boiling in turpentine pieces of amber can be softened so that they can be kneaded together or moulded into any form. By mixing equal parts of turpentine and rectified spirit of asphalt and boiling slowly until the mixture becomes thick a kind of amber may be produced. The clouded light yellow mouthpieces for pipes are nearly all made from a composition prepared in some such manner, and known in the trade as amberoid.

This makes us a little suspicious of queer and exceptional specimens and has given rise to the suggestion that the ancients had some method of making it plastic and to a certain extent, at any rate, soluble, because the size of the vessels recorded seems to be so much greater than they could turn or cut out in any way from the pieces of amber likely to have been available.

It may be, however, that some of the pieces which are recorded to have been found were large enough to have

yielded any of the vessels referred to. In the great store brought back to Rome in the time of Nero, there was one lump weighing thirteen pounds, and others are on record weighing eleven pounds, eighteen pounds, or even twenty-two pounds.

One large amber bowl found in a tumulus in Ireland suggests many thoughts. Ireland was from very early times within easy reach of Baltic and North Sea traffic, and amber was an article of value and therefore of barter among the ancient Britons. Was this bowl then carved out of a solid lump of amber, or were the Irish of that age acquainted with the not very complicated appliances required for reducing amber to a plastic state, or is it a made-up thing imported by merchants from the Far East, and exchanged perhaps for Irish gold?

Objects carved in amber have always been much valued. The material is soft and requires care and delicate manipulation, but when finished it is very beautiful from the play of light and colour in it. Mounted with a foil at the back, it can be made to resemble most of the precious stones which have a red or yellow tint. Pliny records especially how well amethyst can be imitated in amber.

Some think that light is thrown upon the origin of the diamond by the constitution and mode of occurrence of amber, giving as a series amber, jet, anthracite, carbonado, diamond.

There is considerable range of colour in amber, as may be seen in the collection which I exhibit this evening,<sup>1</sup> but the colours may be grouped under a very few heads. There is the opaque, light-yellow, or straw-coloured variety, known as "fat amber" from its resemblance to the fat of beef. This is sought after for mouth-pieces for pipes. There is a honey-coloured transparent variety; another like dark sherry, which is the one referred to when we speak of "amber" as a colour, as in "amber ale." This was probably the colour of the old Falernian wine which was compared to amber and may be the chryselectron of Callistratus. Another we may compare to treacle or golden syrup. Then we have the

less common ruby-coloured amber with its still more rare variety which has a blue tint pervading it, like the bloom on a plum.

Amber has long been regarded as one of the most important articles of commerce for the purpose of tracing trade routes. It was thought that practically it might be considered an almost exclusively Baltic product, and indeed that is very nearly true at the present time. There is not much brought into the market from any other source.

The earliest historical notices point to the Baltic as the source of amber. From an Assyrian inscription of the tenth century B.C. it has been inferred that Asiatic caravans following the river valleys crossed Russia in Europe to seek for amber. The merchants of the Eastern monarch gathered it, they said, on the shores of "the seas where the Lesser Bear is in the Zenith," so that they could no longer shape their course by it.

If we may accept the interpretation of this inscription given by Oppert,<sup>1</sup> it pretty well settles the question as to whether the electron of Homer was really amber or an alloy of four parts gold to one of silver. These Asiatics visited the Baltic before the time of Homer and before the Milesians and the travellers of whom Herodotus speaks, and they certainly did not go there for gold and silver.

It is dug out of a bed full of decayed trees which occurs along the eastern shores of the Baltic from Memel to Dantzig, among strata of sand and gravel now referred to the Oligocene. It is supposed that similar beds occur within reach of the waves somewhere along the coast, as large quantities of amber are thrown up on the shore after storm. The forest must have grown over part of the area which is now covered by the Baltic Sea and have extended through Lithuania and Pomerania into Poland and Moravia.

Owing to its small specific gravity it is easily carried by currents over a shallow sea bottom or along the shore, and it is accordingly found not only on the South Baltic Coast, but also along the shores of Sweden, Nor-

<sup>1</sup> Oppert, Professor J., *L'Ambre* *Journal Officiel de la Republique Francaise*. Delaunay's *Revue Historique*, 1881, p. 1862.

way, and Denmark. Professor Heer discovered it in Heligoland. It is dredged up in the North Sea, and occasionally picked up on its shores, but to what conditions and what age its occurrence in this area may be referred is not so clear. There may be, or may have been, some nearer source of supply, or its transport may belong to the period when the Baltic had more open access to the North Sea.

The frequent mention of Ligurian amber was thought to indicate that it was obtained along the Riviera. But no source of supply has been found in that region, and this difficulty was got over by the suggestion that there was some port of export and import in the Gulf of Genoa from which the amber was spoken of as Ligurian. This was not, however, quite satisfactory, as the distinctive title implied some difference in the quality of the substance obtained from Liguria, which perhaps was not amber at all.

Then it was observed, that amber had for ages been gathered from the alluvial deposits in the basin of the Simeto and of the Salso, washed down, of course, from the Tertiary deposits that lap round the flanks of Etna. It is carried by these rivers, and by the Gioviatta, out to sea, and then washed up along the coast near Catania and Licata and the ruins of the ancient Morgantium. It has been found in a brownish grey porous sandstone mixed with lignite at Calascibetta and at Castrogiovanni.<sup>1</sup> This is probably a decomposed calcareous rock of Tertiary age. It has been suggested that Sakal, the name used by the Egyptians for amber,<sup>2</sup> was only a mispronunciation of Sikel, the people or land from which they brought it home.

But the conditions were very different in the two regions. The amber procured from the Baltic was found in the partly submerged debris of an ancient forest or washed out from that into the sea, whereas in Sicily it was found in the alluvial deposits of the Simeto, or recently thrown up on the shores near the estuaries. The Sicilian amber was generally much darker than that from the Baltic, and it was in Sicily only, as was

<sup>1</sup> Buffum, pp. 13, 21.

<sup>2</sup> Pliny, *Nat. Hist.*, xxxvii, 2, 36.



then supposed, that the red-tinted amber was found. It was therefore thought to be still quite a safe inference that trade with the Baltic was proved by the occurrence of any of the pale ambers in the Mediterranean region.

It is a very curious fact that Diodorus Siculus, who was born on a part of the island which has since his time yielded large quantities of amber, should make no mention of its being found in Sicily; he says it is found only on the shores of the island of Basilia beyond Gallia, opposite Scythia.

Perhaps the island of Basilia meant the promontory of Samland, or may have included the strips of low ground which run from near Königsberg north to Memel, and south almost to Dantzic, and which, with the Kurische Haff and the Frische Haff behind them, would probably be taken for an island lying off the coast of the ancient Scythia. An island in the mouth of the Neva at St. Petersburg is now known as Wasiliev. Indeed, Basil or Vasil is so common a name in Russia that one is inclined to speculate upon the possibility of its being an old Scythian place name perpetuated by its fitting into royal names of later date and different origin. There is no difficulty in the statement that Basilia was *beyond* Gaul, because the trade route from the Western Mediterranean was through Gaul, as, to a traveller by the long sea route, India is *beyond* the Cape of Good Hope.

Amber is found not only in the Baltic and in Sicily, but in many other places, though not often in workable quantities—in the Adriatic, for instance; in Switzerland near Basle; in France, in the Departments of Aisne, Loire, Gard, and Bas Rhin. In Italy it used to be found in the basin of the Po. Amber of somewhat the same character as that of Sicily is said to have been found in Roumania and on the Lower Danube. It occurs in the London clay near London, in the Cambridge greensand near Cambridge, in the brown coal of Alsace and Austria.

Dana records its having been found in the greensand of the United States, generally in lignite or marl, or washed into more recent soils. He mentions the localities Gay Head or Mather's Vineyard near Trenton,

Camden in New Jersey, and Cape Sable near Magothy River in Maryland; on Judith River in Montana and at Harrisonville in New Jersey. It has been found on Lebanon, and is recorded from Syria, India, and Madagascar. But there is some doubt about some of the localities from which amber is said to have been procured, as it is not always easy to distinguish the true fossil resin from some of the more recent gums which closely resemble it, while in some of the old descriptions it is evidently confounded with other substances—ambergris, for instance.

North Burmah yields considerable quantities to the markets of the East, especially to China, and Armenian merchants distribute it, from whatever source it can be obtained by them, through Egypt, Persia, China, and Japan, in all which countries the demand is greater than the local supply. It occurs along the north coast of Siberia, as far as Kamschatka, and Professor Heer has found small grains of it in the coal-beds of Greenland, where he thinks it may be a product of the sequoia which grew there in early Tertiary times.

Professor Milne<sup>1</sup> records that in some of the Tertiary beds of North Nipon lumps of amber up to a foot in diameter are found. Some are cracked and opaque, while others are transparent and free from flaws, and many contain remains of insects. He does not, however, mention whether there is any evidence that this has at any time been an important source of the amber of commerce.

This wide distribution shows that there must always be some doubt as to the origin of any isolated specimens found among ancient works of art, unless we can make out some distinctive features of constant occurrence and permanent character between the specimens obtained in the several different localities.

In an interesting series of articles on amber, Professor Conwentz maintains that the amber of these various countries, or some of them, can be distinguished by the proportion of succinic acid they contain and suggests distinctive names. Succinite, from the Latin name, he

<sup>1</sup> *Catalogue of the Minerals, etc., in the Geol. Depart. of the Impl. Coll. of Engineering, Tokio, 1880, p. 71.*

assigns to the Baltic amber ; Simitite to that from the Simeto ; and Burmite to that from Burmah.

Even if we could feel sure of the results of the analysis of such small quantities and small number of examples, there does not seem to be any advantage to be gained by multiplying names for varieties of a common substance, when so little is known as to the differences which are due to the varieties of tree from which the resin was derived, to the differences of age and climate, and, more than all, to the differences of texture and composition which are superinduced by the mode of preservation of the specimen.

Moreover, succinite, one of the names suggested, had been already used by Berzelius in another sense, namely, for one of the constituents of amber which is insoluble in alcohol, but which in combination with small proportions of two other resins, isomeric with succinite, but soluble in alcohol and ether, goes to make up common amber.

With a view to making out whether there are any marked characters belonging to either, by which the origin of isolated pieces could be determined with any confidence. I have been collecting evidence from the North Sea and from Sicily. For some of my Catanian specimens I am indebted to my friend the Marchese di Gregorio. But I have procured the ruby-coloured amber from the North Sea and all the paler varieties from Sicily. In the North Sea the honey and sherry-coloured amber is by far the most common, and ruby-coloured specimens are exceedingly rare. In the Catanian amber, on the other hand, the darker tints prevail, and a large proportion of the amber beads worn by the peasantry of Sicily are of a syrup or ruby or plum-bloom colour.

In illustration of this point I exhibited at a soirée of the Royal Society a small collection containing ruby, syrup, sherry, and honey-coloured amber both from the North Sea and from Sicily. If the chemical composition follows these two markedly different colours, the ruby and the yellow, then we must give up the identification of Baltic and Catanian amber by that test.

The quantity of really ancient amber objects, about which this question could be raised, is so exceedingly small that there might be anywhere a dark red bit from

the North Sea brought in the course of trading operations to the Mediterranean or *vice versa*, but the chances are against it. No precaution on the part of collectors could guard against an accident of that sort, save rejecting all specimens not procured directly from the amber-bearing stratum. My specimens were purchased with a number of others, sold by weight or in a lot, no attention being drawn to any difference of colour, and no additional value being attached to the darker varieties in the case of those found on the shore or dredged up in the North Sea, or to any of the variously coloured specimens in the case of those procured from Sicily.

Taking such evidence for what it is worth, it shows that colour, which is the most obvious and constant character by which the varieties of amber may be distinguished, is not a sure test of the district from which amber has been derived, as I have procured all the varieties both from Sicily and from the North Sea. Some of this difference of colour may have existed in the original resin, owing to the different species of tree from which it was derived or some difference in the conditions of exudation. Anyone who has collected gum from conifers and from cherry trees will know that there is some variety in the shades procured from the fir trees, but that most of it is of a light colour, whereas there is a greater variety in that which is obtained from cherry trees, and much of it is of a darker colour than the average of that from the firs.

There was a great variety of trees in the ancient Baltic woodland which bore a considerable resemblance to the North American forests of to-day in the general character of its flora. Goepfert has determined no fewer than one hundred and sixty-three species among the plants found in amber. Nearly a hundred species of trees and shrubs are recorded from it. He distinguished thirty species of pine, to which Menge has added one more. There were also yews, junipers and cypresses, oak, willow, poplar, birch, and beech and alder and the camphor tree; also ferns, mosses, funguses, and liverworts. There is likely to have been some original difference in the resin exuded, seeing that there was such a variety of trees, as is proved by the fragments of twig and leaf which

were blown on to its sticky surface or on to which it dropped.

Flaws in amber do not always detract from its charm. On the contrary, in many cases the light reflected from the surface of the flaw, as sometimes from the "feather" in quartz, adds greatly to the brilliancy of the specimen and throws back iridescent flashes of great beauty. When these flaws are numerous, small flakes appear glistening throughout the transparent body of the amber and produce somewhat the effect of aventurine. Sometimes when larger they have been mistaken for fish scales.

But when the surface of the amber is exposed to strong vicissitudes of temperature, as when the sun is allowed to shine full on the case where it is displayed, heating it up when it passes across and allowing it to cool as suddenly when it disappears, the exterior of the amber by the rapid expansion and contraction becomes covered all over with very minute cracks, and if this process is allowed to go on long enough it becomes opaque. In all amber that has been exposed to what is called weathering of the exterior, whether above ground or in the soil, this is the condition of the surface. It is covered all over with minute flaws which have all to be ground away before the specimen can be polished. It is not clear what the exact process is by which this result is arrived at in so many different circumstances, but it is evident that when this condition of surface has been produced, the specimen must be much more susceptible of chemical changes affecting the colour and proportion of succinic acid.

When, however, we have regard to the very different conditions under which the amber has been preserved in the two areas, there is room for suspicion that the mode of preservation may have much to do with its different character. I have some pieces of amber found in an Etruscan tomb at Monte Ottone, in the province of Marche, associated with objects in bronze and iron, one piece of the amber having an iron pin passing through it with traces of a bronze mount at one end. This amber is all of a dark syrup colour with a tinge of ruby here and there in the larger fragments. The character and distribution of the colour in relation to the exposed

surfaces suggests in this case that it has been superinduced since the fashioning of the ornament into its present form.

I have also some amber beads from a Saxon grave near Mildenhall, in which the same colours and relation of tints may be observed. In this case the presumption is very strong that it is an example of yellow North Sea or Baltic amber changed to a rusty red colour, with sometimes a more rosy tint within, by the conditions to which it has been subjected since it was fashioned into ornaments. These beads were buried round the neck of the dead body, and they have therefore been exposed in an exceptional manner to the action of organic acids.

There is therefore much to suggest that this oxidated hydrocarbon may be changed in time under the influence of hydrating or oxidizing agents, and that the chemical composition and colour may be thus affected.

This has been inferred from the condition of the surface of amber objects found in graves the dates of which can be approximately ascertained.<sup>1</sup>

More conclusive evidence that this darker colour is due to a superinduced change in the condition of the amber is offered by a specimen in my possession which has a uniform dull ruby tint to a small depth, while the interior is still of what we may infer was the original light yellow colour.

There was probably the same range of colour in amber as is found in the gum of various trees to-day; but however that may be, it is certain that changes in the condition of amber have been produced by its mode of preservation, which have in many cases caused it to become darker in colour; and therefore colour is not a sufficient test for the discrimination of the sources from which pieces of amber have been obtained; nor can the chemical analysis of small fragments or of a small number of examples of pieces of amber be relied upon to enable us to determine the region from which isolated specimens have originally been derived.

<sup>1</sup> Cf. Buffum. *The Tears of the Heliades, or Amber as a Gem.* London Sampson Low, 1896.