Acta zoologica cracoviensia, **46**(suppl.– Fossil Insects): 411-421, Kraków, 15 Oct., 2003

Amber Imitations in the Warsaw amber collection

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Received: 30 Jan., 2002
Accepted for publication: 31 March, 2002

KOSMOWSKA-CERANOWICZ B. 2003. Amber Imitations in the Warsaw amber collection. *Acta zoologica cracoviensia*, **46**(suppl.– Fossil Insects): 411-421.

Abstract. Celluloid, polystyrene, polyesters (styresol), phenol-formaldehyde resins as bakelite (known as African amber), novolac, resole resins, casein plastics (galalite) were studied.

Key words: amber, copal, artificial resins, forgery inclusions, amber imitations collection.

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I. INTRODUCTION

Illustrations of forged amber inclusions appear in the mid 18th-century work of Nathaniel SENDELIUS along with the description of inclusions in the Dresden amber collection of Augustus II the Strong.

Forgery remains a problem to this day and goes well beyond the counterfeiting of inclusions. Nowadays it is possible to come across both goods made of imitation amber as well as forgeries of natural amber nodules.

Without the appropriate equipment and without carrying out even the most straightforward of analyses (the cheapest being Infrared Spectroscopy) identifying the imitation material itself is very difficult. Only the most popular and well-known imitations, such as necklaces made of formaldehyde and casein (galalite) can be easily recognised with the naked (and experienced) eye. Nor is it always possible to identify natural amber (succinite) using the simplest methods, as these cannot be applied to all products.

A c k n o w l e d g m e n t s. The author is grateful to the owners of amber imitation goods, who put these pieces at her disposal, especially Ms. Emma KUSTER, Family Gabriela and Wiesław GIERŁOWSKI and Mr. Marek TROCHA. Ms Barbara GOSTYŃSKA has kindly translated the manuscript.

II. IMITATIONS OF THE NATURAL RESIN

Prior to the appearance of artificial resins, imitations of amber were made from copal – a natural subfossil resin, which occurs abundantly in many varieties throughout the southern hemisphere.

Copal was used either on its own or with powdered amber and pieces of amber melted into it to improve its fragrance when burned. Originally, items made of copal were not lacquered as they are nowadays, hence they were dirty in appearance and became tacky when held, quickly losing their shine.

The debate as to what should be classified as copal and what as a fossil resin is still ongoing. Age is frequently cited as the key criterion. There are those who believe that copal dates from between five and ten million years ago, thus acknowledging the existence of Pliocene copal. Others claim that copal is no more than one million years old, the earliest examples thus coming from the Pleistocene era.

The absolute age of some pieces of copal from the Warsaw collection has been determined by radiocarbon dating (KOSMOWSKA-CERANOWICZ et al. 1996).

Copal lends itself well to making forgeries, although the production process has to be somewhat altered due to the fact that it has a lower melting point than amber.

	Softening point	Melting point
Amber	150-180°	300-380°
Copal	150°	180-250°

Copal is colourless, though its outermost surface is often darkened as a result of weathering. It is aged by subjecting it to a loamy environment in order to achieve a pale yellow or pale brown colour. Nowadays, copal products are lacquered to improve their sheen and increase their resistance to mechanical wear. Yellow and brownish lacquers are used most often.

Though natural organic inclusions do occur in copal, they are also frequently artificially set in this substance.

The best way to determine whether an item is made of copal is to observe its reaction when rubbed with a piece of cotton wool soaked in ether (sometimes even acetone will be enough). The treated area takes on a matt appearance or may even adhere to the cotton wool. When exposed to ether in the same way amber (succinite) will only display minor changes on its surface after a period of about two weeks.

The most common varieties of copal take their names either from the place where they are found or else from the trees which produced them as for example: B r a z i l i a n c o p a l and A f r i c a n c o p a l derives from broadleaf trees of the tropical family Leguminosae. Copal from Tanzania and the Congo is sometimes referred to as A f r i c a n a m b e r. Similarly, Colombian copal is also spoken of as amber. C o p a l f r o m M a n i l a derived from coniferous trees of the species *Agatis alba*. The genus *Agatis* belongs to the family Araucariaceae, which is a flora common only in the southern hemisphere. Kauri copal is a resin of the species *Agatis australis* (LANGENHEIM 1995).

III. IMITATIONS OF THE ARTIFICIAL RESIN

Analytical research into artificial resins, which is still ongoing, was made possible thanks to the collection compiled at the Museum of the Earth in the 1950s by Zofia ZALEWSKA (custodian in 1958-1974). This collection comprises about 80 specimens and is one of the largest currently held in any Polish museum. It is of great significance both as a research collection and in terms of its exhibition value.

Analysis has not yet been carried out on every item within this collection. Interest in it has only recently been aroused by the growing number of forgeries, which have appeared on the market, particularly among the raw materials being offered to amber-workers.

Based on their thermal behaviour the artificial materials used for making imitation amber can be divided into two groups: **thermoplastics** and **duroplastics**. When heated, thermoplastics repeatedly soften at around 250°C. Duroplastics (thermosets) are a group of polymers (plastomers), which undergo irreversible changes when they set.

Celluloid is also referred to as antique amber. Celluloid is made from nitrocellulose and camphor (hence the characteristic smell when heated) or acetic acid (acetylocellulose) combined with colourants. This type of imitation is easily recognised by its scent and by the large flame it emits when burned. Density c. 1.5. Very easily mouldable. It belongs to a group of natural product substances. It was originally used as a substitute for ivory and later, from 1900, as an imitation of amber.

The post-war era in Poland saw a radical decrease in its popularity as an alternative to amber. More recently, however, forgeries both of raw material and inclusions have emerged which display some of the qualities of celluloid. They do not, however, smell of camphor and do not produce a distinct flame when burned. The IR curve of celluloid is similar to the curves of natural product substances (Fig. 1).

Information available from 19th-century literature about the production of celluloid (KLEBS 1888) is disheartening, to say the least. Celluloid made its debut in 1869 when the brothers HYATT of Newark, New York, began manufacturing it employing a simple technological process involving the use of waste cotton, paper and wood, which had first to be bleached and then pulverized. Factory production of celluloid in the USA began in 1872. Powdered fibre (cellulose) was treated with nitric acid and saltpetre to produce gun cotton. This was then washed thoroughly and dried having had 40–50% camphor and colorant added to it. Subsequently, this material was subjected to high pressure in a hydraulic press at 70°C. With the help of added absorbers celluloid, or amberoid as it was known in France, could be used to produce all manner of goods, such as surgical dishes, combs, billiard balls, photographic film and many others. The fact that it could be readily dyed made it easier to produce imitations, not only of amber, but also of coral, malachite and lapis lazuli.

Celluloid was translucent, hard, flexible, scratch-resistant and similar to horn. If carefully heated to 100°C it could be moulded. Highly flammable, it burned quickly with a smoky flame and exploded if heated to 140°C. The addition of anti-explosive substances did nothing to reduce this reaction. Using cigarette holders, pipes, or baby's teething rings proved to be toxic. Camphor was also harmful to human health. KLEBS (1888) wrote that celluloid jewellery and smoker's accessories reached a market of m i l l i o n s and deserved to be t r e a t e d w i t h g r e a t c a u t i o n by the public.

Polystyrene is obtained through the polymerisation of styrene. It was first made in 1838 by E. SIMON, after which production of it commenced in Germany in 1930 and later in the USA. Some varieties are soluble in benzene and toluene. Other commercial names of this material include Distrel, Trolutol and Trolitul. As wrote SHEDRINSKY (SHEDRINSKY et al. 1999), polystyrene "did not provide a transparency resembling that of real amber" and in consequence the forged amber inclusions are not prepared in this substitute. For the remembrance: polystyrene in nature, which has been named Siegburgite, is also opaque (KOSMOWSKA-CERANOWICZ 1999).

Polyesters – these are produced by the polycondensation of multifunctional alcohols with multicarboxylic acids. Polyester first appeared on the market in 1942-47, though it had already been in existence since 1936. Some types of polyester dissolve in acetone, chloroform, 4-methylene oxide and in benzene.

Polyester consists of 25-40% styrene, thus infrared curves obtained for this material are similar to those of polystyrene. The REICHHOLD company produced polyester under the name Styresol (Fig. 2). In Russia this polyester is used in the manufacture of small items of jewellery (the Museum of the Earth's collections include a Styresol yellow bracelet), whilst attractive sculptures made of

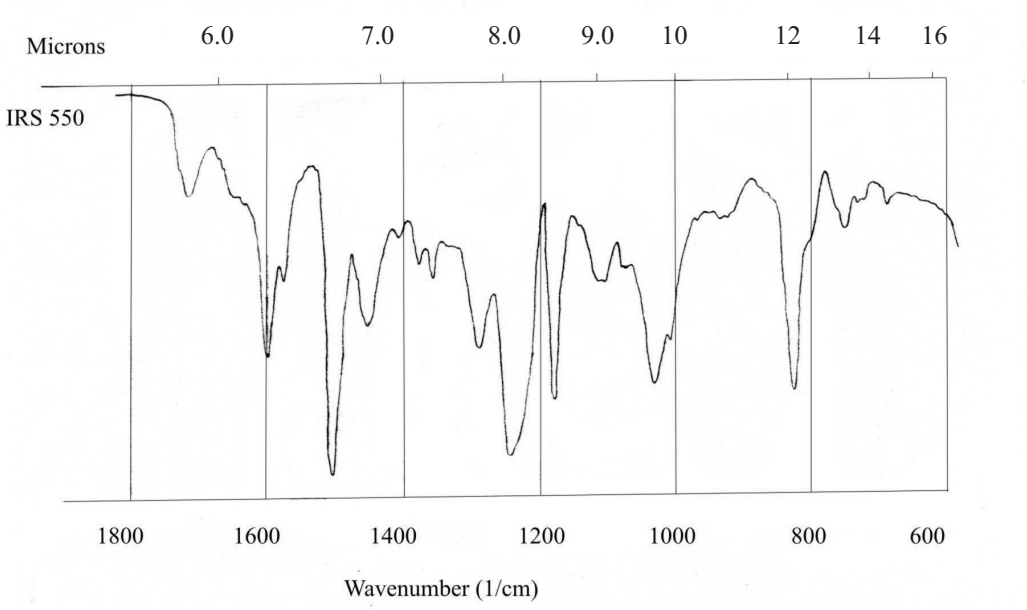

Fig. 1. Infrared absorption spectroscopy curve obtained for a forged lizard (from BACIĄG collection), possibly of a celluloid group (IRS MZ 550).

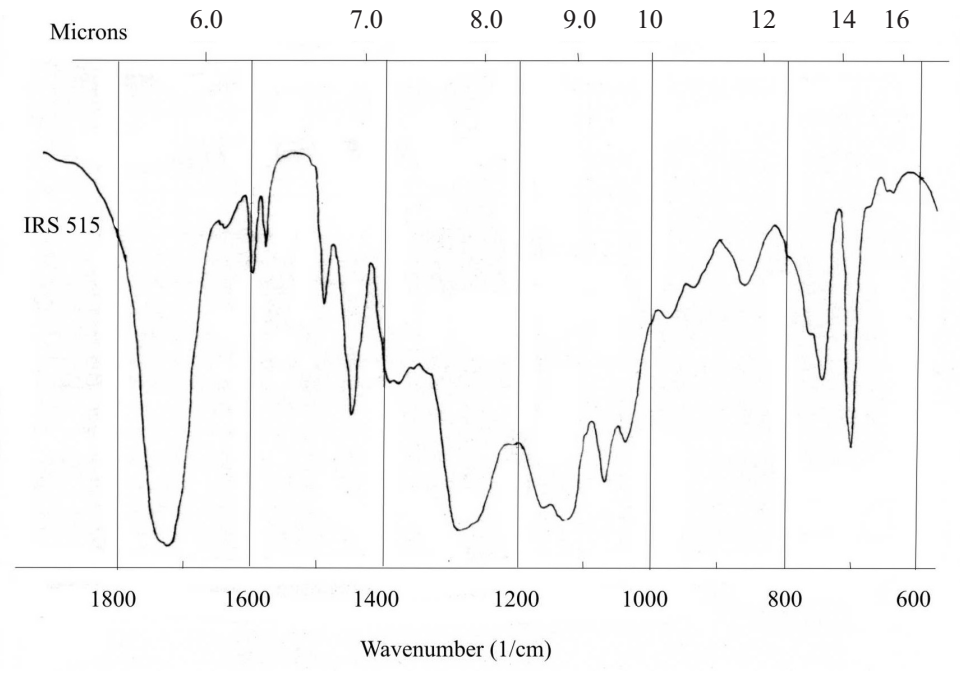

Fig. 2. IR curve of a polyester peach from Emma KUSTER collection: styresol (IRS MZ 515).

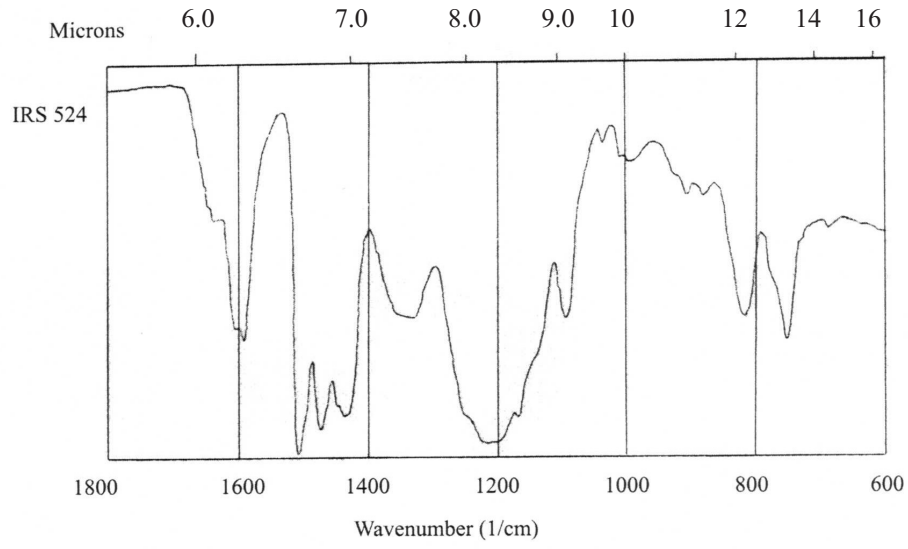

Fig. 3. IR curve of novolac obtained using infrared absorption spectroscopy (IRS MZ 524). The analysed burgundy-coloured bead purchased in Marrakech (Inv. no. 3339).

the same material, imitating aged yellow red amber, can be found in the West (analysis – IRS 515, Fig. 2.) was carried out at the Museum of the Earth on a sculpture (belonging to the Amber Museum in Bad Füssing, Germany). The collections of Łomża Museum include a Styresol nodule, which was proffered as amber. Occasionally, nuggets of Synacryl, which has a similar IR curve to that of Styresol, are also offered for sale.

PHENOPLASTICS. These are synthesised by the polycondensation (creation of macroparticles from monomers) of phenol and formaldehyde. The earliest phenoplastics were already in production by 1872, when it was discovered that phenol reacts with aldehyde to produce resins. Manufacture on a technical scale began in 1907-1909.

B a k e l i t e was introduced by the State Königsberg Amber Manufactory as a cheaper alternative to amber (which it eventually out-rivalled!), in the 1920s. Bakelite from Africa (as used in the famous African necklaces) is known as African amber. Other names for this product include urea-bakelite or in England: beetle.

Available Bakelite powders, i.e. mixtures suitable for pressing, consisted of 30-60% resole, or novolac with added fillers to make it less brittle (e.g. wood pulp) and colorants. Resistance to mechanical wear was improved by the addition of asbestos(!), whilst stone dust, graphite or chemicals were used to increase its heat resistance.

The Museum of the Earth has two novolac necklaces, both transparent, one dark red and one burgundy in colour, a number of single beads and a nodule purchased from private individuals as 19th-century amber “antiques” (Fig. 3).

Resole resin – this cast resin (also known by the names katalin and trolon) is used for making jewellery. It can be dyed and polishes well, displaying good transparency. Resole was used at the

State Königsberg Amber Manufactory as well as in some of Gdańsk's workshops during the post-war period (KWIATKOWSKA 2001).

The Museum of the Earth owns over ten examples of this material, mostly in the form of small panels intended for the production of ornaments from the Amber Artefacts Factory in Gdańsk-Wrzeszcz dating from 1957. An African necklace purchased in 1973 as a specimen of natural African amber also proved to be made of resole. Analysis revealed that a nugget offered for sale to the Łomża Museeum was also made of resole resin (Fig. 4).

AMINOPLASTIC RESINS are synthesised by the condensation of urea and formaldehyde.

Galalite: from the Greek words meaning milk and stone. It is also referred to as artificial horn. This substance is produced by condensing caseine (1890) (a component of milk, which reacts with acid to produce curd) with formaldehyde. In England it was manufactured from Irish milk. In 1934 there were 55 trade names for this product. Density 1.32–1.39.

Thus far, two galalite necklaces from the Museum of the Earth's collections have been examined, one of them black, the other greyish-yellow (Fig. 5). Both consist of round beads and were purchased at the Amber Artefacts Factory in Gdańsk-Wrzeszcz in 1957.

Infrared absorption spectroscopy analysis of the imitations listed yields curves, which are characteristic, though not identical, for each variety of material. This is understable given the different proportions of components used in their production.

Analysis of new examples of imitation amber appearing on the market produces IR curves, which often necessitate the study of large quantities of comparative materials. The most important is atlas of polymers, resins and additives (HUMMEL & SCHOLL 1969). This research can at times prove fruitless, as there are often no existing models for newly created artificial resins.

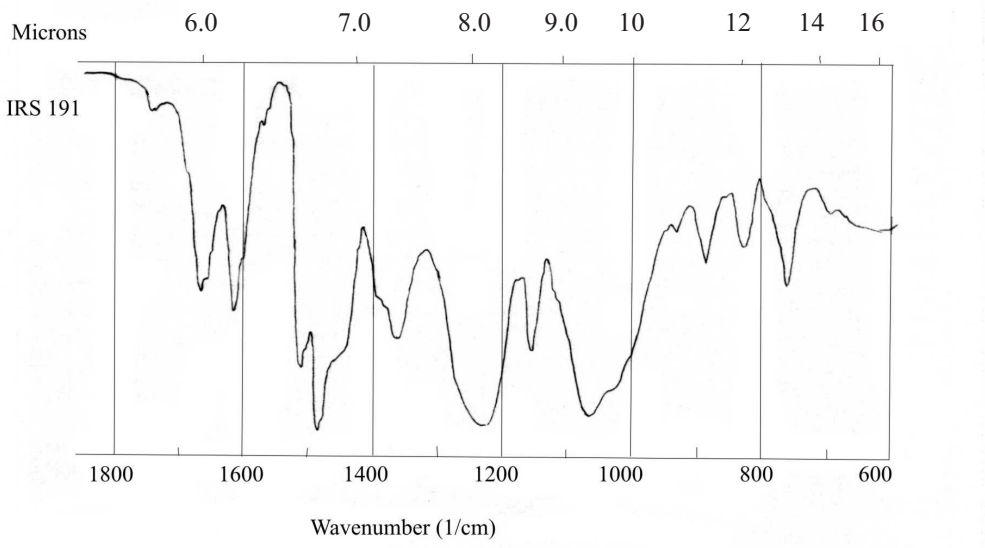

Fig. 4. IR curve of resole resin. The analysed yellow coloured nodule from Museum in Łomża (Kurpie region) (IRS MZ 191).

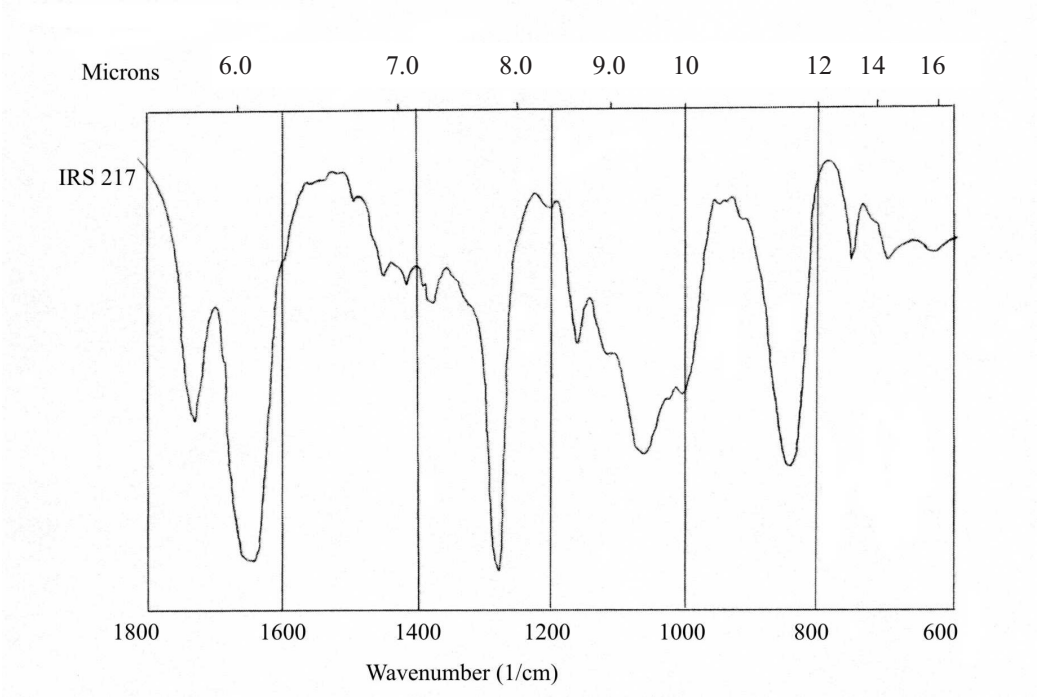

Fig 5. IR curve of unidentified artificial resin (IRS MZ 217). An old "amber" bead from Egypt "from the tomb of Pharaohs" has been analysed.

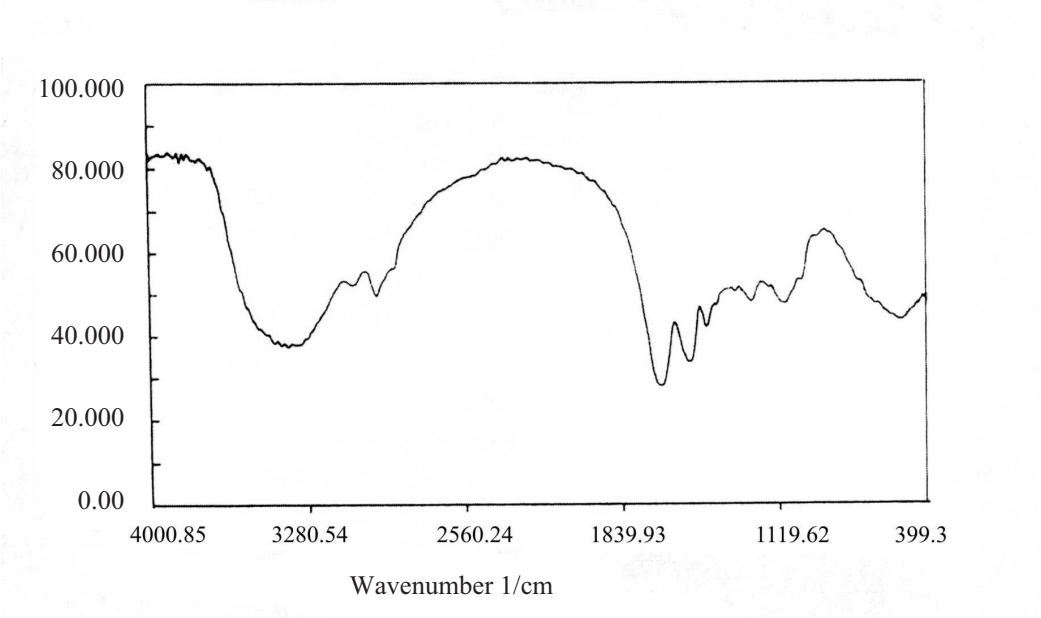

Fig. 6. IR curve of galalite from a necklace (Inv. no. MZ 1841a) obtained using infrared absorption spectroscopy carried out by A. GOLLOCH of Duisburg.

Table I

List of the source materials: *IRS according to prof. GOLLOCH from Duisbourg; ** the name of Art Magazines in Poland, *** The beads have been collected from Persian villages and country towns. True Natural Amber is highly treasured in Persia but very seldom available. Mostly it is Copal mixed with plastics and seldom with Burmese amber. According to the Prophet prayer beads should be made out of Amber. These beads were collected by an American engineer who worked in Persia and in his free time he went to the countryside to look for amber in many small villages and cities. He had collected more than 100kg when the revolution forced him to leave Iran (after E. KUSTER)

Inv. No MZ or owner	Description of samples	Provenience	From where, from whom, year of donation or purchase	No of MZ IR[S [G IRS]*	Group of imitation	Art. of imitations
159	bead „olive", yellow-red		donation, 1954	[25]	phenol-formaldehyde resin	resole resin
205	a lump, yellow-orange	old Göppert collection	Wrocław Univ. donation, 1954	542, [29]	copal	
235	necklace, cherry		Ełk, purchase, 1955	[14]	phenol-formaldehyde resin	novolac
239	necklace oliwe, crystal cut, dark-red		Trębicka, purchase, 1956	[14]	phenol-formaldehyde resin	novolac
271	brooch, yellow, "flowers"		Wrzeszcz, shop, purchase, 1956	546	?polyester - like	
593	raw, plate, yellow, 6x4 cm	Amber Artefacts Fact. Gdańsk Wrzeszcz	purchase, 1957	[25]	phenol-formaldehyde resin	resole resin
594	raw, plate, red, 5.5x3 cm	Amber Artefacts Fact.Gdańsk Wrzeszcz	purchase, 1957		phenol-formaldehyde resin	resole resin
595	raw, plate, red, 5.5x3 cm	Amber Artefacts Fact. Gdańsk Wrzeszcz	purchase, 1957		phenol-formaldehyde resin	resole resin
596	raw, plate dark-yellow, 5.5x3.5 cm	Amber Artefacts Fact. Gdańsk Wrzeszcz	purchase, 1957		phenol-formaldehyde resin	resole resin
597	raw, plate, yellow, 6x4 cm	Amber Artefacts Fact. Gdańsk Wrzeszcz	purchase, 1957		phenol-formaldehyde resin	resole resin
598	raw, plate yellow-cherry, 7x1.6 cm	Amber Artefacts Fact. Gdańsk Wrzeszcz	purchase, 1957		phenol-formaldehyde resin	resole resin
599	raw, plate cherry-brown, 6.3x1.6 cm	Amber Artefacts Fact. Gdańsk Wrzeszcz	purchase, 1957		phenol-formaldehyde resin	resole resin
600	raw, plate black	Amber Artefacts Fact. Gdańsk Wrzeszcz	purchase, 1957		phenol-formaldehyde resin	resole resin
1837	ear-rings, yellow	Amber Artefacts Fact. Gdańsk Wrzeszcz	purchase, 1957		phenol-formaldehyde resin	resole resin
1839	necklace, balls, „old"	Amber Artefacts Fact. Gdańsk Wrzeszcz	purchase, 1957	[17]	phenol-formaldehyde resin	resole resin
1841	necklace, balls, dirty yellow	Amber Artefacts Fact. Gdańsk Wrzeszcz	purchase, 1957	[18]	aminoplastics resin	galalite
1841a	necklace, balls, black (Fig. 6.)	Amber Artefacts Fact. Gdańsk Wrzeszcz	purchase, 1957	[16]	aminoplastics resin	galalite
1844	necklace, balls, yellow	Amber Artefacts Fact. Gdańsk Wrzeszcz	purchase, 1957	[22]	phenol-formaldehyde resin	resole resin
1879	figurine fish, yellow		Gdynia, purchase, 1958		phenol-formaldehyde resin	resole resin
2036	necklace, red, 48.5 g, old		Desa**, purchase, 1958	[20]	phenol-formaldehyde resin	novolac
2044\2	cigarette holder, dark-cherry		purchase, 1959		phenol-formaldehyde resin	novolac?
2057a	brooch "rose"	?State Königsberg Amber Fact.(1926-1945)	Kulczycka (Łódź), purchase, 1958	545	phenol-formaldehyde resin	resole resin
2057c	brooch, yellow-green	State Königsberg Amber Fact.(1926-1945)	Kulczycka (Łódź), purchase, 1958	[26]	phenol-formaldehyde resin	resole resin

Table I cont.

Inv. No MZ or owner	Description of samples	Provenience	From where, from whom, year of donation or purchase	No of MZ IRS [G IRS]*	Group of imitation	Art. of imitations
2157\1	lump	Sobieszewo-Jantar, form the beach	Domaradzki, purchase, 1960	[10]	colophonium	
3338?	bead „old", yellow-brown	Marrakesh	Zalewska, donation, 1968	523	phenol-formaldehyde resin	resole resin
3339	bead, cherry (Fig. 3.)	Marrakesh	Zalewska, donation, 1968	524	phenol-formaldehyde resin	novolac
3344	plant in "amber"	Kadela, Gdynia	purchase, 1968	562	?celuloid	
3359	a lump, light-yellow, 45g		Karnawalski, purchase, 1968	543, [24]	copal	kauri
3496	dragon fly in "amber"	Paris	Zalewska, donation, 1968	561	copal	
3516	"raw amber", lump with patina, red	Sieradz, or vicinity	Fortini, purchase, 1968		phenol-formaldehyde resin	novolac
3586	necklace, orange-yellow		Warsaw, purchase, 1970	[15]	phenol-formaldehyde resin	resole resin
3587	necklace olive, cherry coloured		Desa, purchase, 1970		phenol-formaldehyde resin	novolac?
3805	necklace kegs, cherry-brown, 99.9g.		purchase, 1970		phenol-formaldehyde resin	novolac?
3874	necklace, olive,cherry-red		purchase, 1971	42	phenol-formaldehyde resin	novolac?
7551	"raw amber", a lump with patina, red	„excavated in Pomerania"	Zalewska, donation, 1972	522	phenol-formaldehyde resin	novolac
8297	necklace with masks, brown	Africa	purchase, 1973	43	phenol-formaldehyde resin	resole resin
10928	Diptera in an "amber" pendant	Hippel. Gdańsk-Orunia, 1975	purchase, 1975	563	?	
MZ	model of natural form of resin, brown		Kasprowski, Opole, purchase	473	phenol-formaldehyde resin	resole resin
MZ	bead, yellow	from big Persian collection***	Kuster(Germany), donation, 1990	253	phenol-formaldehyde resin	resole resin
MZ	lump			544, [28]	phenol-formaldehyde resin	resole resin
MZ	bracelet, yellow-white	Russia	donation, 1991	311,[30]	polyester	
MZ	crumb	Klesov (Ukraine) from borehole	Srebrodolski (Lvov)	116	natural ?celuloid	
MZ	crumb	Klesov (Ukraine) from borehole	Srebrodolski (Lvov)	115	natural ?celuloid	
mus.coll.	fragment of lump	old Göppert collection	Wrocław Univ.	257	phenol-formaldehyde resin	novolac
mus.coll.	lump	"found" in Surowe	Museum in Łomża	376	polyester	styresol
mus.coll.	lump (Fig. 4.)	"found" in Wach, 1989	Museum in Łomża	191	phenol-formaldehyde resin	resole resin
mus.coll.	peach with snake,cherry, black flakes (Fig.2.)	purchase in Peking, China	Kuster, Amber Museum, Fürstenzell	515	polyester	styresol
priv.coll.	fragment of lump	"found"	Loriński, private collection	106	polyester	synacryl
priv.coll.	necklace, dark-red, olive, cristal cut	"old"	Ajnenkel, private collection	554	phenol-formaldehyde resin	novolac
priv.coll.	fragment of amber-like lump	Russia	Trocha, private collection	541	?celuloid	
priv.coll.	forgery of lizard (Fig. 1.)	"found on the beach"	Baciąg, private collection	550	?celuloid	
priv.coll.	forgery of lizard	Polish-Russian firm "Family" in Gdynia	Gierłowski, private collection, 2001	533	?celuloid	
priv.coll.	bead, dark (Fig. 5.)	Egypt	Drozd, private collection	217	?similar to the IRS 563	

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Figs 7-8. Forgery of lizard in amber. The lizard has been placed on the natural amber (the under part) and covered by the artificial resin (upper part; IRS 533: celluloid group). The border is visible on the photo 8. (Private collection). Phot. G. GIERŁOWSKA.

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