

Determination of genuineness using the thermoluminescence method ("TL") on cast cores of African bronze objects ¹:

Not an Illusion !

by Ralf Kotalla "Laboratory Kotalla - Haigerloch, founded 1979

It is possible based on practical experience and work on approx. 800 African "bronze" objects to allocate old casting work to various ages and determine work performed in modern times.

1. Basis

The determination of genuineness fulfils two necessary imperatives of scientific dating methods (absolute dating):

1. A process with *constant speed* must take place, the reaction speed should not depend on external conditions or environmental influence.
2. The *reaction* must take place at the time of manufacture of the object being dated.

The "TL" method requires for this purpose the cast core of the bronze object - a clay which comprises quartz and feldspar which was heated by metal flowing into the casting mould, the geological TL is however, eliminated - zero position. The elimination of the geological TL is the required *reaction*, the process of a *constant speed* is the result of the annual new inflow = "annual dosage" of energy to be stored until the time of measurement - test day - of the energy accumulated since manufacture = zero position! The TL method determines therefore the final time of heating which is usually the time of manufacture.

Demands for exact scientific dating not only of cast cores but also of customary terra cotta from collections, trade and museums are extremely difficult to fulfil in practical work as the site of discovery and its specific environmental factors and their measurement parameters can no longer be reconstructed to calculate the age exactly!

The "authenticity test with limited dating" whose result refers mainly to material-internal effects of inner radioactivity and thus requires a wider range of interpretation, suffices fully to recognise modern age work and to allocate work to varying ages.

Due to the widely used "TL" in the meantime, we renounce on giving an account of the physical basis of the "TL". The present level of knowledge can be found in *Aitken* (1985) in detail or in *Goedicke/Henschel* (1994) - Possibilities and limits of dating methods on bronze objects.

¹ Copper-tin alloys are defined as "bronze". African metal objects contain mainly zinc so that "brass" would really be the correct term. Lead and tin are to be found in African alloys which is the reason for keeping to the term "bronze" as ethnological literature mainly uses this term and thus avoids confusion.

2. Conditions

The age of a "bronze" object can be determined indirectly when a cast core of fired clay (-with Benin max. 80% partly blackened quartz+feldspar due to wax) is found for a TL analysis. The direct relation of the age to "bronze" is possible when this cast core is connected with the manufacture = casting procedure = *reaction*.

If the cast core originated directly from the "bronze object", the determined age is also the age of the object as far as the last heating as manufacturing process is concerned, irrespective of the subsequent external *changes* whether natural or unnatural. (Cleaning, touching up, restoration etc.).

The determination of whether the cast core belongs to the object, is the responsibility of the sampler whose experience and thoroughness in taking samples is fundamental. Manipulation by attaching old cast cores or pulverised clay must be determined and proved. (Details in Chapter "Practical experience").

3. Experience in applied practical work

a. Tested objects - sample sites - sampling - sampled amount -

Over the last 21 years, I have been presented with approx. 1100 African "bronze objects" for performing a TL analysis. (Frequency ratio: 1. Head plates, 2. Pendant figures 3. Receptacles)

In approx. 300 objects no cast core material whatsoever or too low amounts of usable cast cores were found. Of the approx. 800 examined objects, 20 % proved to be geologically contaminated and therefore could not be evaluated.

According to my practical experience, the claim that in open plates, pendants and commemorative heads no core remains² are to be found, must be contradicted. (This also refutes the holdings of the Berlin Ethnology Museum which at the present time has approx. 372 objects of this type of which over 300 objects have adequate cast cores. Also in the Ethnology Museum in Dresden and similar museums there are sufficient examples to refute this claim).

The sampling sites are in some cases not easily accessible. The cast core material must be removed near to the wall. With larger cores, it should be noted that due to their poor thermal conductivity characteristics despite a cast temperature of approx. 1000 /C , there is a risk that the geological TL was not eliminated thus making classification impossible.

The sampling amounts which are removed for performing the authenticity test, are around min. 40-100 mg so that a careful processing of samples and at least one measuring sequence with 10 measurements per sample can be realised. This relatively small sampling amount can be carefully removed from the smallest pores of the wall, e.g. corners, edges, folds.

Contaminated samples give an unnatural curve diagram when measured with an age which is probably too high or geological.

² O. Langevin "Determining the age of metals": An illusion? Tribal art 2000 II.

In the case of pulverised clay used to fake terracotta objects (of corresponding age!), experience made by the laboratory in question, shows that this can be detected without doubt using the natural TL curve diagram.

Old cast core of the same age used for faking!?! This does not have the same resistance and incrustation to the metal surface as a natural cast core.

If this resistance is produced by adhesive/bonding agents, this can be reliably proved by the FT-IR Fourier-Transform infrared analysis. The scanning electron microscope and the EDX (Energy dispersive x-ray analysis)

also provide proof.

- b Does the TL analysis require stylistic specifications ?

N O !!! See point 1. and 2 on the demands on scientific absolute dating/determination of genuineness !

On the contrary: The stylistics of African bronze sculpture require the specifications of the TL analysis, if one can believe *Willet* 1983 who determined that "the history of Nigerian sculpture still has an episodic character" Duchateau, 1989, Eszra 1992; Eisenhofer 1998 confirm this estimation by extensive work on Benin "bronze casting".

Knowledge gained from experience (Langevin - Tribal Art 2000/ II), that the large part of "bronze objects" offered on the African art market are not old, must be "*examined individually*" and not generalised based on stylistic specifications which are not reliable.

Absolute neutral analysis results must be taken into consideration for stylistic determinations.

- c. Accuracy - Tolerance

Accuracy based on practical work on approx. 800 African objects and approx. 400 Asian and numerous European bronze objects, can be determined as being

Approx. 100% "New or old"

Although the age tolerance of approx. +/-25-30% as regards the determined overall age is acceptable due to the usually unknown circumstances of the site of discovery and the missing measurement data on site and their replacement by interpretation variants, so-called mean values. This allows stylistic considerations a natural scope. (300 years +/- 75 = 1625-**1700**-1775 a.d.)

The risk that the smallest geological remaining amounts see a recent signal with a "fictitious age" in the range of 100-1100 years, is according to my experience in the range of 2-4 per mil. This possibility only applies to so-called extremely small sampling amounts around and under 40 mg.

- d. Independent further scientific examination methods of "bronze" objects

Quoting references, so far, such as "*Craddock*" or "*Werner*" and their examination methods as a possibility for determining genuineness and dating, represent an outdated standard which is recognised as a standard examination but which is supplemented by **contemporary**, more highly sensitive **analysis equipment** and their use and which are far more convincing.

The latest **Patina examinations** - since 1997 - with e.g. species determination, correlating, highly precise element analysis, data base-supported molecule spectroscopy and atom spectrometry provide adequate scientific statements on proving the genuineness of "bronze" objects.

Riederer 1994 - genuine and false - gives detailed insight into the multitude of analysis possibilities and provides impartial interested parties with extensive information.

- e.: Final summary - personal concern

Thanks to *TL analyses* as the only possible absolute way to determine genuineness/dating methods on cast cores and *the newest metal and patina analyses*, it is possible, to provide references for developing reliable stylistics and dating of the ancient cultures of Africa - e.g. Nigeria.

Traditions in cultures south of the Sahara were only provided orally and not in writing (documents from that age which could be used for stylistics and reasoning of same are virtually all missing). Here is the possibility of placing methodical standpoints of ethnological circles, knowledge and experience gained from trade and scientific methods on a moderate "**ethnological, practice-related scientific**" foundation. I am aware that it is impossible to unite all competitors when one-sided interests and ignorance block the readiness to solve future tasks with new methods.

As far as my work with thermoluminescence is concerned, I would be grateful if open discussions could take place on this difficult topic and cooperation surmount existing barriers. This would strengthen each individual position and would not lead to individual spheres or areas of responsibility becoming superfluous.

It goes without saying, of course, when in individual cases, analysis results are doubted, that the entire examination result is questioned. The obvious reaction in such cases is to speak to the relevant expert before the validity and accuracy of proven analytic methods are questioned and it is alleged that these are no good. As an example, I would like to present the argumentation on the use of old pulverised clays for manufacturing entire objects which today can be recognised as such or the influence of sacrificing metal objects to the patina growth process which is also recognisable. Those who ask experts about this problem will find them willing to pursue this matter and answer relevant questions.

The basis for a scientific/technical application of an analysis method remains the neutral approach to the object without giving consideration to the mercantile environment.

Betr.: TL-Analysen on objects „Kunst aus Afrika „
Museum für Völkerkunde München M.Keckskézi

TI.Nr.:	Objekt			Alter
010135	Platte mit Krieger und Speer	Inv. 99.7	S.74	340 Jahre +/- 70 J.
010137	Figurengruppe mit zwei Leoparden	Inv. 11.2	S.70	370 Jahre +/- 70 J.
010136	Kopf König	Inv. 98.40	S. 68	290 Jahre +/- 85 J.
010133	Platte mit zwei Kriegern	Inv. 99.6	S. 75	340 Jahre +/- 90 J.
010134	Platte mit Leopard	Inv. 99.8	S. 178	500 J. +/- 150 J.

bedarf aber einer zweiten Gegenprobe von hinten, zur Absicherung, da sehr schwierig !!

Die vorgefunden Festigkeit der Gusskernproben , Kurvendiagramme , Alterswerte (neu – „alt“)
+ einer Datierung mit entsprechenden Toleranzen stehen im absoluten Einklang mit den gemachten
Erfahrungen von ca 1200 Objekten auf dem sog. freien Markt.

Literatur:

Aitken M.J.

1985 Thermolumineszenz Dating , London

Craddock, Paul T.

1985 Medieval Copper Alloy Production and West African Bronze Analysis

Duchâteau

1989 Benin , Kunst einer Königskultur , Paris

Eisenhofer

1998 “Ein Übermaß an Autorität” Neue Folge 119 ÖÖ -Landesmuseum Linz

Ezra , K.

1992 Royal Art of Benin , The Metropolitan Museum of art , New York

Goedicke/Henschel

1994 Zur Chronologie der Berliner Benin-Bronzen , Möglichkeiten und Grenzen
naturwissenschaftlicher Datierungsmethoden Baessler Archiv bd 41 Heft 2 Berlin 1994

Riederer , J.

1994 Echt und Falsch , Schätze der Vergangenheit im Museumslabor
Berlin, Heidelberg , New York

Werner , O.

1970 “Metallurgische Untersuchungen der Benin-Bronzen des Museums für Völkerkunde Berlin “

Willet F. und Eyo. E.

1983 Kunstschätze aus Alt-Nigeria , Mainz