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# Innovations That Failed to Materialize: Why Was There No Copper Metallurgy in the Central European Early and Middle Neolithic?


## Summary

In this paper we propose a sociological concept of innovation capable of transcending the limitations faced by the approaches of common theories of action. The concept was formulated by Ulrich Oevermann and is based upon Max Weber's theory of charismatic authority. We apply this concept to archaeological data, using the example of Neolithic copper metallurgy in central Europe, and discuss the importance of analyzing innovations that failed to materialize even though they might have been "in the air" at the time. The concept sketched here enables the scientific study of such a phenomenon.


Keywords: Innovation; charisma; neolithic; copper; metallurgy; theory of action; Max Weber.

In diesem Beitrag wird zum einen ein soziologisches Modell von Innovation vorgestellt, das die handlungstheoretischen Beschränkungen der gängigen Innovationstheorien zu überwinden vermag. Dieses von Ulrich Oevermann entwickelte und auf dem Charisma-Konzept Max Webers basierende Modell applizieren wir exemplarisch auf archäologisches Material zur neolithischen Kupfermetallurgie Mitteleuropas. Dabei wird zum anderen der Blick auf ‚ausgebliebene' Innovationen gerichtet, das heißt auf solche, die gewissermaßen ‚in der Luft' lagen, aber nicht verwirklicht wurden. Auch diese Phänomene lassen sich mit dem hier vorzustellenden Modell differenziert betrachten und einordnen.

Keywords: Innovation; Charisma; Neolithikum; Kupfer; Metallurgie; Handlungstheorie; Max Weber.

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## 1 Charisma and the Emergence of the New: A Sociological Innovation Model

We apply the term 'innovation' in the following in a broad sense, encompassing the three phases traditionally distinguished in technology research. One is *invention*, in other words, the development of a new concept (further differentiable according to the psychology of creativity), another the *innovation* in the narrow sense, meaning the realization of such a new concept, and finally its *diffusion*, which overlaps with the establishment and spread of an innovation.[1] Patent law narrowed down these ideas further and produced the impression that an invention is a necessary precondition for any innovation. However, this is not necessarily the case, and Joseph Schumpeter already pointed out that an innovation is "any 'doing things differently' in the realm of economic life".[2] This can include an invention, but can also consist of a simple recombination of known factors.[3] In our paper we want to present and test through application to an example a sociological model that differs from others in one particular respect. It places emphasis on the objective course of innovation processes rather than on acting subjects.

The investigation of the formation and development of 'the New' in the social sciences is burdened by a legacy of practice theoretical approaches.[4] Practice theories evolved out of the notion of a rational, linguistic, and actionoriented subject. This outer layer of rational intentional action is in fact thin and superficial, and all other elements of action appear as irrational. Such supposedly irrational social phenomena turn into residual "unanticipated consequences of purposive social action", also called "latent functions".[5] Robert K. Merton, who coined these terms, demonstrated the magnitude of their significance and tried to conceptualize them in the framework of a theory. The development of this theory from a subjective-intentional to an objective-structural-analytical perspective can be traced back to both of his central works on *Unanticipated Consequences* from 1936 and the *Manifest and Latent Functions* from 1949.[6] While the later text analyzed the objective functions of the unintentional and objective rationality in social practice, the viewpoint of the practicing agents that dominated the earlier text

1 For the three phases cf. Ropohl 2009, 258–261; Max Eyth summarizes "the conception of the idea, its incarnation and finally its dissemination and use" (Eyth 1919, 245. – Translation by authors) under the heading "invention".

2 Schumpeter 1939, 84; for a political economical reduction of the innovation concept to economic usability cf. Röpke 1970, 75.

3 Schumpeter 1939, 87–88; for differentiation of invention and discovery, cf. Machlup 1961, 280–281.

4 Another legacy is that of social constructivism as represented in the field of sociological innovation research in the concept of SCOT ("Social Construction of Technology") by Trevor J. Pinch and Wiebe E. Bijker (cf. Pinch and Bijker 1987; Bijker 1995).

5 Well illustrated in the listing of 150 consequences of the introduction of the radio in the USA Ogburn and Nimkoff 1964, 571–587), or a compilation of the social consequences of the transition to irrigated farming by migrant farmers in Madagascar (Rogers and Shoemaker 1971, 334 Abb. 11.2). Only for a fraction of these consequences can we assume an intentional background.

6 Merton 1936; Merton 1968.

describes "unanticipated consequences" as simple mistakes. While the intended is comparatively easily identified in empirical research, it is much more difficult to categorically classify the realm of objective results. This is why theories that try to accomplish this often resort to metaphors such as "the invisible hand" (Smith), the "cunning of reason" (Hegel) or "*Das Sein bestimmt das Bewußtsein* – being determines consciousness" (Marx).[7] In order to appropriately shed light on the field of innovation, it must be subject to a change in perspective: the "latent functions", as they are described in Oevermann's model of innovations, must be moved from the periphery of a practice-theoretical approach to the center of a structural analysis. Even if the content of 'the New' cannot be anticipated, its processes of formation and distribution include a regularity that serves as a background to a reconstruction of the substantially unforeseeable as indirectly motivated. The New cannot be grasped in such practice-theoretical terms as 'rational' and 'irrational' because it appears in light of previously prevailing routines and scales of rationality as irrational but will prove itself via the chances of future practical trial as rational. This also applies to industrially planned innovations, for which developmental failure in the market is minimized with great effort but cannot be completely excluded.[8] What then constitutes the specific quality of the New between rationality and irrationality, where the quality that caused a new phenomenon that is not in accordance with prevailing rationality is still given the chance to practically prove itself? And to prove itself without an anticipation or warranty of its potential later rationality? Resorting to a central concept of Max Weber,[9] Oevermann identified this quality as *charismatic*. The concept of charisma can be dislodged from Weber's comparatively limiting use in a sociology of power and religion and inserted in a universal intrinsically logical model of innovation. In this connection, it is irrelevant whether the charismatic quality is a substantial element of the New or merely a successful staging of it.[10]

Five phases of this process can be analytically identified:[11]

1. The difference of the New from the existing routine must be distinguished; it is either obvious, or it must be made acceptable through a process of recognition.

7 In the field of innovation research, Jochen Röpke drew attention to the importance of an investigation of the unintended consequences of actions: Röpke 1970, 67–74.

8 For the 'failed innovations' neglected by innovation research cf. Braun 1992; Bauer 2006; insightful case studies can be found in Schneider 1989 (screen text); Lindgren 1990 (the difference engine and precursor); Knie 1994 (rotary engine); for 'camouflaged' innovations cf. Jung 2015.

9 Weber 1968, 1111–1157.

10 "Charisma may be either of two types. Where this appellation is fully merited, charisma is a gift that inheres in an object or person simply by virtue of natural endowment. Such primary charisma cannot be acquired by any means. But charisma of the other type may be produced artificially in an object or person through some extraordinary means" (Weber 1968, 400).

11 For the systematic background and detailed description of this model cf. Oevermann 1991; Oevermann 1995.

2. The rationality of existing routines must become questionable and appear as problematic in the light of the New.

3. The New must be seen as a potential solution to the emerging problem, a solution that is credible enough to be given the chance to prove itself.

4. This credibility must go hand in hand with the formation of a kind of followership that testifies to its credibility.

5. In the case of standing a practical test, the New in turn becomes routine and establishes new standards of rationality.

The generalization of this process, as abstract as it may seem at first, allows the overcoming of the undialectical dualism "of irrational, accidental and mutation-like change on the one hand and a completely rationally developed invention on the other hand".[12] Basic concepts of Oevermann's model are charisma, crisis and standing a test. They open the possibility for a genuine sociological approach to a complex of innovations. To avoid any misunderstandings: the concept that is discussed here is neither a derivative nor a variant of the instructive, empirically-based model of innovation diffusion of Everett M. Rogers and F. Floyd Shoemaker.[13] Three aspects of this model seem to us problematic that are also central differences to Oevermann's model. First, Rogers and Shoemaker reduce an examination of innovations to the processes of their communication, and, what is more, to a limited and one-sided transfer of information.[14] As a consequence, their disregard for the real qualities of the New or that which is touted as the New, leads them to a model in which the decision of whether something is an innovation or not is left entirely in the hands of acting individuals.[15] Second, this reductionist perspective implies that phenomena of appropriation[16] and redesigning of the New, in their own

12 Oevermann 1995, 50. – Translation by authors.

13 Rogers 2003; Rogers and Shoemaker 1971.

14 It is only logical that the title of the second edition of Rogers' basic work on *Diffusion of Innovations*, the one written with Shoemaker, is *Communication of Innovations*. This book states concisely: "Communication is the process by which messages are transmitted from a source to a receiver" (Rogers and Shoemaker 1971, 23).

15 "An innovation is an idea, practice, or object perceived as new by an individual or other unit of adoption. […] If an idea seems new to the individual, it is an innovation" (Rogers 2003, 12).

16 On different theories of appropriation, see Hahn 2011. Röpke has already pointed out the importance of appropriation as an "act of property seizure" in exploring innovation-induced cultural change: "The diffusion of radical innovations is slow. This process of adoption of innovations by mixing, fusion, 'métissage', the recombination of previously unconnected elements, can be called syncretism. Since syncretism amounts to the 'essence', the basic process of an adoption of innovations in a situation of acculturation, we can interpret it as an acculturation accelerator. Syncretism is the 'ideal process' of acculturation" (Röpke 1970, 88. – Translation by authors). However, Röpke understands such a formation of syncretistic compromise merely as a stage in a process that ends in extensive acculturation.

right often a source of innovations, cannot be adequately covered.[17] Third and finally, Rogers and Shoemaker evaluate practices of individuals who are confronted with innovations by ultimately applying standards of abstract rationality.[18]How can models of innovation such as the one by Rogers and Shoemaker be transferred to archaeology? Any such attempt leads immediately to a central problem of the archaeological disciplines. However, this is a problem that is constitutive of archaeology and must not be seen as a deficit: the genesis of innovation can be reconstructed when a preceeding constellation, the boundary conditions, are known; in contrast, archaeology has to start with an already materialized innovation in order to then investigate the preceding conditions that led to its realization. Normally that is impossible, as one cannot infer from a knowledge of a factual innovation any corresponding needs for a specific object or a necessity that has been invented. As explained above, such a need could have been produced *post hoc* by the already existing innovation, in light of which existing practices could have become suddenly questionable. But this would not have been perceived as such prior to that innovation.[19] Therefore, what can be researched through this model's application to archaeological evidence is primarily the process of dissemination and routinization of the New.

With Oevermann's innovation model and its rejection of a rationalistic practice theory, the direction of the question is reversed. Not only successful innovations require an explanation, but also the withdrawal of an innovation. An example for the latter process is Noel Perrin's[20] account of the 'extinction' of firearms in Japan in favor of the traditional sword. Equally in need of explanation are innovations that did not take place, in particular those that stopped only a small step before their realization, or those for which only a simple link between already existing phenomena would have been necessary. Below, we discuss such a 'non-happening' innovation,[21] the non-advent of metallurgy in early and middle Neolithic central Europe. The needed technological and

17 The use of this model might be self-evident for the explanation of the distribution of objects that have their own communicative properties. Ursula Eisenhauer's study on Middle Neolithic pottery styles of the Wetterau is such a case. It is based on the assumption "that ceramic styles (ornamentation) are a medium of communication that transmits information about the identity (group membership) of its users" (Eisenhauer 2002, 127. – Translation by authors). The model of Rogers has also recently been used for the reconstruction of the development of copper metallurgy in the Sinai (Pfeiffer 2013).

18 Rogers 2003, 232.

19 Expressed in the terminology of systems theory: "Preadaptive advances are achievements that can be developed and stabilized in the context of an older order type, but which occur only after further structural changes to the system in their final function. Preadaptive advances are as it were solutions to problems that do not yet exist" (Luhmann 1978, 433. – Translation by authors).

20 Perrin 1979.

21 Cf. also Marie Louise Stig Sørensen's remarks on the "ignored" innovation of iron in late Bronze Age Scandinavia (Sørensen 1989). Based on a study by Edward Wellin, Rogers also presents at the beginning of his investigation the case study of a 'missed' innovation, the failure of a health care campaign during which the inhabitants of a Peruvian village were to be convinced to drink only boiled water (Rogers 2003, 1–5; based on Wellin 1955).

logistical grounds for the development of metallurgy were present but clearly did not suffice to initiate such a process.[22]

## 2 Case study: The non-development of copper metallurgy in Early and Middle Neolithic Central Europe

Dating back to the 5th millennium BCE, 'non-metallic' artifacts such as figurines, Spondylus jewelry or pottery show a striking uniformity on aesthetic and technical levels across Europe. Direct contact with copper-processing Neolithic groups developed even before the Late Neolithic. Therefore, the comparatively late and sparse appearance of the first copper artifacts in the late 5th millennium in central Europe is surprising. Seen from a current archaeological perspective, all the cultural, technological and logistical requirements for the acquisition of copper as a new material were present at the latest by the beginning of the second half of the 5thmillennium. However, at least according to the current state of research, this did not lead to the import or use of copper artifacts, metallic copper, copper ores or carbonates (for example, colored minerals such as malachite and azurite). The relevant cultural and technological conditions, which can be interpreted as a ready background for the development or acquisition of metallurgy, will be outlined below.

### 2.1 Pre-existing cultural and technological conditions

The term 'cultural preconditions' does not refer to a specific culture concept but should merely be considered a framework for the technological requirements to be discussed below. Cultural preconditions include the following:

- An extensive communication network existed across central Europe and adjacent areas, which is reflected, for example, in the distribution of goods such as flint or Spondylus. The existing trade routes could have been used in part for the distribution of metal ores or artifacts.
- There were contacts from the Linear Pottery complex to the Vinča culture where copper was known. These relations are reflected in the material and spiritual worlds of the first farmers and stock breeders of central Europe.[23] Figurines and Spondylus jewelry of Linear Pottery culture are not everyday, mundane objects, and their

22 This is not the place for a discussion of Christian Strahm's phase model of metallurgical development (Strahm 1994; most recently Strahm and Hauptmann 2009; see de Zilva 2007, 68–95).

23 See Lazarovici 1983.

occurrence in two neighboring cultures cannot be explained as a phenomenon of functional convergence or by recourse to concurrent aesthetic preferences. Rather, these commonalities point toward similar background meanings and a comparable value system. In the archaeological inventories of the western Black Sea coast, Spondylus is regularly associated with copper or malachite beads since 5000/4900 BCE[24]. Therefore, the acquisition of two clearly interconnected symbol or value carriers into the Linear Pottery complex could have been expected.

- At the transition from the Middle to Later Neolithic in much of todays central Europe, we see an archaeological change which is characterized by an intensification and differentiation of previously existing 'cultural concepts'. Adapted in the wake of former Danubian Linear Pottery Neolithization, they include a further development of autochthonous strategies of artifact production, agriculture, house construction, mining of raw materials and of an exchange and communication network. This willingness to test new conceptual approaches manifests itself already at the end of the Linear Pottery Culture and is particularly evident in the course of the second half of the 5th millennium and the beginning of the later Neolithic in the vast number of contemporaneous, chronologically and regionally overlapping archaeological cultures.[25]
- In addition, an interest in color can be presumed. This is evident from the processing and use of colored minerals such as hematite, ocher or serpentinite and the use of the reddish to purple-skinned maritime spiked oyster *Spondylus gaederopus*.[26] Apparently, people also felt a need to adorn the body, as is evident in tombs with rich jewelry throughout the distribution area of the Linear Pottery Culture.

Existing technological requirements for a development of metallurgy are the following:

- The principles and procedures for mining raw materials were known. In this connection, Early Neolithic well digging and mining for flint should be mentioned.
- There was significant practical pyrotechnic knowledge, resulting from the use of furnaces, differentiated procedures for swidden agriculture and birch tar production.[27]

24 Todorova 1999, 237.

25 For the transformation processes during the transitional phase to the Later Neolithic see Schier 1993.

26 For this 'interest in color', cf. the contributions in Cochrane and Meirion Jones 2012 and Saunders 1999. For the importance of color qualities of metals, cf. Hosler 1995.

27 With respect to the pre-ceramic Neolithic in the Near East, W. David Kingery, Pamela B. Vandiver and Martha Prickett consider the production of mortar with quicklime as a binder as an important step for the mastery of pyrotechnology: "Plaster innovations supplied the requirements for metal smelting and provided all the technology necessary for, and set the stage for, the subsequent adoption of pottery as a major industry in the ceramic Neo-

As the examination of traditional non-ferrous and precious metal blacksmithing shows, the smelting of copper, gold or silver in small amounts of about ten grams does not require a structurally fixed smelter or crucible. For such small amounts, a small depression in a charcoal layer is sufficient, combined with a targeted effect of heat by directing an open flame using blowpipes.

– For the production of beads from malachite, there was no need to acquire new, material-specific knowledge and skills. Instead, already existing stone processing techniques – grinding, cutting, drilling and polishing – would have been entirely sufficient for a cold processing of copper minerals or of native copper, since the steps in the production of malachite beads correspond to those necessary for the manufacture of beads from other minerals.

There is thus no compelling, archaeologically tangible reason for the rejection of the new material copper in the central European Early and Middle Neolithic cultures. Since the initially sparse use of copper in the later Neolithic, during the transition from 5th to the 4th millennium, was without question in technological terms conventionally Neolithic, economically insignificant and in practical, user-specific respects initially not beneficial, this stage could have already been reached in Early or Middle Neolithic times.

### 2.2 Social and ritual restrictions

Although it is methodologically quite reasonable to first explore whether the functionality of an innovation has been exploited, without assuming *a priori* extra-functional motivations,[28] a merely technological-procedural perspective is inappropriate for an understanding of pre-modern societies.[29] Especially 'fire crafts' were traditionally a source of anxiety and ambivalence that had to be ritually banned or at least channeled. According to many ethnographies, it is the norm rather than an exception in need explanation that the exploitation of 'Mother Earth,' the procurement and processing of specific raw materials, are connected to taboos and complex norms.[30] However, practices connected to such beliefs remain archaeologically invisible.[31] Modern scientific studies of 'prehistoric innovations' all too often lose sight of the fact that the acceptance of a new raw material and the modes of its processing in premodern societies were influenced by

lithic" (Kingery, Vandiver, and Prickett 1988, 241); see also Pfeiffer 2013, 56 n. 28.

28 On this, cf. Jung 2010.

29 Nayanjot Lahiri has shown by way of an example of the processing of copper and copper alloys in India how misleading a purely procedural interpretation can be. This investigation refutes the implicit evolutionist premise of "what is considered to be technologically superior must therefore be culturally preferred" (Lahiri 1995, 18).

30 Cf. Godoy 1985, 208–210; Knapp and Pigott 1997; Taussig 1980.

31 Cf. e.g. Böttcher 1981.

ideas that a technological perspective or a research-oriented mind would classify as irrational. Ethnographic studies of traditional blacksmiths or potters give the impression of a ubiquitous ritual contextualization without which prehistoric fire technologies are inconceivable.[32] At the same time, the mythical interpretive systems of such groups can be studied based on the ritual framing of metallurgy.[33] A vivid description of this dimension is provided by Georges Celis in an example of iron-working and blacksmithing in Africa:

> With regard to the characterization of the typical smelting process, we may not think that we need to concede any meaning to the rites and beliefs of the smelters and forgers. And indeed, these matters are influenced by people who do not have the slightest idea about the work of smelting and forging, i.e. diviners and healers. When one asks them, they will explain failures that may happen to the smelters and blacksmiths as the result of a non-observance of religious norms or as a result of black magic from disapproving neighbors – not, however, as a result of a lack of technological effectivity in need of improvement. Even those who are smelters and diviners in one person will respond in this way from the very start. They are convinced that the primary cause for a failure is to be found in a violation of traditional norms.[34]

Analogous to the exaggerated personalization of the emergence of the New in practice theories, traditional notions personalize reasons for the above-mentioned failures of smelting and forging processes by making deliberate or unintentional transgressions of individuals responsible for these failures. If we apply this finding to the question of why the development of copper metallurgy in the Early and Middle Neolithic failed to materialize, we would look for the reason in the religious or spiritual arena. But at what stage of the innovation model did the first approaches to a use and manufacture of copper objects come to a halt? The difference of the new material to the previously known and used ones is phenomenologically evident. But this does not mean that a second exploratory phase of experimental exposure will occur, with the aim to identify inherent possibilities of the new material and the exploitation of its technological potential. Insofar, the new material cannot prove its possible advantages over prior traditions, it cannot provoke a questioning of prevailing practical routines. Against the backdrop of a principal knowledge of copper through contact with other cultures that knew this material,

32 Cf. Budd and Taylor 1995; Childs and Killick 1993, 325–329; Herbert 1993; Reid and MacLean 1995.

33 In this respect, Eugenia W. Herbert's findings can be generalized for the working of iron in Africa: "Ironworking offers a precious window into African cosmologies and a model for other technologies with similar cosmological grounding. It corresponds to what refers to as a 'synedochic' representation of culture where one activity can be seen as a microcosm of more general beliefs and practices" (Herbert 1993, 3; see Clifford 1983).

34 Celis 1991, 116. – Translation by authors.

its lack cannot be qualified as merely due to disinterest or an inability to recognize the possibilities of the new material, but rather as a defense against the New. The reasons for this can only be speculated about.[35] It is conceivable that people feared 'magical' properties ascribed to copper and the modes of its processing, properties that escaped control; potential consequences of the acquisition of the new material for the social fabric could also have been a source of fear.[36] Most impressive is Lauriston Sharp's portrayal of the consequences that resulted from the introduction of steel axes to the Australian Yir Yoront. These objects replaced the traditional stone axes that were exchanged over long distances.[37] Even though the steel axes represented only a small and gradual improvement and acceleration for the work performed, their introduction amounted to the destruction of existing structures of this community. Traditionally, the stone axes were owned by the old men. Even though they could be borrowed by younger men and women, they were the most meaningful expression of "superiority and rightful dominance of the male".[38] When mission stations began distributing steel axes, the old men lost their privilege. The result was "a revolutionary confusion of sex, age, and kinship roles", as well as the collapse of the whole social organization.[39] Denial and rejection of a new material can be reasonable and appropriate for social reasons, even if its adaptation would imply an optimization of workflows.[40] It would be wrong to reproach the old men of the Yir Yoront in the fashion of a critique of ideology "to represent a particular interest as general or the 'general interest' as ruling"[41], because the decline of the dominant system has led to a lasting anomie.[42]

35 Culturally foreign objects perceived as threatening valences and on the other hand their potentially dominant legitimatory importance for those who are familiar with them, have been explained by Mary Helms (Helms 1988).

36 Even for inventions of the 19th century, Eyth stated: "It is not the hardship that brings out all these inventions, but inventions have a great need to overcome resistance from all sides by a well-ordered, generally self-satisfied world" (Eyth 1919, 236. – Translation by authors).

37 Rogers also refers to Sharp's study (Rogers 2003, 449–450).

38 Sharp 1952, 59.

39 Sharp 1952, 84. – To recapture their lost sovereignty over other community members, the old men tried to mobilize other objects which originated – like the steel axes – from the Europeans: "During a wet season stay at the mission, the anthropologist discovered that his supply of tooth paste was being depleted at an alarming rate. Investigations showed that it was being taken by old men for use in a new tooth paste cult. Old materials of magic having failed, new materials were being tried out in a malevolent magic directed toward the mission staff and some of the younger aboriginal men. Old males, largely ignored by the missionaries, were seeking to regain some of their lost power and prestige" (Sharp 1952, 89).

40 See the resistance of loggers in the 19th century against the replacement of axes by saws (Radkau and Schäfer 1987, 11–15).

41 Marx and Engels 1976, 61.

42 Innovations can be rejected not only for the sake of the preservation of specific status positions of the members of certain groups. Another reason can be the prevention of accumulating political power that may threaten a largely egalitarian state of a community. See Pierre Clastres for an example of the South American Indian mechanisms to safeguard equality (Clastres 1976).

### 2.3 New wine in old bottles: 'trinket metallurgy'

If we take into consideration the need for any metallurgy to incorporate 'fire crafts' into cultural ascriptions of meaning, the earliest Late Neolithic copper horizon of central Europe in the 5th millennium appears as an expression of social and cultural openness to new ideas, an attitude that did not exist previously. The subsequent stage in the development of the earliest northern Alpine copper metallurgy can be characterized with Barbara Ottaway's catchphrase of a "trinket metallurgy",[43] since the earliest copper artifacts followed familiar forms, such as awls and hooks:

> It is possible that this was a reflection of the inventor 'playing safe' and not wishing to 'violate community norms' (Arnold 1985:220). This meant staying within the framework of known forms with the new material until such a time when the invention had been accepted by the community. Only then would it be culturally possible to experiment with new forms.[44]

Such a development can be observed in various cultures around the world that adopted metalworking. In these cases, the initial appropriation process is mainly dominated by restrictions stemming from a degree of caution in combination with a pre-existing technological tradition. We do not witness a maximalist exploration of the possibilities of a new raw material. Consequently, the first castings or crucibles are usually found only after a certain time, in fact when new forms require a new technological standard, or, respectively, when a new technological standard allowed the development of new forms. The 'new forms' – in this case, the first copper axes – require smelting and especially casting by way of crucibles. These copper axes were 'new' only with regard to the new material. Morphologically, they resembled contemporaneous stone axes, although knowledge about their production was already quite complex.[45] We are confronted here with a pattern, in which the New is disguised in the forms of old.

If we relate our knowledge of the later Neolithic copper metallurgy to Oevermann's innovation model, the following contours emerge:

1. The difference of the New to known traditions is obvious. This led to misgivings, so that an appropriation was not necessarily possible or desirable.

43 Ottaway 2001, 103.

44 Ottaway 2001, 103, quoting Arnold 1985. The 'community norms' are essentially those of a stabilization of the social order, whether marked by equality or inequality.

45 Tobias Kienlin notes in the context of metallographic studies of copper flat axes of type 'Altheim': "It turns out that quite early, a complex sequence of manufacturing steps was followed. Castings were not just further processed by mere rounding, but by a more or less intensive, in the majority of cases multistage reforging" (Kienlin 2008, 108. – Translation by authors).

2. Despite continuities with the preceding Neolithic periods, routines become questionable in the Late Neolithic, also in other sectors such as construction or the economy.[46] Such a process would have been unthinkable in the formerly culturally uniform and rigid system of the Linear Pottery Culture. We can assume an increasing openness to innovation, albeit to a limited extent.

3. The New – in our case a new material – has the opportunity to prove itself in the traditional, i.e. in known forms ("trinket metallurgy"). In this way, dealing with an innovation appears largely to be familiar and therefore without risk. The New is – and we take that for an extremely instructive finding – not dramatized as new, but remains subdued.[47] If we follow Günter Ropohl's differentiation[48] of functional and structural inventions (taken over from Max Eyth[49]) and generalize it to all processes of innovation, we could say that a potentially functional innovation first occurs in the guise of a purely structural one.[50] Marie Louise Stig Sørensen has summarized a similar use of the raw material iron in late Bronze Age Scandinavia: "Iron in the Bronze Age and iron in the Iron Age were in cultural terms two different things. Only with the exploitation of the functional properties of iron in the late Pre-Roman Iron Age did iron in fact become iron, or in other words did iron become a material in its own right, used for a particular set of products."[51]

4. Embedded in this 'dangerless' state, the New may prove its usefulness. 'Allegiance' emerges in individual and collective examination of the new raw material and the immaterial sphere related to it, for example, a divinity or cosmic force associated with metal. New processing capabilities can be experimented with on the basis of an acceptance of responsibility for the handling and mastery of a new material.

5. Finally, such an innovation becomes routinized through practical trial. The new raw material copper with its new processing options sets new standards in the form of technical forging, metal smelting and casting processes. We must, however, distinguish between a routinization of the production of copper artifacts and their use.

46 Cf. Schier 2009.

47 This shows the importance of what could be described following Nietzsche, as "a little unconventional action" (Nietzsche 1911, 161): A deviation from the ingrained practical routines and the norms that sanction them may appear to be insignificant. Its perpetuation through trial can lead to a questioning of existing routines.

48 "Structural invention" refers to a structural improvement of an existing device which thereby becomes more efficient, whereas a "functional invention" opens a new idea of utilization for the first time (see Ropohl 2009, 261–277). "A functional invention renders (a) the hitherto unfeasible feasible or (b) the hitherto already feasible not only better, but fundamentally differently feasible" (Linde 1982, 10. – Translation by authors).

49 Eyth 1919, 231–233.

50 This is another example of the appropriative transformation of the New that cannot be illustrated in Rogers' model because the criterion of "observability" of the New is not met (cf. Rogers 2003, 258–259).

51 Sørensen 1989, 195.

The proposed interpretation of the phases of Oevermann's model in terms of copper metallurgy of the Later Neolithic seems to stand in opposition to the processes of a 'charismatic innovation', as the New exactly does not experience an increasing charismatization that would radically question existing traditions. Rather, an innovation remains subdued and withdrawn, so that one could perhaps speak of a 'camouflaged' innovation, and its practical test takes place within the framework of known practical routines. Looking closer, however, Late Neolithic copper metallurgy turns out not to be a counter-example but a variation of the model. To put it in terms of Weberian sociology of domination: central to it is the difference between charismatic leadership as an ideal type and those charismatic elements that must be included in all forms of domination, including decidedly non-charismatic forms of domination.[52] Within traditional forms of power (and traditional lifeworlds in general) factual innovations have to be legitimized as always already materially established and as being in accordance with tradition. In the shadow of this legitimacy, the charisma of the New can unfold on a small scale and in the guise of tradition. It can be routinized through practical trials. Innovations do not command special attention. They do not challenge the traditional in offensive ways and do not appear as material improvements. Initially, they appear solely as functional alternatives. Within these protected settings, the New is given its chance to prove itself. Its charismatic qualities may unfold and potentially lead to the formation of an allegiance, consolidation and finally displacement of the old.

52 Dirk Krauße's interpretation of the dead from the Late Hallstatt 'princely grave' of Hochdorf as charismatic ruler is based on an inadequate differentiation of these spheres of the charismatic (Krauße 1996, 338–345; see also Jung 2006, 171–179). However, Krauße is in good company, since even Pierre Bourdieu does not distinguish adequately between the ideal type of the charismatic and historically concrete phenomena with charismatic dimensions: he accuses Weber of having "been trapped in the logic of realist typologies. This leads him to see charisma as a particular form of power rather than as a dimension of all power" (Bourdieu 1990, 141).

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