

Drs. 10464-11
Berlin 28 January 2011

Recommendations on Scientific Collections as Research Infrastructures

CONTENTS

	Preamble	5
	Summary	7
A.	Scientific collections as research infrastructures	10
A.I	Introduction	10
A.II	Research based on scientific collections	11
A.III	Definition of the subject matter	14
A.IV	Definitions	15
A.V	Aim of this statement	18
B.	Critical analysis: status and function of scientific collections as research infrastructures	19
B.I	Structural features	19
	I.1 University collections	20
	I.2 Non-university collections	23
B.II	Resources	27
	II.1 Finance	27
	II.2 Accomodation	28
	II.3 Human resources	29
B.III	Use	30
	III.1 Functions of scientific collections	30
	III.2 Use for research	32
	III.3 Intensity of use	33
B.IV	Usability	33
	IV.1 Management and quality assurance	34
	IV.2 Care	35
	IV.3 Access	35
	IV.4 Documentation, indexing, digitisation	36
B.V	Financial support options	39
B.VI	Networking and coordination between institutions	41
C.	Recommendations on the further development of scientific collections as research infrastructures	45
C.I	Determining the status of a scientific collection	47

C.II	Development of collection concepts	48
C.III	Requirements for scientific collections as research infrastructure	50
	III.1 Organisation and management	50
	III.2 Resources	52
	III.3 Indexing, accessibility, digitisation	53
C.IV	Networking and organisation of scientific collections	55
C.V	Financing and grants for scientific collections and collection-based research	57
Annexes		60
	List of abbreviations	67

Preamble

Scientific collections are a significant research infrastructure. In the past, the German Council of Science and Humanities was concerned mainly with investment-intensive infrastructure and large-scale equipment that is primarily required in research relating to the natural and engineering sciences. The Council of Science and Humanities is now widening its focus to include infrastructures which have a greater disciplinary breadth and are characterised by high operating costs rather than high investment costs. To this end, the Council has set up working groups to deal with the following topics: research infrastructures for the social sciences and humanities, library network systems and scientific collections.^{|¹} In addition to these focus areas, the Council prepares general recommendations for information infrastructures.^{|²}

As long ago as 1965, the Council considered museums and scientific collections in the context of its recommendations for the expansion of scientific institutions, noting that “as reference material and as objects of scientific research” these were “significant for many scientific disciplines.”^{|³} More recently, the Council has considered scientific collections particularly in the context of the “*Blaue Liste*”^{|⁴} museums, again expressly emphasising the significance of these collections for research.^{|⁵} Whereas, in the past, the Council’s attention there-

^{|¹} Cf. Wissenschaftsrat: Recommendations on Research Infrastructures in Humanities and Social Sciences (Drs. 10465-11), Berlin, January 2011, Wissenschaftsrat: Empfehlungen zur Zukunft der bibliothekarischen Verbundsysteme in Deutschland (Drs. 10463-11), Berlin, January 2011.

^{|²} Wissenschaftsrat: Übergreifende Empfehlungen zu Informationsinfrastrukturen (Drs. 10466-11), Berlin, January 2011.

^{|³} Wissenschaftsrat: Empfehlungen des Wissenschaftsrates zum Ausbau der wissenschaftlichen Einrichtungen, part III, Forschungseinrichtungen, vol. 2, Cologne 1965, p. 22.

^{|⁴} Translator’s note: Institutes included in the so called “*Blaue Liste*” [„Blue List“] are jointly funded through both federal and Länder governments in accordance with the research funding framework agreement.

^{|⁵} Wissenschaftsrat: Stellungnahmen zu den Einrichtungen des Sektors Museen der Blauen Liste, Cologne 1992 and Wissenschaftsrat, Stellungnahmen zu Instituten der Blauen Liste, Museen der Blauen Liste, vol. VII, Cologne 2000.

fore focused mainly on collections located outside of universities, it is now widening its scope to include the many scientific collections in universities. It has set up a working group to look at this area, which began its work in April 2009. Participants in this working group also include experts who are not members of the Council, to whom the Council feels particularly obliged.

Particularly at universities, collections play an important role as infrastructure for research and teaching. Yet especially here, due to a shortage of resources and allocation decisions that are often guided by other interests, their scientific potential is not always exploited to the full. Germany has a wide variety and large number of scientific collections in universities which often tend to be small and linked to individual institutes and departments. Outsiders often know little about the content of the collection or its condition.

One goal of these recommendations is to compile systematic knowledge about scientific collections, especially at universities. The Council of Science and Humanities has therefore conducted an extensive survey at selected universities. |⁶ University administrators and the staff responsible for a total of 151 collections were asked to submit information and opinions concerning collection-based research, concepts, upkeep, presentation, use, digitisation and networking, and integration into the university. In addition, the working group set up by the Council visited collections at the universities of Heidelberg and Jena, which were chosen as examples, and analysed the experiences gained from the evaluation of the *Zoologisches Museum Hamburg* [Hamburg Zoological Museum]. |⁷ Interviews were also conducted with representatives of university and non-university scientific collections and funding institutions (German Federal Ministry of Education and Research, German Research Foundation, Volkswagen Foundation). The Council wishes to thank everyone involved for their support.

The Council adopted its recommendations on scientific collections as research infrastructures on 28 January 2011 in Berlin.

|⁶ These were the following universities: *Humboldt-Universität zu Berlin* [Humboldt-University Berlin], *Technische Universität Dresden* [Technical University Dresden], *Universität Göttingen* [University of Göttingen], *Universität Greifswald* [University of Greifswald], *Universität Heidelberg* [University of Heidelberg], *Universität Jena* [University of Jena], *Universität Regensburg* [University of Regensburg].

|⁷ Wissenschaftsrat: Stellungnahme zu den wissenschaftlichen zoologischen Sammlungen im Zoologischen Museum Hamburg (ZMH) (Drs. 9273-09), Hamburg, July 2009.

Summary

Scientific collections and objects form an essential basis for research in numerous scientific disciplines; many disciplines came into existence only as a result of collections. In some cases, outstanding research results are generated in research with and about collections – particularly in research fields such as evolution, the environment, biodiversity, ethnology and archaeology, art and culture, the history of science and engineering – and have received a great deal of attention from the public. Object-based collections have a special impact due to their specific materiality, which is utilised in research and teaching.

Germany has a diverse array of collections that are available to users as a valuable infrastructure for their research. The considerable scientific potential of collections has been utilised countless times before, providing material for scientific publications and exhibitions. However, alongside a large number of well-known scientific collections offering excellent access and usability, there are also many collections, especially at universities, whose potential cannot be fully exploited for various reasons – for example a lack of indexing, visibility, staff, care or accommodation. The potential of scientific collections for research should be utilised more effectively in the interests of the scientific system, and also in the search for answers to current questions with urgent relevance for society as a whole.

Since there is a need for action particularly with regard to university collections, these are the main focus of the Council's recommendations. However, the recommendations are not aimed solely at the supporting institutions and funding bodies for scientific collections as they also demand a high degree of personal initiative and self-organisation on the part of those persons who are immediately responsible for the collections.

– It is fundamentally important to determine the status of the scientific collections. Existing contents should be documented and classified in terms of quality by the people or institutions that are directly responsible for the collections, using assessment criteria that are collection-specific and primarily oriented to scientific benefit and usability. This will increase the transparency and visibility of collections and enable a realistic assessment of their worth.

- _ Universities should assign responsibility for the collections to persons who will adopt a comprehensive perspective. From this perspective they should operate within the university as an interface between levels of university management and collections, promote conceptual development and internal networking, coordinate the documentation of collections' contents and offer advisory services. Externally they should particularly encourage networking and consultation with other institutions.
- _ The status determination should be used as a starting point for the further systematic conceptual development of the collections. Only an analysis of potential that is carried out from such a perspective can enable a decision to be made as to whether a collection should be maintained and expanded, safely stored, relocated, disposed of or closed down. A systematic concept for the collection will mean that well-founded equipment and resource requirements can be established.
- _ The German Council of Science and Humanities recognises the value of scientific collections as geographically distributed infrastructures. However, this decentralised structure requires a certain degree of interdisciplinary, self-organised networking and coordination between the collections. The Council therefore recommends that the German federal government should fund, for the medium term, a body that performs corresponding advisory and coordinating activities. Mainly specialist groups that deal with collections should be involved in this body. In the first instance, such a body should support the university collections in particular with the documentation and evaluation of their inventories, and enable them to make coordinated conceptual decisions. Cooperation and synergies should be generally encouraged through stronger networking between collections. The overall visibility of collections should be increased both within the scientific community and for financing decisions.
- _ Guidelines and standards are required for the documentation, (digital) indexing, management, upkeep and conservation of collections. The research museums of the *Leibniz-Gemeinschaft* (WGL) [Gottfried Wilhelm Leibniz Science Association] should play a pioneering role in the subsequent development of these guidelines and standards, and support the university collections in particular in an advisory capacity.
- _ The Council recommends the (further) development of appropriate financing options and funding instruments for scientific collections. As research infrastructures, collections at universities are an ongoing task and should receive appropriate coverage through core funding. The Council stresses that university scientific collections should remain within the remit of the universities as the organisational centres of the scientific community. Joint financing by the German federal and *Länder* [state] governments, e.g. in the context of the *Leibniz-Gemeinschaft*, does not constitute a preferable alternative to funding by the

universities. Rather, the funding agencies in the German federal and *Länder* governments should consider alternative funding methods: options such as the creation of foundations and supplementing core funding through appropriate – also medium-term – project funding instruments (particularly the German Federal Ministry of Education and Research [BMBF], German Research Foundation [DFG], Volkswagen Foundation and other foundations) should be examined accordingly.

A. Scientific collections as research infrastructures

A.1 INTRODUCTION

“Things” have a way of sparking curiosity. This curiosity has many causes: one might be fascinated by an object’s composition, or its appearance. But often it is only the knowledge about certain properties of an object that are not immediately apparent – for example, knowing how old it is, where it comes from, how rare it is, the natural forces or human ingenuity that went into making it – that give an object its special “aura” and make it truly fascinating, even aside from individual consideration. Enriching an object with knowledge about its invisible characteristics, in addition to its visible properties, discovering the relationship between inherent and external attributes, results in a considerable increase in importance. As a result of these qualities, an object is no longer merely a curiosity – it can take on the significance of a cultural asset, serve the purposes of self-affirmation and identity formation in society, function as a material witness, may supply answers to all kinds of questions, and stimulate further questions.

As well as pragmatic reasons – in particular, for example, making provisions, building up reserves to be used later – this allure of the object may explain why humans collect things, why we develop a passion for collecting. A passion for collecting often finds expression in hoarding, the undirected accumulation of things. If the passion for collecting is combined with an overarching epistemological interest, the object is removed from its primary functional context and transformed from an object of utility into an object of contemplation. If collecting is based on selection criteria and structured according to the principles that guide research, the objects organised in this way have a value that exceeds the individual object in its specific materiality and implies a well-founded taxonomy. Even more than a single object, a structured collection is capable of constituting a knowledge base and offering new insights.

A collection organised in this way stimulates new questions, enables new investigations and can thus generate new knowledge. It is therefore of great benefit

to science, which is also seen in outstanding research with and about collections. A scientific collection is simultaneously the object, tool and product of science. The materiality of the objects lends collections a special intrinsic value that is used particularly by universities in research and teaching, and for transfer to the public. Although disciplines have existed (and still exist) which are concerned less with objects than with texts and abstract models, particularly in recent times numerous disciplines have turned (back, in some cases) to objects and collections in order to elicit all kinds of information from them. At the same time, one and the same object in a collection may answer very different questions over the course of time as new methods of investigation are developed, even in the context of completely different disciplines.

Object-based scientific collections held by research museums and universities provide reference material and documentary evidence from all regions of the world and from a wide range of historical contexts which in some cases no longer exists outside of the collection. They preserve cultural and natural heritage and bear witness to the history and development of nature, culture, technology, society and science. They can be utilised in a large variety of ways and can therefore enable unique ways of answering certain research questions. Scientific collections are therefore an indispensable basis for many research processes. In particular, research into biodiversity, the transformation of ecosystems and material culture, and research questions in the fields of anthropology, archaeology, ethnology, geoscience, the history of art, and the history of science and engineering are fundamentally reliant on objects.

A.II RESEARCH BASED ON SCIENTIFIC COLLECTIONS

Collection-based research encompasses various different approaches: research about and with objects and collections, and research in the context of exhibitions are the main forms of collection-based research. Documenting and indexing a collection can also be challenging research activities that often only become routinised over time – the boundaries between scientific and technical activity are fluid, especially in the context of infrastructure-related research (cf. A.IV). |⁸

|⁸ Various examples of current collection-based research projects can be found, for example, in the Volkswagen Foundation's "Research in Museums" programme, cf. the grants in 2009 and 2010 in: <http://www.volkswagenstiftung.de/foerderung/gesellschaft-und-kultur/forschung-in-museen.html> of 27 September 2010, and also in the BMBF's support programme for the humanities, "*Übersetzungsfunktion der Geisteswissenschaften*" ["Translation function of the humanities"], cf. http://www.pt-uf.pt-dlr.de/_media/Projektliste_UEBERS_Museen.pdf of 27 September 2010.

Scientific collections have a constitutive and innovative importance for research: without collections, many scientific disciplines would be inconceivable. The use of collections and objects, the application of new methods to them, enables scientific innovation and answers to new research questions.

Disciplines and subdisciplines such as archaeology, botany, zoology, the history of art or the history of technology in some cases only came into being because of collections, without which their research questions could not be answered. Zoological and botanical research builds substantially on natural history collections, which are traditionally the places where types, i.e. reference organisms for the scientifically described species, are documented. New research projects and investigative techniques, but also changing taxonomic opinions, make repeated inspection of the documentary material necessary, and also require its long-term preservation. In archaeology, the contextualised material culture of past societies that is documented in collections supplies the source material for any investigation. Likewise, the history of technology is barely conceivable without recourse to object-based collections which enable an understanding of lines of development and contexts of origin in the development of technology.⁹ History of science research is also fundamentally reliant on collections: in this case, collections themselves become the object of research, for example allowing conclusions concerning the way in which scientific disciplines portray themselves and have developed in the historical context. |¹⁰ In general, collections have the potential to serve as contemporary witnesses for historical research, as it were. |¹¹

For many subjects, collections are an essential basis for scientific advancement: innovations often occur in connection with collections and objects that have

|⁹ For example, preserved historical equipment allows its design methods to be understood. This can lead not only to historical understanding but also to insights relevant to present-day engineering. One of many examples is the reconstruction of Leibniz' four species calculating machine: supported by the DFG, the reconstructions were exhibited as part of the University of Hanover's Leibniz exhibition and the research results were published in an accompanying publication, cf. Stein, E., Wriggers, P. (eds.): Gottfried Wilhelm Leibniz. Philosoph, Mathematiker, Physiker, Techniker. Begleitbuch zur Leibniz-Ausstellung der Universität Hannover, Hanover 2006.

|¹⁰ For example, this is currently being carried out for archaeology with the help of the department of pre-history and early history at the Focke Museum in Bremen, cf. "Vorgeschichtsforschung in Bremen unterm Hakenkreuz": <http://www.focke-museum.de/de/museum/projekte> of 24 September 2010.

|¹¹ For example, the clothing collection at the Oberhausen museum of industry enables research into everyday habits and consumption patterns, influences and ideologisation, and manufacturing processes in the 1930s and 1940s, cf. the research project "Soziokulturelle Untersuchungen zur Bekleidungs-geschichte der 1930er/40er Jahre": <http://www.uni-marburg.de/fb03/euroethno/forschung/vwprobekl> of 24 September 2010. From more of a social history perspective, for example, home appliance objects illuminate the technologisation of the home in conjunction with increasing energy consumption, cf. www.energiekonsum.mwn.de of 24 September 2010.

been around for some time but which can be used and interpreted in new ways as a result of new methodological approaches and research questions. Developments in DNA analysis, in particular, have brought about a changed approach to collections. With these investigation methods, for example, research in evolutionary biology can gain completely new insights based on prehistoric bones held in palaeontological collections: a recent example is findings concerning the closer relationship between Neanderthals and modern humans which resulted from an investigation of the genome from Neanderthal bones. |¹² In a similar way, archaeology relies upon close cooperation with the natural sciences. In recent times, DNA analysis of excavated objects for research on kinship and material analyses for research into the history of technology have gained in significance. |¹³ Research questions and investigative methods have directly influenced manners of collecting. For example, in recent times, during excavations, bones have been collected under virtually cleanroom conditions to avoid contamination. In this way new types of collections are also created, such as DNA databases in which the physical DNA and the organism are stored together to create links between molecular information and the physical material. |¹⁴

Recently created collections also allow valuable knowledge to be gained for medical research, for example for current classification questions |¹⁵ or also for research into penicillin resistance. |¹⁶

Research into biodiversity, which has gained increasing attention in recent years, would be inconceivable without collections: reference material and documentary evidence stored in zoological and botanical collections enable insights into the extinction of species and their distribution. Thus, for the Census of Ma-

|¹² Cf. Green, Richard E. et al.: A draft sequence and preliminary analysis of the Neandertal genome, *Science*, 7 May 2010, vol. 328, no. 5979, pp. 710-722.

|¹³ Cf. e.g. Kienlin, Tobias L.: *Frühes Metall im nordalpinen Raum: Eine Untersuchung zu technologischen und kognitiven Aspekten früher Metallurgie anhand der Gefüge frühbronzezeitlicher Beile*, Bonn 2008.

|¹⁴ Cf. <http://www.dnabank-network.org> of 27 September 2010; DFG supported the project from 2007-2010 in the context of its support for Scientific Library Services and Information Systems (LIS).

|¹⁵ For example, investigations using the collection of microscopic slides and tissue samples of the Kiel-based pathologist Karl Lennert allow conclusions about the methods used to create the Kiel classification of malignant lymphomas, which could be significant for the current classifications used by the World Health Organisation, cf. the research project "Das persönliche Archiv des Kieler Pathologen Prof. Dr. Karl Lennert: Bedeutung der Lymphbiopsie-Sammlung für die Diagnostik und Klassifikation maligner Lymphome": <http://www.volkswagenstiftung.de/foerderung/personen-und-strukturen/forschung-in-museen/bewilligungen-2009.html> of 24 September 2010.

|¹⁶ Research into the evolutionary development of such resistance in bacteria only became possible on the basis of collections of corresponding bacterial strains; the DFG-supported project within the priority programme 1047 "Ökologie bakterieller Krankheitserreger: Molekulare und evolutionäre Aspekte" [Ecology of Bacterial Pathogens: Molecular and Evolutionary Aspects] has now been completed, cf. DFG's GEPRIS database: <http://gepris.dfg.de/gepris/OCTOPUS>.

rine Life, in addition to recording the plants and creatures that are found in the world's oceans it is also necessary to compare the organisms that are found with the reference organisms. This is the only way to determine whether the found objects belong to new species. |¹⁷

Object-based collections – even independently of the original context in which they were formed – are often amenable in principle for use by different disciplines and can help to test current theories. |¹⁸ Due to their internal order, collections allow knowledge to be gained through the serendipity principle, i.e. finding something other than what one was looking for. Here too the openness of collections to answering different research questions is again confirmed: based on an extensive zoological collection of dog skulls held by the Albert Heim Foundation at the Natural History Museum (NMBE) in Berne, a new kind of mechanism for short-term genetic changes was discovered.

A.III DEFINITION OF THE SUBJECT MATTER

The value of a collection of objects for science results from how it is used in research. This paper therefore focuses on the scientific discovery of new knowledge through scientific work with collections which have been and continue to be developed systematically with the goal of accumulating materials and storing and classifying knowledge. Accordingly, object-based collections are primarily considered as research infrastructure |¹⁹, as an object and tool for collection-based (fundamental) research. Attention therefore focuses not only on collec-

| ¹⁷ For the Census of Marine Life cf.: <http://www.coml.org> of 24 September 2010.

| ¹⁸ For example, the recordings of foreign languages made in German prisoner of war camps during the First World War by the Royal Prussian Phonographic Commission, which are preserved in the sound archive of the Musikwissenschaftliches Seminar at the Berlin Humboldt University, are a unique resource for testing theories about the development of dialects in Great Britain, cf. <http://publicus.culture.hu-berlin.de/lautarchiv/bestaende.htm> of 24 September 2010.

| ¹⁹ The term is not consistently defined. In Europe, however, the definition of the European Strategy Forum on Research Infrastructures (ESFRI) has become established: "We deal with facilities, resources or services of a unique nature that have been identified by pan-European research communities to conduct top-level activities in all fields. This definition of Research Infrastructures, including the associated human resources, covers major equipment or sets of instruments, as well as knowledge-containing resources such as collections, archives and databases. Research Infrastructures may be 'single-sited', 'distributed', or 'virtual' (the service being provided electronically). They often require structured information systems related to data management, enabling information and communication. These include technology-based infrastructures such as grid, computing, software and middleware." See European Strategy Forum on Research Infrastructures: European roadmap for research infrastructures, 2006 report, 2006, p. 16. For a definition of the term "scientific infrastructure" see also Wissenschaftsrat: Recommendations on Research Infrastructures in Humanities and Social Sciences (Drs. 10465-11), Berlin, January 2011.

tions at the major research museums |²⁰ but also particularly on scientific collections at German universities. The subject matter is collection objects and collections in so far as they constitute an important resource for current and future research processes. Providing access to and maintaining these research infrastructures is a challenge for universities and research museums, and for research funding bodies at federal and *Länder* level in Germany.

Hence the focus is not on the unsystematic amassing of objects driven solely by the allure of the object and a certain passion for collecting, nor is it on collection merely for the purpose of preserving materially visible cultural heritage and material historic evidence for future generations. Collections of data, archive collections and libraries are also expressly not the subject of consideration. |²¹

A.IV DEFINITIONS

An object-based scientific collection is characterised by certain parameters. It differs from a pure amassing of things in a certain degree of order in the way objects are documented, for which there are inclusion and exclusion criteria. Objects are organised within a certain spatial order. Scientific collections are also defined by a chronological component, by their current relevance to scientific research but also by their potential relevance. The latter brings foreseeable and plausible future usage options into consideration. Not least, a scientific collection is characterised by the persons who study it, who look after it in an administrative or supporting role, and who use it for scientific purposes. These defining parameters result in a great degree of internal differentiation in scientific collections.

Aside from distinctive individual characteristics, one common feature of scientific collections from the point of view of this paper is their function as long-

|²⁰ In its standards for museums, ICOM, the International Council of Museums, defines research as a traditional core task for museums alongside collecting, preserving and informing; cf. Deutscher Museumsbund e.V. / ICOM: Standards für Museen, Kassel/Berlin, February 2006, p. 6. In this respect the term "research museum" would appear to be tautological. However, it refers to the group of museums which expressly consider themselves to be research institutions and see collection-based research as being a focus of their work, e.g. the research museums in the *Leibniz-Gemeinschaft* (WGL), cf. below, section B.I.2.

|²¹ In the context of recommendations on research infrastructures in the humanities and social sciences, the Council also considers collections of data, cf. Wissenschaftsrat: Recommendations on Research Infrastructures in Humanities and Social Sciences (Drs. 10465-11), Berlin, January 2011; further recommendations are dedicated to the library network system, cf. Wissenschaftsrat: Empfehlungen zur Zukunft des bibliothekarischen Verbundsystems in Deutschland (Drs. 10463-11), Berlin, January 2011.

term research infrastructure. |²² As research infrastructure, collections are “facilities, resources or services of a unique nature” |²³, that enable and facilitate research for entire scientific communities. As such they are an essential basis (“basic service”) for research in various disciplines both in the natural sciences and in the social sciences and humanities, and in interdisciplinary contexts. The respective research need for collections is subject to change. This affects the status of a collection, which can change from being an infrastructure that is used primarily for research to being a facility that is primarily used for purposes of viewing and preservation – and vice versa.

Consideration of scientific collections always also requires a consideration of collection-based research, the former being an enabling condition for the latter. A definition of collection-based scientific research necessarily expands the traditional notion of research |²⁴: the complexity of research increases as a result of new investigation methods and increasingly sophisticated research infrastructures such as scientific collections. Activities in the context of preparing and providing a research infrastructure are often directly research-based activities themselves. In the case of scientific collections it should be noted that in particular the documentation and indexing of objects often require scientific expertise and can themselves be characterised as research activities – for example the identification and systematisation of objects is generally not possible without in-depth scientific knowledge about the context and unapparent characteristics of the object. Developing new methods for the investigation of objects, or their transfer from other disciplines, also requires scientific expertise, whereas after a transitional period the application of these methods can be carried out as

|²² This infrastructure perspective also corresponds, for example, to the views of the OECD, cf. their internal interim report: OECD Global Science Forum, Second Activity on Policy Issues Related to Scientific Research Collections, Washington DC, 17-19 July 2008, 3: "Scientific collections are essential parts of the research infrastructure of all countries with scientific enterprises, and they are critical to many areas of sciences, from microbiology to space science (...). Finally, although collections comprise fundamental infrastructures for the scientific research enterprise, they are generally not managed as such." An Interagency Working Group on Scientific Collections set up by the U.S. government also emphasises the value of scientific collections as infrastructure, cf. National Science and Technology Council, Committee on Science, Interagency Working Group on Scientific Collections: "Scientific Collections: Mission-Critical Infrastructure for Federal Science Agencies", Washington DC, 2009, 14: "Object-based scientific collections [...] are valuable components of the Federal government's and the Nation's research infrastructure, alongside buildings, scientific instruments, and human resources. [...] Scientific collections are vital infrastructure, often outlasting the research projects that created them."

|²³ European Strategy Forum on Research Infrastructures (ESFRI): European roadmap for research infrastructures, 2006 report, p. 16. The Council endorsed this definition in its statement on two large-scale facilities for fundamental research in the natural sciences, Cologne 2007, pp. 89-247.

|²⁴ Cf. Frascati Manual 2002: Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002. Basic research, applied research and experimental projects are subsumed under the term "research and development".

a routine activity. In this sense a definition of the term “collection-based research” also covers the (further) development of methods, including long-term systematic research in addition to the more or less short-term investigation of hypothesis-led research questions. Moreover, the term “collection-based research” also includes exhibitions as the starting point and outcome of research-driven activity. Such a concept of research captures the dynamism and increasing complexity of the research process.

Collection-based research in this sense comprises:

- _ Research about objects, i.e. systematic classification and identification of the object, its origin, its context of creation and historical context, and its historical provenance (provenance research); also: restoration and conservation research; research about objects provides a basis for research based on objects; preparatory and accompanying activities such as the inventorying and documentation of objects can also be part of the scientific study of objects; |²⁵
- _ Research about collections, i.e. research into the origins of the collection, its provenance and context, research in cultural history and science history across individual collections, for example in the context of research into the development of disciplines;
- _ Research based on collections and objects, i.e. collections and objects serve as reference material and documentary evidence in the context of systematic research; this research starts with a higher-level question that can be answered with the aid of objects and collections;
- _ Exhibitions and associated research activities, i.e. the systematic investigation or new grouping of objects in the context of a particular research question having the aim of knowledge transfer for an exhibition. Historical or interdisciplinary contexts are often first revealed in connection with exhibitions through the arrangement of objects guided by the respective exhibition concept, as a result of which further research questions are stimulated. Knowledge gained in the context of the preparation of exhibitions is usually published in an exhibition catalogue or in specialist journals. |²⁶

|²⁵ Cf. Wissenschaftsrat: Stellungnahmen zu Instituten der Blauen Liste, Museen der Blauen Liste, vol. VII, Cologne 2000, pp. 15 ff.

|²⁶ On the exhibition concept as research work, cf. also Wissenschaftsrat: Stellungnahme zu den Instituten der Blauen Liste, Museen der Blauen Liste, vol. VII, Cologne 2000, e.g. p. 17, and Graf, Bernhard: Gutachten zu Forschungsbegriff und Forschungsanteilen der Bund-Länder-geförderten Forschungsmuseen in der Leibniz-Gemeinschaft (WGL), Berlin 2009, pp. 15 and 18. An outstanding example of research in connection with exhibitions is the touring exhibition which has been presented at various locations since 2003 – most recently in 2010 at the Pergamon Museum in Berlin – called “*Bunte Götter*” [“Colourful Gods”]. Meth-

The value of a scientific collection as infrastructure for research results from how it meets the specific requirements of research. Scientific collections in Germany whose primary function is their use in scientific research need to be measured against this criterion.

A.V AIM OF THIS STATEMENT

In view of the importance of object-based research and positive public perceptions, the question arises of whether the scientific collections that exist in Germany can currently be used in a suitable way as objects and tools for research, and whether their scientific potential is sufficiently visible and can be exploited appropriately. Also with regard to the international competitiveness of German research, making better use of scientific collections is an important task.

The Council's findings in its statement on research in the "Blue List" museums from 2000 were that museums in Germany in some cases have rich collections that are of great value to research, but in many cases their existence is threatened and they are not sufficiently utilised owing to a lack of financial and human resources. |²⁷ The research museums in the *Leibniz-Gemeinschaft* have since seen a considerable improvement in their situation. This positive trend has not yet reached university collections, however.

In museums and universities, Germany possesses a great variety of scientific collections that have grown historically in different subject contexts and which have considerable scientific potential. Better exploiting the potential of these collections as research infrastructures and making the collections systematically available to research is the aim of this paper.

To this end, the Council is analysing the current situation of scientific collections with a focus on university collections as this is where there is currently the greatest need for action. The recommendations are aimed primarily at the German federal and *Länder* governments as the agencies that provide funding for collections, but also, in addition, at the universities and non-university institutions that are directly responsible for the collections, at the community of persons who are involved with collections, and at funding organisations.

ods from the natural sciences, such as UV fluorescence and UV reflectography, have been used to detect traces of pigment on ancient marble. The result is an impressive rebuttal of the concept of an ancient world of white marble, which held sway for a long time in the field of ancient studies, cf. Brinkmann, Vinzenz und Wünsche, Raimund (eds.): *Bunte Götter – Die Farbigekeit antiker Skulptur*, Munich 2003.

|²⁷ Wissenschaftsrat: *Stellungnahme zu den Instituten der Blauen Liste, Museen der Blauen Liste*, vol. VII, Cologne 2000.

B. Critical analysis: status and function of scientific collections as research infrastructures

There is an extraordinary wealth of collections in Germany which have grown up over time and which represent an invaluable resource for scientific research. This rich variety is reflected not only in the objects, collection focuses, collection concepts, contexts of origin and current functions of collections, not only in their diverse uses, in their organisation, institutional embeddedness and in their physical, human and financial resources, but also in their condition: very well preserved, renowned collections on the one hand, with poorly housed, undeveloped, acutely threatened collections on the other. This diversity necessitates a differentiated description and analysis of the state of the scientific collections in their role as research infrastructures.

B.1 STRUCTURAL FEATURES

Science policy is focused on the particularly visible research collections with national significance that are jointly funded by the German federal and *Länder* governments within the *Leibniz-Gemeinschaft*. Yet these collections are not the only ones that represent an opportunity for research – collections are also held by *Länder* and municipal museums. It is almost impossible to make generalised statements about their level of equipment, structure and scientific usage as the available information is scanty.

In addition, there are a large number of scientific collections at universities which science policy has so far not considered. University collections exhibit great diversity. Comprehensive information about these collections has also only become available recently.

Due to the very different forms of institutional embeddedness that collections have (municipal, private, national, *Länder* or university collections), it is difficult to give a comprehensive overview of collections in Germany.

1.1 University collections

Nearly all universities in Germany have object-based scientific collections, primarily in the fields of biology, medicine, earth sciences, art and archaeology. |²⁸ There are many reasons why collections are created: a collection may be built up to accompany the formation of a university, a new discipline, or the establishment of a new professorial chair. University collections are created because they are required for teaching or research, or because they promote the image of a discipline. Sometimes scientific disciplines have only come into being because of a collection. Not infrequently, a collection has been transferred to a university following the closure of a museum. The various ways in which many collections from different contexts of origin have continued to develop is an indicator of their great dynamism.

University collections and museums were recorded in a publicly accessible database by the *Hermann von Helmholtz-Zentrum für Kulturtechnik* [Hermann von Helmholtz Centre for Cultural Techniques] as part of the “*Universitätsmuseen und -sammlungen in Deutschland*” [“University museums and collections in Germany”] project that was supported by DFG from 2004 to 2009. As a result, it is possible to make substantial statements concerning this area. |²⁹ The database contains details of 1,051 university collections and museums in Germany. Of these, however, 292 have since been broken up, are no longer in their original location, their whereabouts is unknown, or they have been lost. |³⁰ Most of the preserved collections are natural history collections, followed by art and art history collections, then medical collections (see table 1).

|²⁸ The database held by the *Helmholtz-Zentrum für Kulturtechnik* indicates that 82 out of a total of 105 universities have collections, cf. <http://publicus.culture.hu-berlin.de/sammlungen/dokumentation/statistik/sam/uni> of 27 September 2010.

|²⁹ The database can be viewed at: <http://publicus.culture.hu-berlin.de/sammlungen/> of 27 September 2010.

|³⁰ See <http://publicus.culture.hu-berlin.de/sammlungen/> of 27 September 2010. Historical and archaeological collections have remained relatively well preserved. Only 5% of these have been broken up, lost, or their whereabouts is unknown. More than half of the natural science and technology collections have not been preserved or can no longer be found.

Collection type	Collections	Collections broken up, lost, or whereabouts unknown	Total	Percentage of collection type in relation to entire spectrum	Percentage of preserved collections
Ethnology & cultural anthropology	20	6	26	2%	77%
History & archaeology	104	5	109	10%	95%
Cultural history & art	137	34	171	16%	80%
Medicine	123	45	168	16%	73%
Natural history	251	73	324	31%	77%
Natural science & technology	124	129	253	24%	49%
Total	759	292	1.051	100%	72%

Source: Database of the Hermann von Helmholtz Centre for Cultural Techniques, Berlin Humboldt University, as at September 2010

Most universities (46 of 82 recorded) have no more than ten collections. However, five universities have more than 30 collections. TU Dresden leads the field with 39 collections, followed by *Technische Universität Bergakademie Freiberg* [Technical University Mining Academy Freiberg] and the University of Tübingen, which each have 35 collections.

While collections broadly relating to the humanities are widely distributed between the different universities, individual universities are predominant among the natural science and technology collections: with 23 and 22 collections respectively, *Technische Universität Bergakademie Freiberg* and TU Dresden have by far the most natural science and technology collections in Germany.

One characteristic of most university collections, particularly the smaller and medium-sized ones, is that they are linked to chairs or smaller departmental organisational units with whom sole responsibility then lies. Although other institutional bases for collections do occur, for example as central university institutions, this form of organisation is primarily found with larger collections such as botanical gardens. The decentralised way in which the majority of collections are organised and managed has often developed historically due to collections having been formed and maintained based on the particular specialised interests of an individual scientist. Without this commitment resulting from a particular research interest, many collections would not exist today.

³¹ The database held by the *Helmholtz-Zentrum für Kulturtechnik* explains "types of collections" as follows: "Sammlungsart charakterisiert den inhaltlichen Schwerpunkt einer Sammlung insgesamt. Die Klassifikation wurde an die UNESCO-Klassifikation für Museen angelehnt und für den Bereich der akademischen Sammlungen modifiziert" ["The type of collection characterises the main overall focus of a collection's content. Classification is based on the UNESCO classification for museums and modified for academic collections." – own translation].

The model based on departmental organisation in the university can have various advantages compared to an amalgamation of collections in a central university facility that is independent of the departments: it guarantees a direct link to the subject and close ties can be formed between the institute, faculty or chair and the collection. This particularly encourages the personal commitment of those persons who are responsible for the collection. Beyond their departmental base, many collections are comprehensively integrated into both teaching and research, they are well networked with other departments, and furthermore have gained additional importance for university management, such as for prestige purposes.

However, decentralised institutionalisation of collections in universities also has its disadvantages:

- _ The use of collections is strongly dependent on the research priorities of the immediately responsible organisational unit (chair, institute, department, faculty, etc.), which may change over time, and on personal dynamics; the link to an individual person results in structural uncertainty for the collection;
- _ Collections are often linked to smaller subjects, which in recent times have frequently been hit by restructuring measures. These then have a direct impact on the collections;
- _ Collections based in smaller organisational units often have a visibility problem and only a limited ability to articulate themselves with respect to university management. Sometimes this is due to a lack of departmental or interdepartmental coordination which could make them visible to university management.

In general, subject-based organisation can mean that collections are not well integrated into the university as a whole, with the result that their potential is not exploited for interdisciplinary use and networking. For a research infrastructure this is an unsatisfactory state.

Smaller collections in particular are often affected by these disadvantages. They are little known, do not have appropriate resources and are underused. These collections suffer from a kind of “sleeping beauty” syndrome: to an extent the collections are simply gathering dust; but through a change in management in the department responsible for them, through better networking within and outside of the university, or through central coordination combined with external stimuli (such as suitable support programmes), they could be “awakened”, as it were.

As a matter of principle, scientific collections should continue to be the responsibility of universities. There are strong reasons to support this: synergies can be

developed by integrating collections into higher-level institutions existing in the universities (research, infrastructure, administration, etc.); there is a direct link to research and teaching which can also result in direct orientation of the collection concept to the corresponding user groups; and in addition, spatial proximity to users in research and teaching facilitates access to the collections.

1.2 Non-university collections

Many scientific collections are not based in a university, including collections in *Länder*-, municipal and private museums. There is diversity – and a lack of clarity – with regard to their number, content and form.

Research is also conducted on and with collections that are not the responsibility of universities; this is seen, for example, in applications for funding for collection-based research. |³²

For non-university museums in Germany, the Institute for Museum Research (IfM) regularly publishes the “Statistische Gesamterhebung an den Museen der Bundesrepublik Deutschland” [Complete statistical survey of museums in the Federal Republic of Germany], which in 2007 contained details of 6,197 museums. |³³ However, it focuses on museums’ exhibition activities and visitor numbers, regardless of whether they are active in research or not, rather than on scientific collections. Furthermore, the survey does not exist in the form of a publicly accessible database as it is published in printed form. The statistics provide information on the thematic focuses of the museum collections:

|³² Examples of research involving non-university scientific collections can be found in the projects supported by the Volkswagen Foundation as part of the “Research in Museums” initiative, cf. <http://www.volkswagenstiftung.de/foerderung/gesellschaft-und-kultur/forschung-in-museen.html> of 27 September 2010.

|³³ Cf. Institut für Museumskunde, Statistische Gesamterhebung an den Museen der Bundesrepublik Deutschland für das Jahr 2007, vol. 62, Berlin 2008. The survey covers museums that are state funded, local authority funded, publicly funded in other forms, run by associations, societies and cooperatives, private foundations, private individuals, and those that have mixed public and private funding.

Table 2 Types of museums |³⁴

Museum type	Quantity	% of total
Folklore / local history	2.787	45
Art museums	631	10,2
Palace/castle museums	262	4,2
Natural history museums	318	5,1
Natural science, technology	754	12,2
Historical, archaeological museums	419	6,8
Collective museums ¹⁾	27	0,4
Special cultural history museums	925	14,9
Museum complexes	74	1,2
Total	6.197	100

1) = Museums with multiple collection focuses

Source: Institut für Museumskunde, Statistische Gesamterhebung an den Museen der Bundesrepublik Deutschland für das Jahr 2007, vol. 62, Berlin 2008, table 9

Collections having an ethnographic, local history or regional history focus are strongly represented among non-university museums.

The scientific collections held at German museums must comprise several hundred million objects. The collections in the *Leibniz-Gemeinschaft* museums have

|³⁴ On the definition of “type of museum”: „Die Zuordnung der Museen zu Museumsarten erfolgt nach ihren Hauptsammelgebieten und -schwerpunkten. Museen, die einer Person gewidmet sind, werden je nach Sammlungsschwerpunkt in die entsprechende Museumsart eingruppiert. Seit der Erhebung der Besuchszahlen für das Jahr 1987 verwendet das Institut für Museumsforschung eine der UNESCO-Klassifikation angeglichenen Einteilung. Hierdurch ist eine bessere internationale Vergleichbarkeit der Besuchszahlen von Museen gegeben. Eine vollständige Übernahme der UNESCO-Klassifikation war nicht möglich, da bei der UNESCO z. B. Ethnografische, Anthropologische Museen und Regionale Museen jeweils unterschieden werden. Aufgrund der spezifischen Museumsstruktur in der Bundesrepublik Deutschland werden diese Museen in unserer Statistik weiterhin in einer Gruppe (Museen mit volkskundlichem oder heimatkundlichem Sammlungsschwerpunkt) geführt. Zoologische und botanische Gärten sowie kommerzielle Privatgalerien und historische Gebäude ohne Ausstellungsgut werden entsprechend unserer Abgrenzungsdefinition nicht erfasst“ [“Museums are categorised as types of museums according to their main collection fields and focuses. Museums that are dedicated to a person are grouped under the corresponding museum type according to the main focus of their collection. Since the survey of visitor numbers for 1987, the Institute for Museum Research has used a classification system that is broadly in line with the UNESCO classification system. This allows greater international comparability between museum visitor numbers. It has not been possible fully to adopt the UNESCO classification system as UNESCO distinguishes, for example, between ethnographic, anthropological and regional museums. Due to the specific museum structure in the Federal Republic of Germany, these museums still appear in one group (museums whose collections have an ethnographic or local history focus) in our statistics. In accordance with our exclusion criteria, zoos and botanical gardens, commercial private galleries and historical buildings without any exhibits are not recorded”, own translation] cf. Institut für Museumskunde, Statistische Gesamterhebung an den Museen der Bundesrepublik Deutschland für das Jahr 2007, vol. 62, Berlin 2008, p. 18.

both natural history and cultural history focuses, and with some 73 million objects account for a good portion of the scientific collection objects that are preserved outside of universities. The *Museum für Naturkunde* [Natural History Museum] in Berlin, alone, has around 30 million objects in the fields of zoology, palaeontology, mineralogy and geology (cf. annex 2, key figures for the research museums in the *Leibniz-Gemeinschaft*).

The research museums that are supported within the *Leibniz-Gemeinschaft* occupy a special position among non-university collections. Because of their national importance and a science policy interest for the whole country, they are jointly funded by the German federal and *Länder* governments under art. 91b of the German Basic Law. Since early 2009, all *Leibniz-Gemeinschaft* museums have fallen within the portfolio of the German Federal Ministry of Education and Research (BMBF). Information on the research museums (thematic focuses, staffing, budget) is recorded by the *Leibniz-Gemeinschaft* and by the BMBF as the department responsible for them (cf. key figures in annex 2).

Eight research museums are currently jointly funded by the German federal and *Länder* governments within the *Leibniz-Gemeinschaft*:

- _ *Deutsches Bergbau-Museum*, Bochum (DBM) [German Mining Museum],
- _ *Deutsches Museum München* (DM) [German Museum, Munich],
- _ *Deutsches Schifffahrtsmuseum*, Bremerhaven (DSM) [German Shipping Museum],
- _ *Germanisches Nationalmuseum*, Nuremberg (GNM) [Germanic National Museum],
- _ *Museum für Naturkunde – Leibniz-Institut für Evolutions- und Biodiversitätsforschung an der Humboldt-Universität zu Berlin* (MfN) [Natural History Museum – Leibniz Institute for Evolution and Biodiversity Research at the Berlin Humboldt-University],
- _ *Römisch-Germanisches Zentralmuseum*, Mainz (RGZM) [Roman-Germanic Central Museum],
- _ *Senckenberg Gesellschaft für Naturforschung* (SGN) [Senckenberg Society for Natural History Research], based in Frankfurt am Main and
- _ *Zoologisches Forschungsmuseum Alexander Koenig – Leibniz-Institut für Biodiversität der Tiere*, Bonn (ZFMK) [Zoological Research Institute and Museum Alexander Koenig].

The research institutes and natural history museums in the SGN are located at nine sites in six *Länder* in Germany.

Within the *Leibniz-Gemeinschaft*, the research museums are grouped in different “sections” depending on their subject focus – either in the “humanities and educational research” or the “life sciences” section. Subject-based classification of the research museums is helpful for networking with other institutions in the *Leibniz-Gemeinschaft*, although interdisciplinary contexts and similarities between the research museums have no bearing on this classification.

An important structural feature in the collections held by the research museums is their direct integration into the facility as a whole. The four closely related basic tasks for the research museums, “collect, preserve/maintain, gain knowledge/analyse [...], transfer specialist information/service for the public” |³⁵ act as a structuring element: in general the larger research museums in particular have set up departments for collecting, for research, and for exhibitions. Combining these tasks is both an opportunity and a challenge as a balance needs to be struck between the various demands. Research museums report a relative increase in services for third parties compared to their own research activities.

In the wider context of collections, research museums in the *Leibniz-Gemeinschaft* perform an important function as partners for collection-based research and for other collections, and as a source of advice for smaller and medium-sized collections. Furthermore, long-term collection-based research projects are easier to implement here than in the universities, whose research tends to be oriented to the frequently short-term focuses of external funding. |³⁶

A collection can only be included in the *Leibniz-Gemeinschaft* and receive joint federal/*Länder* funding if certain criteria are met. These are the national importance of a facility, a science policy interest for the whole country in funding it, and a certain minimum size. |³⁷ University collections often fail to gain joint funding within the *Leibniz-Gemeinschaft* because of these criteria. Moreover, there are certain reasons – among them, in particular, the integration of the collection into university research and teaching – why the collection should remain with the university and these should also be examined closely alongside the acceptance criteria. In exceptional cases in the past, joint funding within the *Leibniz-Gemeinschaft* has been given precedence over a university basis. This was the case, for example, with the Research Station of Quaternary Paleontology in

|³⁵ Leibniz Association: Bericht der Leibniz-Gemeinschaft an den Ausschuss Forschungsförderung der Bund-Länder-Kommission zur Sitzung am 16. Oktober 2007 [Report of the Leibniz Association to the research funding committee of the Federal/State Commission for its session of 16 October 2007].

|³⁶ On this point cf. also Wissenschaftsrat: Stellungnahmen zu Instituten der Blauen Liste, vol. VII, Museen der Blauen Liste, Cologne 2000, p. 11.

|³⁷ The acceptance criteria are set out in the "Ausführungsvereinbarung zum GWK-Abkommen über die gemeinsame Förderung der Mitgliedseinrichtungen der Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz e.V." (AV-WGL) [Implementation agreement for the Joint Science Conference Agreement concerning joint funding of member institutions in the Leibniz Association] of 27 October 2008. Accordingly, joint federal and state involvement can be justified if the required contribution to the running costs of the facility being included generally exceeds EUR 5 million (engineering, natural sciences, life sciences, medical institutions) or EUR 1.5 million (institutions relating to the humanities, social sciences and economics). In special cases a deviation from these sums may be justified. Should it be necessary, the appropriateness of these amounts is checked.

B.II RESOURCES

The scientific use of non-university and university collections places particular demands on their financial, physical and human resources. Resource shortfalls set clear limits on usability and the intensity of use, and they do so irrespective of the scientific relevance of the objects or of the collection. Unless they are expressly prioritised, university collections often do not receive sufficient consideration in questions of financing, and they have to work hard to secure appropriate resources. Large differences in the resources allocated to collections are seen between and within universities. At the same time, there is generally no discernible pattern of preferential or discriminatory treatment of particular types of collections. Resources appear to be mostly adequate among the research museums in the *Leibniz-Gemeinschaft*, even though their broad range of tasks creates significant demands.

II.1 Finance

The great benefits for research that scientific collections bring are also accompanied by costs for the institutions that fund them. In particular, money has to be spent on acquiring objects, making collections accessible, on the continuous maintenance and long-term preservation of objects, and on their digitisation. Responding to enquiries from the scientific community and lending objects to other institutions are also tasks for scientific collections that require spending money. Typically, especially for smaller and medium-sized university collections, operating costs are far more relevant than the investment costs.

As infrastructure facilities, scientific collections have a need for continuity that can be met through sufficient core funding. This core funding may be supplemented but cannot be replaced by project financing with a more short-term and thematic focus. At present, however, the financing of university collections – in terms of both structure and volume – is in many ways unsuited to maintaining them as a long-term, fundamental research infrastructure or facilitating their use in line with demands. Core tasks relating to collections (care, preservation, indexing) are often not sufficiently covered by core funding. When it comes to

|³⁸ Cf. Wissenschaftsrat: Stellungnahme zum Forschungsinstitut und Naturmuseum Senckenberg (FIS) Frankfurt am Main, in: Wissenschaftsrat: Stellungnahmen zu Instituten der Blauen Liste und zu Aufnahmeanträgen in die Blaue Liste, vol. V, Cologne 1998, pp. 9-62.

competition within universities for scarce resources, collections and collection-based research are often at a disadvantage due to internal criteria for resource allocation that tend not to be suited to collections (particularly teaching performance, external funds, bibliometrics) and due to low visibility. |³⁹ If universities experience a financial squeeze, collections are easily allowed to fall by the wayside. |⁴⁰

Only a very few university collections have budgets for the acquisition of objects. It is more difficult to make targeted additions to a collection if new objects can only be acquired via donations, foundations, donations in kind, etc., over which there is only limited control.

Compared to university collections, the *Leibniz-Gemeinschaft* research museums, as independent institutions, are in a better financial position (see annex 2). As well as placing the *Leibniz-Gemeinschaft* under the responsibility of the German Federal Ministry of Education and Research, their resources have been improved. For example, they benefit from the annual increase in financial support for *Leibniz-Gemeinschaft* institutions of three to five percent under the “Joint Initiative for Research and Innovation”, from the recalculation and increase in the research portion of the museums’ budgets, which is decisive for joint financing, at the end of 2009, and from investment by the German federal and *Länder* governments in the double-digit millions. These financial moves indicate that the German federal and *Länder* governments have recognised the specific importance of research museums in the *Leibniz-Gemeinschaft* and will continue to support the museums’ positive development trend.

II.2 Accommodation

Collections need appropriate accommodation that both corresponds to their function as research infrastructure and supports the long-term preservation of the objects. Currently there are no reliable international standards or guidelines which could provide guidance for the persons who are responsible for the collections. Conservation research could provide some pointers as to what constitutes good accommodation that meets the various different requirements of the

|³⁹ University administrators can be constrained by forms of funding allocation which are structurally disadvantageous to collections, for example if the allocation of funds is linked principally to the teaching performance of scientific staff and the funding ratio does not adequately take the specific characteristics of collections into account.

|⁴⁰ A recent example of a closure decision due to financial difficulties was the closure of two departments of the botanical garden at the University of Marburg. This was due to the pressure to make savings in connection with the Higher Education Pact between the university and the State of Hesse, cf. dpa-Dossier Bildung Forschung, no. 25/2010, 21 June 2010, p. 22.

objects, but university collections in particular do not yet sufficiently utilise opportunities for collaboration with this field of research (cf. B.IV.2).

In many cases, collections are accommodated in such a way that storage rooms are directly linked to work rooms, often with the addition of exhibition spaces. However, many university collections are not housed in such a way that both makes them available for research and also ensures their long-term preservation: they are stored in areas that are difficult to access and are in acute danger through a lack of theft protection, fire protection and climate control. Minimum standards for appropriate conservation are not always met. This also applies to objects that are highly relevant to science or as cultural heritage.

In accordance with the mostly subject-related organisation of university collections, at most universities they are not housed together. Their accommodation at different locations facilitates direct access to the objects by users in the relevant specialist field. However, separate accommodation of individual objects in a collection can reduce its functionality as the value and relevance of a collection often result from the grouping together of individual items. Breaking up the ensemble results in a substantial loss of specific scientific value and scientific usability for the collection. It is also often the case that the original spatial context of the collection enhances its value for research. Relocating the collection is then also a step that reduces its scientific value.

Investments that would be important for the adequate accommodation of university collections are often not made. Even among the research museums in the *Leibniz-Gemeinschaft* there is a need for refurbishment, although this is set to be addressed as a result of investment decisions made in recent years.

II.3 Human resources

Scientific collections have specific requirements for professional staffing in order to fulfil custodial functions. Yet full-time curators who oversee a collection in a preservation, maintenance and research capacity are something of a rarity. In terms of their concept and job description, curator positions are highly disparate; curators often also perform teaching tasks to a certain extent. |⁴¹

Care of collections is often in the hands of extremely dedicated and motivated scientific personnel who perform collection-based activities as a sideline. In many cases collections are also looked after by retired (former) staff, students, non-scientific staff and by volunteer helpers from associations and foundations.

|⁴¹ A number of specialist groups – mainly in the natural sciences – are now making efforts to standardise and agree on the roles of curators, e.g. the Society for Biological Systematics, cf. <http://www.gfbs-home.de/> of 27 September 2010.

Voluntary involvement has a very high value for collections and is often indispensable. It is also evidence of the great importance that is attached to the collection. But not all collections can attract voluntary involvement to the same extent. It is particularly difficult for smaller, relatively unknown collections.

Overall, university-based scientific collections have critical staff shortages. Only in a very few cases do university collections have adequate staff resources that meet their usage requirements and are equally tailored to the needs of the collection and of collection-based research. Some collections have to completely do without budgeted staff, while many are subject to high fluctuation. Not infrequently, the lack of staff means that research enquiries cannot be dealt with. Staff qualification requirements generally result from the function of a collection: a large living collection |⁴², for example, requires a large number of maintenance and support workers – such as gardeners and animal keepers – in addition to scientific personnel. Custodial care is not required for a self-contained collection that is used exclusively for teaching, for example; yet there is often a lack of professional and scientific support that cannot be replaced by voluntary support, especially as orientation training, accompanying advice, and guidelines, rules or standards for dealing with collections are generally not available (cf. B.IV.1).

Scientific involvement with a collection is often not recognised as a research activity or as an activity that accompanies research. Thus the scientific personnel who are involved with collections generally lack extrinsic motives for dedicated involvement, for example suitable qualification opportunities, career prospects, opportunities to increase their status, appropriate recognition for caring for the collection, etc. As a result, when there is competition between the divergent tasks performed by scientific personnel, activities relating to collections often lose out.

B.III USE

III.1 Functions of scientific collections

Scientific collections are used for different purposes, some of which are closely related, among which the most important are:

- _ Research,
- _ Teaching,
- _ Transfer of scientific knowledge to the public, and

|⁴² “Living collections” refers to collections of living plants or animals.

The use of collections for research and teaching makes it clear that they are among the core tasks of a university, and that they are an integral part of universities. However, the functions of transferring knowledge to third parties (teachers in schools, school students, journalists, publishers, the wider public, etc.) and exhibitions also illustrate their relevance beyond the science context: many collections are regularly visited by a broad and also non-specialist public; no doubt such usage is best known in the case of botanical gardens. Many collections – especially ones which don't have regular opening hours – also pull in large crowds during special events such as a *Lange Nacht der Wissenschaften* ["Long Night of Science"] or *Lange Nacht der Museen* ["Long Night of the Museums"], when museums stay open until the small hours. This promotes a positive external image and helps regional science networking. It is also not unusual for the exhibition rooms of university collections to be used for university events, i.e. in a representative function. In particular the unique haptics and visual nature of an object collection are utilised for transfer and teaching activities. The potential of scientific collections for transferring knowledge to a broader public has been exploited more fully recently and represents an obvious legitimisation strategy for the collections.

Moreover, scientific collections perform the important function of promoting scientific dialogue. Many scientific collections, due to their uniqueness, also receive scientific enquiries from abroad. As a result they contribute to the establishment and development of national and international cooperative relationships and to an increase in the (inter)national visibility of the institution which houses the collection.

Use for scientific teaching is a more important function for university collections than for non-university collections. Exhibitions, knowledge transfer, and preservation are more important for non-university, museum-based collections. Pure research collections and also pure teaching collections can be found at universities. It is rarer to find collections which are held solely for the purpose of exhibitions or the preservation of objects. Most collections fulfil multiple functions. Priorities are set within a range of purposes and can also relate to individual parts of the collection, for example if parts of the collection are regularly accessible to the public in exhibitions while other parts are regularly made available to external users for research purposes. Prioritisation makes particular sense because the different functions can compete with each other. For exam-

|⁴³ These functions essentially correspond to ICOM's definition of research museums, with the addition of the function of teaching, which is relevant to universities, as a specific form of transfer, cf. Deutscher Museumsbund e.V. / ICOM: Standards für Museen, Kassel/Berlin, February 2006, p. 6.

ple, active use by researchers is not always compatible with a primarily preserving function. Or placing objects in an exhibition can make it more difficult for them to be used for research purposes outside of the exhibition concept.

A collection's functions can change. A collection that was originally formed for exhibition purposes can gain increasing relevance as a research collection. Conversely, collections which were originally created for research purposes can be used increasingly for teaching and exhibition purposes over the course of time.

The concepts of university collections – if they exist at all – do not always reflect the functions of the collection. Instead they often merely reflect the current inventory of the collection, which has been built up in an undirected fashion, without any systematic concept for future development.

III.2 Use for research

As noted earlier, collection-based research occurs in the form of research with collections and objects, and research about collections and objects; documentation and indexing of collections can be added to this, as can scientific activities relating to exhibitions and knowledge transfer (cf. A.IV).

Scientific collections are usually permanent institutions which are preserved beyond their context of origin, i.e. the research interest or specific research project that led to their formation. Thus they are also important witnesses to long-term scientific developments. Their function goes well beyond a purely conservational one, however, as they also enable earlier insights to be checked, confirmed and in particular expanded through new methods and new questions. It is often difficult to predict what use and relevance a collection will have for research given all manner of scientific developments, especially since a collection can acquire relevance in different question contexts or in other disciplines beyond the original disciplinary context in which it was formed. Specific examples of research with and about collections are given in part A of this paper.

The following types of scientific collections can be distinguished according to the way they are actually used for research:

- 1 – Research-active collections of undisputed scientific value that are currently integrated into research;
- 2 – Collections which have been indexed and can be used for research projects;
- 3 – Collections that are not accessible or whose existence is not known, but which could be useful for research (“sleeping beauty collections”);
- 4 – Collections which as far as is currently known will not be relevant for research even in the future.

Classic “university collections” are also found at many universities. These are collections of memorabilia relating to the university's history (in Germany they

are often looked after by a “*Kustodie*” department). In general they exist primarily for prestige purposes, but they are also used for research relating to science history and the history of universities.

III.3 Intensity of use

There is great variation in the intensity of use by science, i.e. the frequency, the nature and the extent of use of the university collections. Some collections are regularly used within the university for research and teaching. Others are heavily used by scientists from external research facilities, including ones abroad, with the result that external use is sometimes more intense than internal use. However, some collections are hardly used – not for research, teaching or exhibitions – even within their university except by the units that look after them.

Nevertheless, user numbers alone are not a reliable indicator of the scientific value of a collection. A lack of use of scientific collections for research purposes is often due to the fact that access and visibility are poor or completely lacking. In general, the conditions for use have a decisive influence on the intensity of use (cf. B.IV). Not least, however, the scientific relevance of the collection objects or of the collection as a whole also affects usage intensity. Yet the relevance and specific value of a collection are not necessarily immediately obvious to all; they may need to be realised and communicated first.

B.IV USABILITY

Although research has an identifiable need for scientific collections and collection objects, this is not always identical to the research-related use of the collections. There is a direct relationship between actual use and usability, i.e. use of collections as research infrastructures depends on adequate care and maintenance, on indexing, and on accessibility – both physically and if possible also virtually. The inherent importance that objects in a collection have for science can only be realised if these external conditions for scientific use are actually met.

Maintenance, documentation and the granting of access are conditions for the usability of a collection as research infrastructure and hence are essential services for research. Many collections are very well looked after and outstandingly accessible. They can be used and are used in a wide variety of ways. At the same time there are also discernible shortcomings in this respect, particularly among university collections.

Limitations on the usability of university collections often result from insufficiently professional management and from a lack of quality assurance. A lack of professionalism is primarily due to the fact that no reliable standards for dealing with scientific collections, including adequate care, have been established to date (cf. B.II.3).

Because especially smaller and medium-sized collections are strongly dependent on individual people in their structure and organisation, medium and long-term concepts for content priorities and collection activities that are independent of these often do not exist. If there is no sustainable, forward looking concept for the collection that does not depend on an individual person, the use of resources cannot be managed in any targeted way. There are no objective selection and quality criteria for the collection – for making acquisitions, receiving or rejecting donations, or eliminating objects from the collection – or for setting thematic priorities and profiling a collection in terms of its content. Evidently even the simple collection principle of “*renforcer la force*” – according to which areas should be strengthened which promise to help profile the collection, as opposed to encyclopaedic collecting – is often not taken into account.

Beyond the need to be scientific, there are no reliable standards for managing scientific collections, neither at the national nor international level. |⁴⁴ The “Standards for Museums” developed by ICOM Deutschland and the German Museums Association are an important quality assurance guide for collections in museums. |⁴⁵ Until specific standards for managing scientific collections are developed, the criteria from this publication can also serve as a guide for university collections.

There may also be a need for improvement in the management of all the collections under the responsibility of a higher-level institution (university). This particularly concerns the allocation of funding to the collections (cf. B.II.1), networking between the collections and with other parts of the university, university-wide coordination of the collection strategies, and the visibility of the collections within the university.

|⁴⁴ Standards for managing natural history collections are currently being developed in the SYNTHESYS project, which is funded in the EU's Seventh Framework Programme for Research, cf. http://www.synthesys.info/II_na_2.htm of 27 September 2010.

|⁴⁵ Deutscher Museumsbund e.V. (publisher) in conjunction with ICOM Deutschland, Standards für Museen, Kassel/Berlin, February 2006. These standards are intended as a standardised reference framework for museums with regard to assessing their own performance and potential for improvement. The standards relate to museum concepts, museum management, human resources and museums' core tasks: collection, preservation, research and documentation, plus exhibitions and knowledge transfer.

Appropriate care – accommodation, protection and conservation – of scientific collections is a necessary condition for their usability and long-term preservation. This cannot be assured through a one-off investment or in project form as it is an ongoing task. A collection's maintenance requirements will vary depending on its primary function and the objects it contains. As a minimum requirement, the collection should be inventoried, described and housed in a secure place that satisfies the requirements of the objects.

It is positive to note that in individual cases universities succeed in appointing staff to care in a coordinated way for various collections which have similar requirements. Mutual support between collections and, for example, libraries or archives is also found in individual cases. However, care of collections is often not professionalised.

Care for university collections requires special expertise. Every piece in a collection has more or less complex, individual requirements for its care. For example, most objects require appropriate climate control and protection against water and fire; but some objects have additional requirements such as protection against light, corrosion, and insects. Hence the requirements for conserving and restoring objects are highly complex; special research areas have now become established for this purpose. Restoration and conservation research therefore provides specific solutions for the care of all kinds of objects, but these are actually applied only in very few cases. University collections do not sufficiently exploit opportunities for cooperating with restoration and conservation research. In contrast, the research museums in the *Leibniz-Gemeinschaft* carry out restoration and conservation research themselves. As a result, compared to the university collections, they exhibit a greater degree of professionalism in the way they manage their collection objects, and could develop standards for the preservation, care, storage and presentation of collection pieces.

IV.3 Access

Most collections are directly accessible, even if this is only at certain times in certain places. By contrast, there is still a serious need to expand virtual access via online catalogues or databases (cf. B.IV.4). Some university collections, or parts thereof, have poor or no direct access. Basic requirements for proper access to a collection, which are not met everywhere, include catalogues and inventories which give an initial overview of the collection's content, and suitable rooms in which the objects can be used at certain times, and not least support staff: in addition to requiring on-site support, users' enquiries concerning specific objects, e.g. for loans, need to be dealt with. In many cases, staff capacities at universities are not sufficient to enable users' queries to be processed and to grant access to all potential users (cf. B.II.3).

In comparison, the accessibility of the objects held by the *Leibniz-Gemeinschaft* research museums is better. Providing specialist information and services to third parties is defined as one of their core tasks. This includes ensuring access to the collection objects. However, there are still many challenges to be met here, especially with regard to digital access.

Understandably, access to a collection that is primarily geared to preservation may be restricted so as not to endanger the preservation of the objects; with a scientific collection, where there is a conflict of interests the research interest will take priority.

IV.4 Documentation, indexing, digitisation

The documentation and scientific indexing of a collection are basic requirements for making its scientific potential visible and enabling adequate access for research.

In the first instance, documenting a collection simply involves describing the objects contained in it, for example in an inventory (description of the collection, of the objects, with pictures). The next step is to index the collection. Here the objects are systematised (in a catalogue) and linked to additional information. It makes sense to do this in the form of a database in which objects can be linked to meta data and which enables advanced search options. |⁴⁶ A further indexing step is to link information from individual collections to information from other collections, for example in a comprehensive database, provided that the meta data is in a standardised form that permits this.

For a large number of collections, however, even the first step of inventory taking – the digital or analogue documentation of a collection in inventories that are accessible and comprehensible to third parties – has not happened so far. Often only parts of the collection are documented, and any further documentation is either impossible or can only happen very slowly due to a lack of resources. Building on this basic inventory, the step of scientifically indexing the collection objects, i.e. defining the objects and organising them in catalogues or digital databases, has also often not been carried out, or only partially.

Even if individual documentation and indexing steps can be performed in analogue or digital form, digital documentation and indexing is not only the contemporary alternative, it also offers advantages over analogue procedures: in particular, the usability and usage intensity of collections are considerably boosted by digital documentation in online catalogues and databases as these

|⁴⁶ On this point, cf. also: Wissenschaftsrat: Recommendations on Research Infrastructures in Humanities and Social Sciences (Drs. 10465-11), Berlin, January 2011.

become visible and available to a wider and international public. Even the simple step of making a collection catalogue available online via the internet results in a considerable increase in use for many collections. In addition, digital linking of collections and collection objects enables the generation of new research questions and can promote networking between collections both within and outside of a university. Moreover, the digitisation of objects can be viewed as a form of redundant conservation that offers a certain safeguard in case the original object is lost through force majeure, negligence, by accident or otherwise. All the same, a digital copy can never replace an original object.

Even though the advantages of digital documentation and indexing of objects are no longer in dispute, there is often a lack of resources (staff, server capacities, equipment, software) precisely in this area, with the result that it remains a key desideratum. Although collections are often listed in electronic databases, there is no digital access to the objects themselves as they are not individually digitised and indexed. Conversely, objects are sometimes digitised but not indexed and therefore not searchable via an electronic database. Without online access, the digital copy at most has the value of an electronic reproduction. As such it does not fulfil the purpose of generating visibility, availability and easier access. An increase in the intensity of use cannot be achieved in this way. Three-dimensional digital copies are found extremely rarely, even if these could give the truest representation of the original object. Both two-dimensional and three-dimensional digital copies place high demands on reproduction technologies and server capacities. The last point in particular should not be neglected when considering the long-term cost-effectiveness of digitisation. It can be seen that even for rudimentary digitisation efforts, money is spent ineffectively if the follow-up costs (technical equipment, staff) for an electronic database and making the content available free in the internet are not met.

Nevertheless, positive exceptions of digital indexing can be found, for example via subject-based portals such as the GBIF biodiversity database, |⁴⁷ or also in

|⁴⁷ Digitisation and the linking of data between locations are particularly essential for biodiversity research. The use of collections for modelling purposes requires the collection data to be digitised and made accessible via the internet. Currently more than 1.7 million species of organisms are known to exist on Earth and have been described. Natural history research collections keep preserved reference specimens and, in addition, several hundred million biodiversity data records exist around the world in research facilities, databases and publications. To make this extensive material available for the preservation and sustainable use of biological diversity, in 2001 the Global Biodiversity Information Facility (GBIF) was set up. The GBIF portal links together existing databases of scientific data and information on biodiversity, and makes them accessible via a central portal. The project has a decentralised structure as it merely links data from a total of 321 providers in 54 countries. Forty-eight natural history collections and research institutes in Germany make their data available. Currently more than 217 million biodiversity data records can be accessed via the international GBIF portal. For information on the database see <http://www.gbif.de/> of

interdisciplinary databases that are often linked to a university, for example the “*Katalog der wissenschaftlichen Sammlungen der Humboldt-Universität zu Berlin*” [Catalogue of scientific collections at the Berlin Humboldt University], which was created as part of the “*Kabinette des Wissens*” [Cabinets of Knowledge] project, |⁴⁸ or in the University of Greifswald’s project to develop a central database for all collections. |⁴⁹ Research portals also exist which cover multiple collections and universities, for example the “*Universitätsmuseen und -sammlungen in Deutschland*” [University museums and collections in Germany] database mentioned earlier, |⁵⁰ or – internationally – the “UMAC database”, although this does not go down to the level of individual collection objects. |⁵¹

Due to an insufficient level of analogue or digital documentation and indexing, the majority of universities do not have a comprehensive overview of their respective inventories. Hence there is also no national overview with extensive indexing down to the level of individual objects. Even for the collections of the *Leibniz-Gemeinschaft* research museums, scientific indexing has not yet been carried out to a sufficient extent. New knowledge is even generated through the successive indexing of collections. For example, every year new species are “discovered” in the collections of the major natural history research museums in Germany.

However, overall a positive trend can be seen: if new indexing activities are tackled, the digital option is usually chosen. In many cases, however, such projects are still at the planning stage or have only recently started.

27 September 2010, and for a list of participating institutions in Germany: <http://www.gbif.de/gbif-de/Institute%20Liste.html> of 27 September 2010.

|⁴⁸ Since 1999, in a pilot project at the *Helmholtz-Zentrum für Kulturtechnik*, so far approx. 13,000 collection objects held by the *Humboldt Universität zu Berlin* [Humboldt-University Berlin] and *Charité – Universitätsmedizin Berlin* [Charité – university medicine Berlin] have been systematically documented, indexed and digitised, cf. <http://www.sammlungen.hu-berlin.de> of 27 September 2010; there is no complete documentation of all collection contents.

|⁴⁹ In its initial phase in 2009 this project was financially supported by the Rector's Office of the University of Greifswald; it is not finished yet.

|⁵⁰ Cf. <http://publicus.culture.hu-berlin.de/sammlungen/> of 27 September 2010.

|⁵¹ UMAC, initiated by ICOM, is a worldwide database of university museums and collections that currently contains 2,580 published records from 63 countries. At present, UMAC is represented in 40 countries and aims to make a global directory of university museums and collections accessible to the public; cf. <http://publicus.culture.hu-berlin.de/umac> of 28 September 2010.

Various funding instruments, while not replacing the necessary core funding, offer supplementary support:

The German Research Foundation (DFG) supports collection-based research and collections in different funding streams. Collections are supported in natural science research projects, and also in larger joint projects, for example relating to ecological issues, provided these are clearly hypothesis-led research projects in accordance with the usual funding criteria. In collaborative projects, however, the collections are often seen primarily as service providers. It is problematic that long-term systematic research in particular, of the kind that is important in biodiversity research, for example, cannot meet the usual requirements for DFG funding. DFG also offers funding options for collection-based research in the humanities and cultural sciences, especially via cooperative projects, where it mainly focuses on collections and museums relating to classical studies; smaller and regional collections and museums tend not to be considered here due to the way the funding is targeted.

A positive point is that the DFG also offers funding instruments for infrastructure-related scientific activities. In its “Scientific Library Services and Information Systems” (LIS) funding area, DFG supports the indexing and digitisation of collections. While this programme previously focused primarily on manuscripts and printed matter, its scope has recently been widened to include collections of objects: a call for proposals for “indexing and digitising object-based scientific collections” was published in June 2010. ^{|52} The call for proposals is aimed at scientific information service facilities that curate and archive research-relevant objects. Funding is provided for up to three years with the aim of establishing the fundamental technological, methodological and organisational requirements for object-related indexing and digitisation, and, in addition, developing possible solutions for nationwide digital access to scientific collections. The most important funding criterion is the nationwide scientific need for digital use and the substantial added value to research of the digital availability of objects.

The DFG’s various funding areas represent important funding options for collections and collection-based research, but they have their limits nevertheless. The established assessment criteria, the composition of the decision-making bodies (review boards), the separation of the funding areas (subject-based fund-

^{|52} Cf. http://www.dfg.de/download/pdf/foerderung/programme/lis/ausschreibung_ed_objekte.pdf of 27 September 2010.

ing, infrastructure-based funding) and the project-based nature of the funding, which is designed in a subsidiary way, would appear to have only limited suitability for collections as infrastructure and for collection-based research, which is frequently long-term. The DFG's latest call for proposals for the indexing and digitisation of object collections is to be welcomed as a funding measure specifically tailored to collections. However, in its current form it excludes collections which are maintained as a secondary activity at institutions with a primarily scientific orientation, which is typically the case at universities. As a result of its primary orientation to service facilities and digitisation projects with a mainly technical/methodological approach, it neglects the scientific character of work with scientific collections.

In 2008 the Volkswagen Foundation set up the "Research in Museums" funding initiative, which aims to boost research activities in museums. |⁵³ The initiative hopes to counteract the neglect of research in favour of exhibition and events, which in the view of the foundation constitutes an existential threat to museum work in general – particularly since, in the long term, ideas for new exhibitions can only be generated by researching their collections. The first line of funding is aimed at small and medium-sized museums, which the foundation considers to be particularly threatened by budget cuts. The second and third lines of funding, which run in parallel, additionally aim to promote the international visibility of large museums and raise the profile of museums as research institutions. In 2009/2010, thirteen projects were awarded a funding volume of some EUR 4 million; three events and event series have also been supported to date.

The Volkswagen Foundation's initiative is very well suited to supporting small and medium-sized museums that are active in research, but because it is aimed only at publicly accessible museums with long-term exhibition activities it does not solve the financing problems of university collections.

The German Federal Ministry of Education and Research primarily supports collection-based research in the humanities through its "*Übersetzungsfunktion der Geisteswissenschaften*" ["Translation function of the humanities"] funding programme in the "*Forschen in und mit Museen*" ["Research in and with museums"] section. |⁵⁴ Since 2009, twelve joint projects with museum involvement have received funding worth more than EUR 8 million. The funding is aimed at boosting research in and with museums and enhancing networking between museums, universities and research institutes, for example by carrying out re-

|⁵³ On the funding initiative, cf.: <http://www.volkswagenstiftung.de/foerderung/gesellschaft-und-kultur/forschung-in-museen.html> of 27 September 2010.

|⁵⁴ Cf. <http://www.bmbf.de/foerderungen/10761.php> of 28 September 2010.

search into objects as a collaborative activity between museums and university institutes / research institutes in keeping with the “translation function of the humanities”. As well as developing subject and content related aspects of cultural heritage, the aim is also to develop technologically innovative concepts relating to presentation. Like the Volkswagen Foundation’s funding, this funding is aimed primarily at non-university collections and museums that seek to network with universities. Funding is limited to a duration of two to three years.

A few funding instruments are available for the digitisation of objects. The “Plants Initiative” |⁵⁵ of the Andrew W. Mellon Foundation is significant for the digitisation of herbarium specimens. |⁵⁶ Digitisation (also in three dimensions) and digital indexing of various collections are also promoted in cooperation projects with the Max Planck Institute for the History of Science (MPIWG). The Volkswagen Foundation’s “Research in Museums” programme also supports the digitisation of objects to a limited extent, if this is necessary as part of an innovative research project that is being funded. A recent example of funding for digitisation projects is the DFG’s call for proposals for the “indexing and digitisation of object-based scientific collections” which was mentioned above.

On the whole, the available funding options tend not to be suited to collection-based research and scientific collections at universities. Because they have only a selective focus and support certain areas in projects with narrow time constraints, they are not able to replace the necessary long-term institutional funding of collections. |⁵⁷

B.VI NETWORKING AND COORDINATION BETWEEN INSTITUTIONS

The highly varied collection landscape in Germany has neither been mapped nor is it extensively coordinated. There is no complete record of the collections

|⁵⁵ The Plants Initiative is a partnership of more than 150 herbaria from over 55 countries working to create a database of high quality images of plant type specimens, primarily of African and Latin American origin, in order to reduce loans of original specimens, cf. http://www.mellon.org/grant_programs/programs/conservation of 28 September 2010.

|⁵⁶ Recipients of funding include the *Universitätsherbarium Göttingen* [Herbarium at the University of Göttingen], the Herbarium Haussknecht at the University of Jena, and the Herbarium at the Botanic Garden and Botanical Museum Berlin-Dahlem.

|⁵⁷ A survey of non-university museums conducted by the Institute for Museum Research also included the funding of indexing work and long-term research projects in a list of key desiderata, cf. Parzinger, Hermann: Perspektiven durch Forschung. Anmerkungen zur Zukunft von Forschung in Museen, in: Krull, Wilhelm und Graf, Bernhard (eds.): "Was heißt und zu welchem Ende betreibt man Forschung in Museen?" Tagungsband Berlin 2007, Mitteilungen und Berichte aus dem Institut für Museumsforschung, Berlin 2009, pp.16-27, p. 21.

and objects in Germany, especially those held by non-university institutions. As far as universities are concerned, the DFG “*Universitätsmuseen und –sammlungen in Deutschland*” [“University museums and collections in Germany”] project took an important first step by creating a central record of which collections are located where. |⁵⁸ It is impossible to coordinate collection activities if no comprehensive information is available about the collections that exist and their concepts and strategies. This shortcoming is a major reason why collections often fail to demonstrate their relevance as research infrastructure to decision-makers and funders in the German federal and *Länder* governments and in funding institutions, or even within the respective university. Few steps have been taken to coordinate collection concepts, priorities and acquisition strategies between institutions and on an interdisciplinary basis. The lack of coordination processes and networking may result in redundancies in the collection focuses and collection’s contents, while there may also be a danger of neglecting certain collection themes; if collections are closed in an uncoordinated way, it may become completely impossible to respond to certain research enquiries. There is no “red list” of endangered collections or objects that are urgently required.

Partly as a result of the DFG project concerning university collections, things have started moving recently in the community of people who are involved with collections and who conduct research using collections. For example, conferences and forums have been held to enable dialogue. This informal self-coordination is assisted by institutional partnerships: there are a number of initiatives in which scientific collections have joined together in larger associations to represent their common interests and strengthen cooperation. The most important ones in Germany are the consortium called “*Deutsche Naturwissenschaftliche Forschungssammlungen*” (DNFS) [German Natural History Research Collections] and the Humboldt Ring, both of which are associations of natural history collections.

The DNFS consortium was set up in 2007 and currently has eight full members which are university and non-university institutions in the natural sciences. |⁵⁹ The consortium aims to promote cooperation, coordination and synergies, de-

|⁵⁸ Cf. <http://publicus.culture.hu-berlin.de/sammlungen> of 28 September 2010.

|⁵⁹ Full members of DNFS are: *Botanischer Garten und Botanisches Museum* (BGBM) [Botanical Garden and Botanical Museum], Berlin-Dahlem, *Forschungsinstitut und Naturmuseum Senckenberg* [Research Institute and Natural History Museum Senckenberg], Frankfurt am Main, *Museum für Naturkunde* [Natural History Museum] Berlin, *Staatliches Museum für Naturkunde* [State Natural History Museum], Stuttgart, *Staatliches Museum für Naturkunde* [State Natural History Museum], Karlsruhe, *Staatliche Naturwissenschaftliche Sammlungen Bayerns* [Bavarian State Natural Sciences Collection], *Zoologisches Forschungsinstitut und Museum Alexander Koenig* [Zoological Research Institute and Museum Alexander Koenig], Bonn, *Zoologische Sammlungen der Universität Hamburg* [Zoological Collections at the University of Hamburg].

velop regional focuses and services, and represent German collections “collectively as essential research infrastructure.” Other aims of DNFS are to raise the profile of German natural history research collections, initiate and coordinate joint programmes and third-party funded projects at national, European and international level, develop concepts for the upkeep and sustainable utilisation of collections, develop a joint national digital documentation and information system, and foster young talent. |⁶⁰

Established at the end of 2009, the Humboldt Ring is a new kind of cooperation model for collections. It is an association of six major natural history research collections. |⁶¹ Their longer-term aim is to set up a joint scientific advisory body, implement a joint acquisition policy for collections with shared use of resources, carry out joint research projects and draw up a strategic plan for human resources development and investment. Decisions are taken by a joint steering committee. The institutional independence of the institutions is to be largely maintained within the Humboldt Ring, but the intention is to merge strategic elements to achieve closer ties between the cooperation partners.

In recent years, the *Senckenberg Gesellschaft für Naturforschung* (SGN) [Senckenberg Society for Natural History Research] has developed into a centre for natural history collections. For some collections, transferring the collection to the Senckenberg Gesellschaft has proven to be the option of last resort in a difficult financial situation. The collections are affiliated as departments of the Senckenberg Gesellschaft.

The observation that it is predominantly natural history collections that join forces is also borne out by numerous efforts at networking and coordination at the international level (University Museums and Collections [UMAC], International Council of Museums [ICOM], Scientific Collections International [SciColl], European Academic Heritage Network [Universeum], Consortium of European Taxonomic Facilities [CETAF], European Distributed Institute of Taxonomy [EDIT] etc., cf. annex 1).

In the international arena, the SciColl initiative, which was launched in 2006 by the Global Science Forum of the Organisation for Economic Cooperation and Development (OECD), is an interesting networking platform (“coordinating

|⁶⁰ Cf. <http://www.dnfs.de> of 28 September 2010.

|⁶¹ As at April 2010, the members are: *Botanischer Garten und Botanisches Museum* (BGBM) [Botanical Garden and Botanical Museum], Berlin-Dahlem, *Museum für Naturkunde* [Natural History Museum] Berlin, *Staatliche Naturwissenschaftliche Sammlungen Bayerns* [Bavarian State Natural Sciences Collection], *Staatliches Museum für Naturkunde* [State Natural History Museum], Karlsruhe, *Staatliches Museum für Naturkunde* [State Natural History Museum], Stuttgart, *Zoologisches Forschungsinstitut und Museum Alexander Koenig* [Zoological Research Institute and Museum Alexander Koenig], Bonn.

mechanism”) for natural history collections and museums, which in future will also be represented by a joint secretariat. |⁶² SciColl’s aims include producing a roadmap of collection-based research, defining standards and good practices for collections, and developing self-assessment tools for collections. In Germany, the Museum für Naturkunde, Berlin, is involved in the initiative. |⁶³

There is a confusing array of national and international networking tools, some of which operate in parallel. Existing mechanisms and forums for networking between collections have a strong focus on natural history collections. Smaller and medium-sized collections and museums are also mainly networked in the area of natural sciences. In comparison, networking is significantly less developed in the area of cultural history and art history collections, which is presumably also due in part to different disciplinary cultures.

|⁶² The secretariat and its Executive Director (SciColl CEO) will have the remit of coordinating international collaboration between scientific collections and promoting common interests; cf. OECD Global Science Forum, Second Activity on Policy Issues Related to Scientific Research Collections: Final Report on Findings and Recommendations Submitted to the 19th Meeting of the OECD Global Science Forum by the Delegation of the United States Washington DC, 17-19 July 2008.

|⁶³ Cf. *ibid.* and <http://www.scicoll.org> of 28 September 2010.

C. Recommendations on the further development of scientific collections as research infrastructures

Scientific collections are a significant research infrastructure in many fields. Their materiality and their specific order allow for scientific questions to be investigated and answered in a unique way which would not otherwise be possible; they are also able to stimulate new scientific questions. In Germany there is a large number and great variety of collections, both in terms of their main thematic focuses and in respect of their institutional organisation, and their use and usability in research. The German Council of Science and Humanities expressly welcomes this diversity and the efforts of many universities and non-university supporting institutions to maintain this diversity of scientific collections as infrastructure for science.

A positive development trend can be noted for the research museums in the *Leibniz-Gemeinschaft*. Investments which are currently needed are being made in these museums; their relevance as facilities which combine collecting, research, preservation and exhibitions is undisputed. Some of them are highly visible and are performing very well, and these museums would be in a position to fulfil more of an advisory and role model function for university collections, especially in questions concerning the care of collections, than has previously been the case.

Scientific collections should be seen as essential research infrastructures whose preservation, upkeep and usability for research is not a dispensable ancillary service but a core task for the institutions which support them. The universities

in particular need to embrace this view: even if universities are not museums, in their capacity as organisational centres of science |⁶⁴ and key sites for knowledge production and knowledge transfer, they are substantially dependent on collections as infrastructure. Separating scientific collections from the university context entails the danger of making scientific use more difficult. In addition, it directly weakens university research and teaching, and indirectly diminishes the importance of universities in the scientific system. The Council is therefore expressly in favour of leaving scientific collections which have been run by universities up to now in the area of responsibility of universities in the future as well. This requires the German *Länder* governments – which are the main funding agencies – to take responsibility and develop solutions for equipping and supporting collections in accordance with their function as university infrastructures. Moreover, it is the responsibility of universities to document the value of their collections as infrastructures, to make this visible to scientists, and to articulate this value clearly to the bodies that fund them. Increased effort and commitment is required to make collections more accessible and visible, not only on the part of the funding bodies but also on the part of the people and institutions who are directly responsible for the collections.

The critical situation of many scientific collections, particularly at universities, can only change if their value as long-term research infrastructures is recognised and emphasised, if their future is secure and they acquire visibility, and if their potential can be appropriately exploited for research and teaching. In accordance with their character as infrastructures, considerations in respect of expenditure for their care and maintenance should be seen in relation to the expected improvements in the usability of a collection. At the same time, the people who are responsible for scientific collections are duty bound to provide a realistic justification of the relevance of collections as research infrastructures; the possibility of closing a collection that is irrelevant for research and – in so far as it has a value as cultural heritage and as a material witness – removing it from the scientific system, should not be ruled out.

Solution approaches which strengthen collections as infrastructures for science should initially be developed and implemented at the university level; but they subsequently need to be accompanied by measures at the level of the German *Länder* governments and federal government, by funding institutions (DFG, foundations), by specialist associations and by joint efforts by the German federal and *Länder* governments.

|⁶⁴ Cf. Wissenschaftsrat: Empfehlungen zur künftigen Rolle der Universitäten im Wissenschaftssystem, Cologne 2006, pp. 31 ff., p. 49.

A scientific collection's suitability as infrastructure for research depends on various different factors. Not all collections are usable in the same way for research. To enable decision-makers to determine in a comprehensible way whether there is a need for action for a collection, and, if applicable, in which direction a collection should be further developed, it is first necessary to determine the status of the collection. This has the effect of eliminating the uncertainty about collection content which exists in many cases, especially at universities. As the next step, it is then necessary as part of the status determination to classify the existing collections in terms of quality, and derive a development plan from this.

However, to date there has been a lack of appropriate criteria for assessing scientific collections. The Council therefore recommends that universities should develop such assessment criteria in close cooperation with DFG as a funding institution. Experiences of the research museums in the *Leibniz-Gemeinschaft* should also be incorporated. The starting point for the development of criteria should be the requirements that are made of collections as long-term research infrastructure and as a fundamental prerequisite for collection-based research. The extent to which they fulfil these requirements allows their value to be determined. The most important requirements for scientific collections as research infrastructures – and hence the primary assessment dimensions – are the usability and the use of collections for research:

- _ Usability – to be evaluated via: condition of the objects, accommodation, inventorying, cataloguing, indexing, maintenance, care, physical access, digitisation, resources;
- _ Use – to be evaluated via: scientific relevance of the collection and collection objects, i.e. assessment of the scientific quality of the objects, their grouping and underlying collection concept. This requires scientific and object-based quality criteria, such as the scope of the collection, where applicable the uniqueness of the material, the quantity and quality of available type material, quality of the collection as an ensemble, focuses of collection activities, integration into research activities, quality of research projects, objective selection criteria, and national and international coordination.

The criteria should be weighted according to the primary function of the respective collection (cf. B.III.1).

A functionally adequate determination of the value of a collection based on appropriate criteria yields various options for action for the institutions that support the collections (university, research museum): if their value as research infrastructure is recognised in principle, then – if necessary – measures should be

taken to strengthen them as such and correct any shortcomings that exist. |⁶⁵ Quality assessment then provides a basis for the conceptual orientation of collection activity and ultimately also for financing decisions (cf. C.II). At the same time, possible restructuring measures should be examined which could help to exploit untapped potential – such as merging with another collection or relocation of the collection. The proper evaluation of a collection can also result in a realisation that currently and for the foreseeable future the collection is not needed as cultural heritage or as research infrastructure. In this case it should be examined whether the collection should be closed and the objects properly stored for the long term or transferred to other collection contexts, or whether the collection should be broken up. The possibility can never be completely ruled out that a collection might develop an unsuspected value for future generations of researchers equipped with new scientific methods and questions. As far as possible, this latent relevance of a collection should be taken into account. This demands that a collection should be properly assessed as part of a status determination based on current knowledge.

Using appropriate assessment criteria, it is ultimately possible to draw up a differentiated overview of collections in Germany. This should provide the basis for a national collection concept.

C.II DEVELOPMENT OF COLLECTION CONCEPTS

Scientific collections, especially at universities, face the challenge of meeting researchers' requirements of diversity and of redundant infrastructure, while also guaranteeing usability despite scarce resources. At the same time, they are under a certain pressure to justify their existence and have to argue a compelling case for their specific relevance based on their use for research at the present time or in the foreseeable future.

Initially, universities have to meet this challenge in the context of their research planning and profile development, and work out solutions at the university level. The people who are responsible for the collections at universities, together with the university management level, should develop a guidance framework in the form of medium and long-term collection concepts for the individual collections, which if possible should be integrated into a university-wide collection concept.

|⁶⁵ If it is primarily the usability of the collection that is critical, then improvements should be brought about through suitable collection management, adequate care, accommodation, indexing, etc. If a collection is usable in principle but its actual use is insufficient, improving its visibility and facilitating access to it could have a constructive effect.

The purpose of a collection concept is to give collections an objectivised, forward-looking, sustainable and long-term planning framework. At the same time, the collection concept should substantiate the specific individual relevance and function of the collection. Starting with the collection's existing strengths, this also includes setting thematic focuses and usage priorities. Specific guidelines for collection activities can be derived from this. Based on the concept, it is possible to carry out resource planning and justify demands for human, physical and financial resources with respect to university management and in internal competition for the allocation of resources; at the same time suitable priorities can be set in view of tight resources. In order to serve these purposes, the concept should outline the collection's specific function and perspective, position it thematically in current and future research questions, and take into account the scientific quality of the collection as a whole and of the individual objects. Specifically, universities should take the following aspects into account when developing a collection concept:

- _ Use for science is key for a scientific collection. Hence, based on the assessment criteria and in dialogue with scientists in relevant disciplines, it should be examined whether research or teaching currently or in the foreseeable future has a need for the collection. Current immediate demand and scientific use cannot and should not be the only criteria here – but collecting without clear medium and long-term scientific relevance should require specific justification;
- _ The collection concept should be open to networking with other collections and connecting to the widest possible research environment;
- _ For scientific collections at universities, in the internal perspective, possibilities for embedding the collections in teaching and in the university's profile development and networking should be examined, and, in agreement with departmental representatives, options for exploiting synergies through the close linking or even merger of collections (formation of centres) within the university should be sounded out; in this, considerations of the university's prestige should take a back seat to scientific use, and structural changes should always take specialist considerations into account;
- _ The concept should define a focus within a broad range of tasks in accordance with the potential of the collection that was identified in the status determination; |⁶⁶

|⁶⁶ For example, a collection for which there is currently no research demand should focus on transfer, representation and conservation. Where there are conflicts of interest between a conservation and research function, research should be given priority in a research collection.

_ Object selection for scientific collections should be scientifically motivated while also going beyond scientific fashions and attempting to consider future scientific interests as well. The concept should therefore structure collection activity along the following lines: Are the objects relevant for research or teaching at the present time or will they be in the foreseeable future? Are the objects or their groupings rare? Can they be acquired again at a later date at reasonable cost? Are the objects usable at all, or are they too badly damaged? Is it ethically acceptable to store these objects for research purposes? Do the objects fit the collection's profile? Can the care and accessibility that the individual objects require be guaranteed for the long term?

These conceptual considerations should also guide the formation of new collections.

The directors of the *Leibniz-Gemeinschaft* research museums should examine the extent to which a stronger conceptualisation, based on the aspects mentioned, is also necessary for their collections. They are also asked to give stronger consideration, in their concepts, to nationwide networking with other collections and museums and integration into current research and teaching.

If possible, the concept for an individual collection should also be guided by higher-level considerations. To this end, a greater degree of higher-level coordination between the collections is necessary (cf. C.IV).

C.III REQUIREMENTS FOR SCIENTIFIC COLLECTIONS AS RESEARCH INFRA-STRUCTURE

A scientific collection should be usable as research infrastructure. This involves certain requirements concerning, in particular, issues of organisation and management, resources, and the indexing and accessibility of collections. The critical analysis shows that these requirements are not always met, particularly in the case of university collections, which is why their scientific potential cannot be sufficiently exploited.

III.1 Organisation and management

The functional determination which forms part of the collection concept is necessarily the starting point for deciding an appropriate organisation and management strategy.

The Council believes that collections are tied to scientific expertise and therefore, at universities, should generally remain under the care of the departmental units that work with them, in a decentralised structure. Large-scale centralisation of the individual collections at a university, for example in the same

buildings and under the same management, would remove them from their primary functional context and could have the unintended effect of reducing active involvement with the collections. Such effects should be taken into account in conceptual considerations, from the departmental points of view and according to the greatest possible scientific usability, and the organisational structure of collections should reflect this accordingly.

Especially for the status determination and concept development phase, university management should set up a body within the university (“collection officer”) that has overall responsibility and is affiliated to university management, not to a department or subject. This collection officer should act as an interface between university management, a university’s scientific collections, and collections outside that university. The collection officer has a number of tasks to fulfil within the university, such as:

- _ Arranging a comprehensive inventory of the university’s collections, thereby making them more visible not only to external scientific users but also within the university;
- _ Institutionalising communication and networking between the individual collections and supporting the link between research, teaching and exhibitions;
- _ Developing a medium and long-term collection concept that is applicable internally in the university, in conjunction with the people who are in charge of the individual collections and university management; synergies relating to administration and technical resources (server capacities, digitisation, restoration, technical personnel) and research work should be investigated here;
- _ Contributing to the development of and compliance with standards for the management of collections, and advising the people who are responsible for the individual collections on the management of the collections (care, maintenance, restoration, etc.).

The collection officer’s tasks also include external relationships pertaining to the collections, and he/she should promote communication with the community of scientific collections, including with the aim of reconciling internal conceptual developments with higher-level considerations and preventing the loss of any objects which may be at risk (“red list”).

A fundamental recommendation is that these tasks should not be performed in complete isolation from the individual collections and hence from collection-based research; they should be carried out in close consultation with the departments.

The management of collections should be based on a single set of quality standards and guidelines that meet the differing requirements of different types of collections (as much standardisation as possible, as much differentiation as nec-

essary). These guidelines should be primarily aimed at promoting the long-term scientific usability and use of the collections. The Council sees the development of a single set of management standards as being a higher-level task for which the collections should form networks and engage in dialogue – possibly in the context of their common coordination body – as already happens for the natural sciences in the DNFS association and the OECD “SciColl” initiative. The bodies that fund the collections (German *Länder* and federal governments) should assist these efforts at networking. Best practice examples, procedures and existing guidelines should be gathered together and communicated. In addition to the existing associations, the research museums that are jointly funded within the *Leibniz-Gemeinschaft* should play an important role in the development of guidelines: guidelines should be developed in constant dialogue between the scientific side (researchers), who should articulate the needs of research, and the restorers, curators, etc. who professionally care for and maintain the collections. This dialogue has already been institutionalised in the *Leibniz-Gemeinschaft* research museums.

III.2 Resources

The Council recommends that university management, in consultation with the collection officer and based on the individual collection concepts, should carry out comprehensive infrastructure planning, on the basis of which appropriate resources can be made available to the collections. The collections need storage facilities, accommodation that is suitable for conservation purposes, and easily accessible rooms for scientific work and exhibitions. Regarding accommodation of collections, the Council recommends that universities and/or their collection officers consult more closely with restoration and conservation research. Comprehensive infrastructure planning could also explore options for housing previously separate individual collections in the same space, as long as this does not impair their usability and provided the existing accommodation does not itself have a value for research. The basic principle is that accommodation for collections should correspond to their respective focus within their range of tasks.

Human resources for collections should be oriented to the type and primary function of a collection, as described in the collection concept. The institutions that support the collections should use this as a guide. Research-active university collections should be looked after by a curator who should perform tasks in research and to an appropriate extent also in teaching. For a collection that has not yet been indexed, in addition to scientific personnel, it should be possible to bring in additional non-scientific and if necessary technical personnel to perform an initial inventory. Universities, in close consultation with the collection officers and with regard to the collection concept, should take these different requirements for human resources into account in their higher-level HR plan-

ning, and may also want to examine the possibility of using central pools of technical personnel.

Regarding the personnel who provide scientific support and who care for a collection, the Council recommends that universities and the German *Länder* governments should develop specific incentive structures. To this end, independent research should be enabled, in particular for the scientific personnel who are responsible for collections. This is intended to prevent the continued neglect of collections particularly in the broad range of tasks performed by scientific personnel (teaching, research, administration).

The Council recommends that universities should specifically activate the extremely valuable support of volunteers who are involved in a specialist capacity through advertising activities at the site and through even better communication to the wider public.

III.3 Indexing, accessibility, digitisation

To ensure that a collection's potential for research is recognised, utilised and supported, and to make sure that its usability is not restricted simply because of a certain lack of visibility to third parties, the Council urgently recommends that the content of scientific collections should be documented and scientifically indexed.

Knowledge about existing collection's contents and about endangered objects is also indispensable for higher-level consultation and coordination between and across all collections (cf. C.IV). Only on this basis can decisions about specialisations, expansion, closure or relocation of collections be taken on a coordinated basis and only in this way can it be guaranteed that collections are available in accordance with the requirements of current research questions. Based on such a survey of current stock, it is possible to draw up a "red list" of endangered or urgently needed objects and make sure that there is a certain level of redundancy. This allows losses – e.g. due to negligence or force majeure – to be compensated to a certain extent, it ensures a certain variance among research objects, and it makes collections available to researchers as distributed infrastructure at various different locations.

The need for inventory taking begins with the individual collections. The Council recommends that universities in particular should press ahead with the documentation and indexing of their collections – in digital form if possible. This should proceed in stages: a digital inventory is necessary as the first step. To this end there is an urgent need to develop digitisation software that does not generate high recurring costs for the universities. The Council recommends that the funding institutions should support the development of non-proprietary digitisation software using the open source model, for example

based on the solution developed with the support of the Volkswagen Foundation for the “*Kabinette des Wissens*” [Cabinets of Knowledge] project at the Berlin Humboldt University. As a second step, objects should be systematically indexed and linked to additional information in a digital catalogue. The final step would be to incorporate the catalogues for the individual collections in a comprehensive university-wide database of collections with great depth of indexing, in which all collections can be researched and are therefore accessible via a central interface.

To make scientific collections more easily accessible to a broad public around the world and to gain a central overview of national stock in scientific collections in Germany, both in universities and outside of universities, the Council also recommends, in parallel to the digitisation of collections at individual universities, the creation of interdisciplinary and inter-institutional databases. First of all, in the medium term, at least the inventory lists of scientific collections should be made available in digital form and be accessible via a central portal. This should be done with recourse to existing portals. Ultimately, in the long term, the collections at individual universities and non-university institutions which are systematically documented in electronic databases with great depth of indexing should be combined in a central interdisciplinary database that covers all institutions. As a meta database, this database should be based on existing databases and inventories and be available online free of charge. DFG should see whether it can support the development of such a meta database. For private, municipal and national collections, the German Museums Association could coordinate this kind of data gathering exercise in a similar way to the survey of university collections conducted by the *Helmholtz-Zentrum für Kulturtechnik* in Berlin. In this connection, moreover, the Council recommends that the Standing Conference of the Ministers of Education and Cultural Affairs of the *Länder* in the Federal Republic of Germany (KMK) should promote the digital documentation of the non-university collections and also explore financing options.

Digital documentation and indexing of collections throughout Germany in a meta database urgently requires the harmonisation of digitisation standards for non-text objects. These standards should be developed through corresponding support programmes. In this regard, the Council expressly welcomes the fact that DFG has recognised the need to support the indexing and digitisation of object-based collections and introduced a corresponding funding programme in 2010. The Council recommends that DFG should extend the scope of this instrument to cover university collections as well.

At the same time, also in view of the high follow-up costs, the Council warns against seeing digitisation projects as an end in themselves. Before a scientific collection is digitised, therefore, it should be examined, based on its concept,

whether this is necessary for the future scientific use of the collection and/or whether there are more urgent conservation or other indexing tasks to address first.

As well as digital access via online catalogues and databases, physical access to real objects is still necessary for their scientific use and scientific treatment. This should be enabled through visiting opportunities and options to borrow suitable objects. Collections and museums should make rooms available to third parties for research visits, in which they can work with and on collection objects. As part of a scientific basic service for scientists, access to collections as research infrastructure should not be impeded by unreasonably high fees.

C.IV NETWORKING AND ORGANISATION OF SCIENTIFIC COLLECTIONS

The Council recommends that collections should continue to be developed as decentralised research infrastructure (cf. C.III.1). Especially with decentralisation in this form, a certain degree of higher-level coordination is essential. This should be ensured through self-organisation on the part of the collections.

Overall, the Council's recommendations require a high degree of personal initiative on the part of the people who are responsible for collections, who should act as a community. The Council welcomes the existing efforts to form networks between collections and between scientists who carry out research with and about collections, and it recommends that the stakeholders concerned should continue to develop these networks. In particular this concerns the collections relating to the humanities and cultural sciences, where networking is less well developed than between the natural science collections, but it also involves forms of interdisciplinary networking which, to date, are almost non-existent.

For the long-term intensification of self-organisation and coordination of the scientific collections, the Council recommends that the German federal and *Länder* governments should provide financial and legal support to the specialist groups and collection officers in the development of effective higher-level communication and coordination structures. To this end, in particular the performance of coordinating and advisory services across and between collections should be transferred to an existing institution. The task of this institution should then be to consider the further development of scientific collections from an interdisciplinary standpoint and across all locations, and to facilitate coordinated action by the stakeholders who are responsible for the collections. This institution should expressly not be conceived of as a higher-level planning body.

As a first step, this institution should concern itself with the university collections. Specifically, it should:

- _ Fundamentally establish coordination of the university collections;
- _ Promote the centralised documentation of university collections and the development of a meta-database portal;
- _ Contribute to the development of criteria for the assessment of scientific collections as research infrastructures;
- _ Promote consultation between the collections (non-university and university) in order to reveal synergy potentials and opportunities for cooperation;
- _ Offer a central (also operational) advisory service to the university collections and universities;
- _ Set up a platform for communication between the bodies responsible for the collections and the users of the collections.

As a second step, this institution should:

- _ Initiate the survey of non-university collections and their usability;
- _ Contribute to quality assurance through assessments and recommendations; and
- _ Take on a monitoring function with regard to endangered and urgently required objects.

As far as the organisational structure of such an institution is concerned, it should be ensured that the specialist groups that are relevant to collections have a decisive involvement. Representatives of restoration and conservation research, and political decision-makers at the German federal and *Länder* levels, should also be involved. At the same time, however, the independence of the institution should be guaranteed. To fulfil the tasks mentioned above, members of the community that is involved with and uses collections should get together at regular intervals and, furthermore, should offer a communication platform to a wider group of participants by staging regular conferences.

The Council recommends that the German federal government should issue a call for proposals for setting up such a coordination body, in the first instance for a limited term of five years. The offices of such an institution should be established within an existing organisation.

The Council welcomes the positive development of the research museums, which enjoy great visibility and prominence in Germany. Those who are responsible for the research museums in the *Leibniz-Gemeinschaft* should examine whether they can take on a supportive and advisory role in the collection com-

munity, particularly in respect of developing guidelines for management and care. Networking between university collections and the *Leibniz-Gemeinschaft* research museums is well developed in some cases, and should continue to be strengthened.

The recommendation for stronger networking and coordinated organisation of the collections is not intended to encourage centralisation of the collections. On the contrary, the largely decentralised distribution of collections meets users' needs and facilitates the broadest possible transfer of the scientific knowledge that is gained from collections.

C.V FINANCING AND GRANTS FOR SCIENTIFIC COLLECTIONS AND COLLECTION-BASED RESEARCH

The provision of scientific collections as infrastructure for research is an ongoing task which, for universities, can only be fulfilled via appropriate core funding. This should be provided at a level that allows the safeguarding of collections as well as ensuring their accessibility and usability; additional research activities – as in other university facilities also – can be financed through third-party funding. Securing core funding is a task for the *Länder*, which are responsible for the provision of funding in their *Länder* budgets, and for the universities which have increasingly autonomous responsibility for the internal allocation of funding. A collection's needs, particularly in respect of running costs, should be properly recorded in the collection concept. The bodies responsible for collections do not succeed everywhere in guaranteeing sufficient core funding, even if there is an increase in the effectiveness and efficiency with which funds are used for collections.

The Council wishes to stress that third-party funding for collections should supplement core funding but it should not (even partially) replace it. Accordingly, core funding which is appropriate for an infrastructure facility and should be guaranteed by the German *Länder* governments and through adequate distribution within the university, should be supplemented with sensible and meaningful funding structures and funding instruments which correspond to the diversity of collections and the specific quality criteria of collection-based research.

The Council welcomes the project-based support measures for collections developed by the Volkswagen Foundation, DFG and the German Federal Ministry of Education and Research, and recommends that they and also other funding organisations, especially foundations, should extend their funding instruments so that they also include, more clearly than at present, university collection-based research and university collections. The Council is also in favour of prioritising

support for the scientific use of collections; this also includes indexing activities, which are essential for the scientific study of the object. Universities should additionally examine the extent to which the existing support measures can be used, at least as start-up funding, for digitisation projects in particular. At the same time it should also be checked – based on a status determination and the collection concept – whether digitisation makes sense in the individual case. The follow-up expense for digitisation, the ongoing costs for server capacities, data maintenance, updates, conversion etc. which need to be met, should be taken into account as infrastructure costs by the *Länder* or federal and *Länder* governments in their medium and long-term financial planning.

Even aside from specifically collection-related funding measures, for example in the DFG's "standard procedure" or in collaborative projects, specific assessment standards for collection-based research should be set down that also create incentives for equal partnerships between scientific institutions and collections. Research with and about collections, which often has a long-term and systematic basis and also includes accompanying work as well as exhibition and transfer activities, also requires its own criteria. Therefore, along with the usual criteria for assessing research performance (such as research quality, impact, efficiency), these activities in connection with collection-based research, which are frequently long-term and systematic or related to exhibitions, also need to be classified appropriately in terms of their quality.

Alongside proper institutional core funding for the scientific collections, and in addition to existing project-based funding for collection-based research, new funding options are needed. The Council recommends that German federal and *Länder* governments and the DFG should develop instruments which, with a medium-term funding horizon of around five years, are suited to making scientific collections usable as infrastructures for research. Suitable funding instruments are a good financial incentive for the universities to do more for their collections than they have previously.

Joint funding by the federal and *Länder* governments in the *Leibniz-Gemeinschaft* offers a certain guarantee of sustainability. Hence the decision is often too quickly made that moving to joint funding is the best alternative to a tight financial situation at universities. The decision to include a collection in joint federal and *Länder* funding within the *Leibniz-Gemeinschaft* should only ever be made on the basis of national importance and the interests of the country as a whole, not due to financial policy considerations. Hence all aspects – both for and against a move to joint funding – should always be considered, such as a collection's integration into research and teaching. Moreover, it should continue to be the case that only the usual acceptance procedure is used.

The Council states once again that university collections should remain within the universities' area of responsibility, and therefore urges the collections, uni-

versity management, and the *Länder* governments to seek solutions within the universities wherever possible. In addition, the German federal and *Länder* governments should develop alternatives that open up different institutional development possibilities. One option to examine is the development of foundation models, i.e. to transfer a university collection to a foundation or to merge several collections under the auspices of a joint foundation which could be variably financed by the German federal and *Länder* governments, municipal authorities, or also by private sponsors.

Annexes

Annex 1 National and international networks of collections

CETAF

<i>Location:</i>	Stockholm
<i>URL:</i>	http://www.cetaf.org
<i>Name:</i>	<i>Consortium of European Taxonomic Facilities</i>
<i>Profile:</i>	CETAF is a networked consortium of scientific institutions (natural history and zoological museums, research institutes, botanical gardens) in Europe which – including, for example, by digitising the collections held by member institutions – promote training, research and understanding of systematic biology and palaeobiology and function as a taxonomy network for botany and zoology.
<i>Data access:</i>	Members
<i>Financing:</i>	EU's Sixth Framework Research Programme

<i>Location:</i>	Berlin
<i>URL:</i>	http://www.dnfs.de
<i>Name:</i>	Deutsche Naturwissenschaftliche Forschungssammlungen e.V.
<i>Profile:</i>	The “German Natural History Research Collections” consortium was set up in May 2007 and has the legal form of a registered charitable association. It comprises more than 100 million objects in natural history collections, which probably makes it the largest network of natural history collections of its kind in the world. The DNFS promotes cooperation and coordination between its member institutions (Botanischer Garten und Botanisches Museum Berlin-Dahlem [BGBM] of FU Berlin, Forschungsinstitut und Naturmuseum Senckenberg, Museum für Naturkunde – Leibniz-Institut für Evolutions- und Biodiversitätsforschung at HU Berlin, Staatliches Museum für Naturkunde Stuttgart, Staatliches Museum für Naturkunde Karlsruhe, Staatliche Naturwissenschaftliche Sammlungen Bayerns, Zoologisches Forschungsinstitut und Museum Alexander Koenig Bonn, Zoologische Sammlungen der Universität Hamburg).
<i>Data access:</i>	Members
<i>Financing:</i>	-

EDIT

<i>Location:</i>	Paris
<i>URL:</i>	http://www.e-taxonomy.eu/node/3
<i>Name:</i>	<i>European Distributed Institute of Taxonomy</i>
<i>Profile:</i>	EDIT is a virtual competence centre of 28 leading European, North American and Russian institutions that aims to promote the ability to maintain biological diversity. Participating members present their natural history collections, which are located in their institutions around the world, combine management capacities and aim to make joint progress in this way. Research promotion activities also include scientist exchanges and training programmes.
<i>Data access:</i>	
<i>Financing:</i>	European Commission, launched in March 2006 for 5 years

Humboldt-Ring

<i>Location:</i>	Berlin
<i>URL:</i>	http://humboldt-ring.de
<i>Name:</i>	<i>Humboldt-Ring - Verbund deutscher Forschungsmuseen</i>
<i>Profile:</i>	<p>The Humboldt-Ring is an association of six natural history institutes and collections that was established on 24 September 2009. The founding members who ratified the cooperation agreement were Museum für Naturkunde Berlin, Zoologisches Forschungsmuseum Alexander Koenig (Bonn), Staatliches Museum für Naturkunde Karlsruhe, Staatliches Museum für Naturkunde Stuttgart and Staatliche Naturwissenschaftliche Sammlungen Bayerns (Munich). Botanischer Garten und Botanisches Museum Berlin-Dahlem (BGBM) joined on 28 October 2009. In terms of content, the association's overarching aim is to promote and develop innovative, integrative research in the fields of biodiversity, evolution, interactions between inanimate and animate nature, and system Earth, including the necessary infrastructure. The Humboldt-Ring aims for joint representation in national and international matters while preserving the federal independence of the member institutions. The Humboldt-Ring is open to additional institutions of national importance that support the declared goals. Other goals include developing joint collection standards and strategies, coordinating collection profiles, staffing policy, the use of collections and laboratories, and research and collection projects.</p>
<i>Data access:</i>	Links to the respective research museum
<i>Financing:</i>	-

International Council of Museums – ICOM

<i>Location:</i>	Paris
<i>URL:</i>	http://icom.museum/
<i>Name:</i>	<i>International Council of Museums</i>
<i>Profile:</i>	<p>As the international organisation for museums and museum specialists, ICOM is committed to conserving, protecting and promoting knowledge about cultural and natural world heritage across all disciplines. In collaboration with the United Nations Educational, Scientific and Cultural Organisation (UNESCO), ICOM aims to protect the cultural goods held in museums and place them at the service of society. The organisation develops ethical guidelines for museums and initiated the UMAC database.</p>
<i>Data access:</i>	Fee-paying members
<i>Financing:</i>	Membership fees and funding from various authorities and other bodies

<i>Location:</i>	Berlin
<i>URL:</i>	http://www.icom-deutschland.de/aktuell.php
<i>Name:</i>	<i>Deutsches Nationalkomitee des Internationalen Museumsrats</i>
<i>Profile:</i>	ICOM Deutschland supports the remit and objectives of the International Council of Museums ICOM in Germany. With more than 3,700 members, ICOM Deutschland is the largest organisation for museums and museum specialists in Germany. It is also the National Committee with the largest number of members within ICOM.
<i>Data access:</i>	Fee-paying members
<i>Financing:</i>	Membership fees and funding from various authorities and other bodies

Network of European Museum Organisations – NEMO

<i>Location:</i>	Berlin
<i>URL:</i>	http://www.ne-mo.org
<i>Name:</i>	<i>Network of European Museum Organisations</i>
<i>Profile:</i>	NEMO promotes joint activities by museums and institutions in Europe, such as collaboration in general and in joint projects, and the cross-border exchange of works and people. It also offers support with loan applications. NEMO comprises 31 national museum organisations within the EU Member States and EU-associated countries. Each country appoints up to two representatives.
<i>Data access:</i>	Members
<i>Financing:</i>	EU funding

SciColl

<i>Location:</i>	Not yet decided
<i>URL:</i>	http://scicoll.org
<i>Name:</i>	<i>Scientific Collections International</i>
<i>Profile:</i>	SciColl is an initiative of the OECD's Global Science Forum which was initiated in 2006 by European natural history museums with the aim of being able to index the world's natural history collections (estimated 1.5 to 3 billion collection objects) even better as a collaborative undertaking, and of making them globally usable as a common resource.
<i>Data access:</i>	Goal: Freely accessible
<i>Financing:</i>	The network is in its initial phase. The official launch with establishment of a secretariat is planned for mid-2011 at the earliest. Financing will be primarily via national contributions (based on GERD) in years 1-3 and primarily via membership contributions from the fourth year onwards.

Universitätsmuseen und -sammlungen in Deutschland

<i>Location:</i>	Berlin
<i>URL:</i>	http://publicus.culture.hu-berlin.de/sammlungen
<i>Name:</i>	<i>Universitätsmuseen und -sammlungen in Deutschland</i>
<i>Profile:</i>	"University museums and collections in Germany" provides a database of university museums which enables searches according to locations, collection types, collection forms and collection focuses in Germany.
<i>Data access:</i>	Freely accessible
<i>Financing:</i>	Supported by the DFG

<i>Location:</i>	Padua (Italy)
<i>URL:</i>	http://universeum.it
<i>Name:</i>	<i>Universeum – European Academic Heritage Network</i>
<i>Profile:</i>	Universeum is a European network that was set up in 2000. It aims at the preservation, study, access and promotion of university collections, museums, archives, libraries, botanical gardens, astronomical observatories, etc. The network is open to individuals (heritage and museum professionals, researchers, students, university administrators and all those involved with university heritage).
<i>Data access:</i>	Freely accessible
<i>Financing:</i>	-

University Museums & Collections – UMAC

<i>Location:</i>	Berlin
<i>URL:</i>	http://umac.icom.museum
<i>Name:</i>	<i>University Museums & Collections</i>
<i>Profile:</i>	UMAC, initiated by ICOM, is a worldwide database of university museums and collections that currently contains 25,680 published entries from 63 countries. At present, UMAC is represented in 40 countries and aims to make a global directory of university museums and collections accessible to the public.
<i>Data access:</i>	Freely accessible – but ICOM membership is required to take part in activities to the full extent
<i>Financing:</i>	

Key figures for the research museums in the *Leibniz-Gemeinschaft* (WGL)

Figures for 2009

Research museums	Budget	thereof research portion ²	Total staff	thereof scientific staff	Third-party funding	Objects
	€ million	%	People	People	€ million	000s
Deutsches Bergbau-Museum, DBM	12,9	50	139	34	1,0	300
Deutsches Museum, DM	52,7	34	443	59	13,1	107
Deutsches Schiffahrtsmuseum, DSM	7,2	65	47	12	2,7	140
Germanisches Nationalmuseum, GNM	20,15	65	201	41	0,5	1.300
Römisch-Germanisches Zentralmuseum, RGZM	8,5	65	156	52	1,3	100
Zoologisches Forschungsmuseum, ZFMK	6,65	75	67	46	0,8	5.500
Museum für Naturkunde, MFN	14,1	80	232	83	1,9	30.000
Senckenberg Gesellschaft, SNG ¹	37,08	92	756	205	19,9	35.900
Total	159,28		2.041	532	41,2	73.347

Source: Data from the Leibniz Association database, as at September 2010

¹ The Senckenberg Museum für Naturkunde Görlitz, SMNG, and the Senckenberg Naturhistorische Sammlungen Dresden, SNSD, merged with SNG in 2009. Previously they were both associate members of WGL.

² The research portion is institutionally financed by the German federal and *Länder* governments. The research portions increased significantly as a result of a new definition of "research" for 2010.

BMBF	Bundesministerium für Bildung und Forschung (German Federal Ministry of Education and Research)
BGBM	Botanischer Garten und Botanisches Museum Berlin-Dahlem (Botanical Garden and Botanical Museum Berlin-Dahlem)
CETAF	Consortium of European Taxonomic Facilities
DBM	Deutsches Bergbau-Museum, Bochum (German Mining Museum)
DFG	Deutsche Forschungsgemeinschaft (German Research Foundation)
DM	Deutsches Museum München (German Museum, Munich)
DNA	Deoxyribonucleic Acid
DNFS	Konsortium „Deutsche Naturwissenschaftliche Forschungssammlungen“ (consortium of German natural history research collections)
DSM	Deutsches Schifffahrtsmuseum, Bremerhaven (German Shipping Museum)
EDIT	European Distributed Institute of Taxonomy
ESFRI	European Strategy Forum on Research Infrastructures
GBIF	Global Biodiversity Information Facility
GNM	Germanisches Nationalmuseum, Nürnberg (Germanic National Museum, Nuremberg)
GWK	Gemeinsame Wissenschaftskonferenz (Joint Science Conference)
ICOM	International Council of Museums
KMK	Kultusministerkonferenz (Standing Conference of the Ministers of Education and Cultural Affairs of the <i>Länder</i> in the Federal Republic of Germany)
LIS	Wissenschaftliche Literaturversorgungs- und Informationssysteme (Scientific Library Services and Information Systems)

MfN	Museum für Naturkunde – Leibniz-Institut für Evolutions- und Biodiversitätsforschung an der Humboldt-Universität zu Berlin (Natural History Museum – Leibniz Institute for Evolution and Biodiversity Research at the Berlin Humboldt University)
OECD	Organisation for Economic Cooperation and Development
RGZM	Römisch-Germanisches Zentralmuseum, Mainz (Roman-Germanic Central Museum)
SciColl	Scientific Collections International
SGN	Senckenberg Gesellschaft für Naturforschung, Frankfurt am Main (Senckenberg Society for Natural History Research)
NEMO	Network of European Museum Organisations
UMAC	University Museums and Collections
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WGL	Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz e.V. (Gottfried Wilhelm Leibniz Science Association)