WORLD HERITAGE NOMINATION - IUCN SUMMARY

MESSEL PIT FOSSIL SITE (GERMANY)

Summary prepared by IUCN/WCMC (March 1995) based on the original documentation submitted by the Government of Germany and Land Hesse. This original and all documents presented in support of this nomination will be available for consultation at the meetings of the Bureau and the Committee.

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1. LOCATION

Located in the northern foothills of the Odenwalk, south of Frankfurt am Main, near the city of Darmstadt, in Land Hesse, Germany.

2. JURIDICAL DATA

The Messel Pit is the property of Land Hesse and is therefore publicly owned. In 1991, the oil shale in the pit was declared a historical mineral resource, which makes it part of the cultural heritage as defined in the *Heritage Protection Act (Denkmalschutzgesetz)* of Land Hesse. The site is also recognised as a public monument by the Agreement of June 1992 on the *Conduct of Palaeontological Excavations in Messel Pit with the Senckenberg Society for Nature Research*, and the Agreement of December 1992 on the *Scientific and Cultural Use of the Messel Pit Fossil Site with the Society for the Preservation of the Messel Pit Fossil Site*.

3. IDENTIFICATION

Messel Pit is approximately 1000 metres long (north to south) and 700 metres wide (east to west). The sediments of the Messel formation lie on deposits of 270 to 290 million year Old Red Sandstone and crystalline magmatic primary rock outcrops. The Eocene period basin had been hollowed out by faults in the earth's crust. The gradual subsidence of old sediments resulted in the formation of new sediments above them, and over time immense deposits accumulated. The oil-shale bed at Messel originally extended to a depth of 190 metres. The subsidence of the deposits preserved them from erosion whereas the watercourses that once linked the basins and their sediments are entirely eroded. Outcrops of older seams from the Eocene succession are found on the slopes of the pit. The location of the Eocene Lake Messel lay 10° south of its present position. This accounts for the site appearing to have had a tropical to subtropical climate.

4. STATE OF PRESERVATION

Responsibility for the care, preservation, and operation of the site has been assigned to the Senckenberg Society for Nature Research. Under German mining law (unspecified), the Society is the operator of the Messel Pit.

The Messel Pit fossil site has been divided into five "geoscientific priority areas" categories to ensure that scientific excavations are kept within reasonable limits and that particular care is taken with the more valuable strata. The Senckenberg Society of Natural History and the Senckenberg Research Institute, has used its own funds to purchase a building close to the Messel Pit to serve as a field research station.

A perimeter fence has been erected around Messel Pit to prevent trespassing. The site and perimeter are kept under surveillance by foot patrols to prevent trespassing. A measurement system has been established for the pit and surrounding area to monitor the stability of the slopes. In addition, groundwater and rainwater that gathers on the pit floor is pumped away in order to stabilize the slopes of the pit. All activities are supervised by the Cultural Advisory Council and the Scientific Advisory Council for Messel Pit. On the instructions of the Hessian Ministry of Science and Arts, a basic operational plan for Messel Pit is being drawn up in order to establish permanent statutory safeguards for palaeontological research at Messel Pit. The plan aims to set forth all necessary future operational measures and was due at the end of 1994.

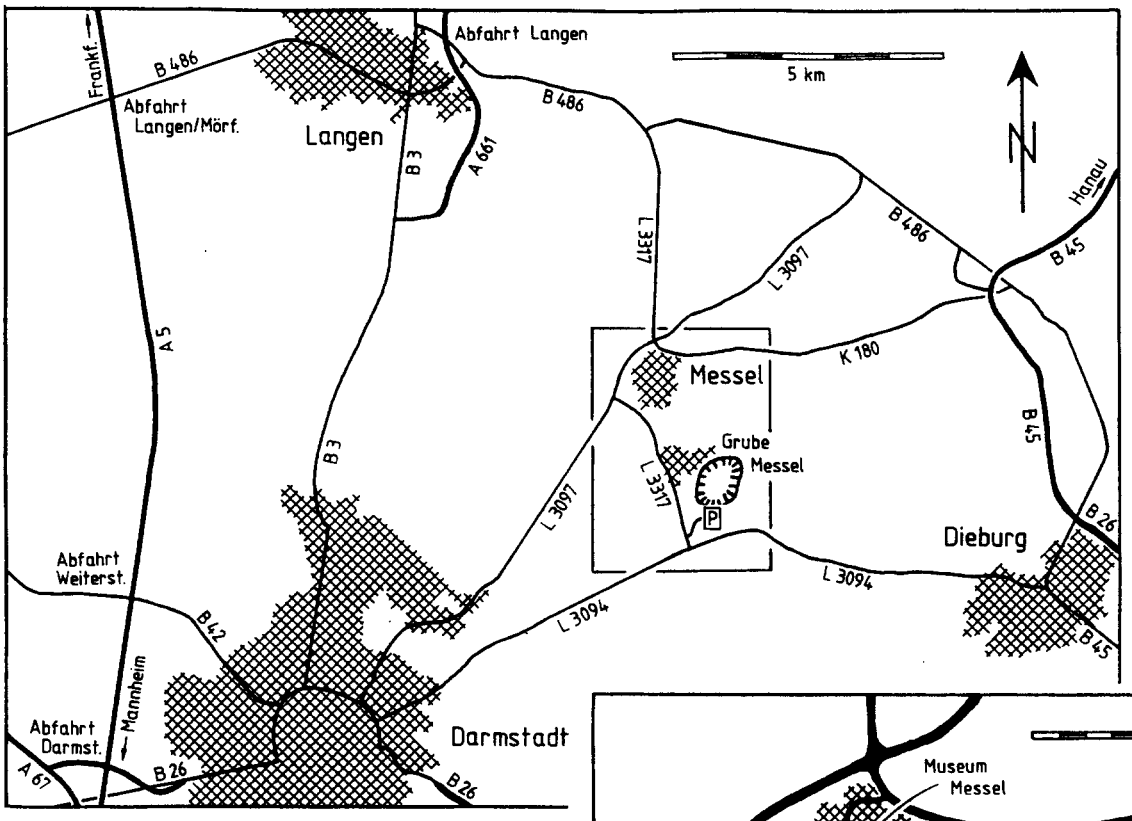
5. JUSTIFICATION FOR INCLUSION ON THE WORLD HERITAGE LIST

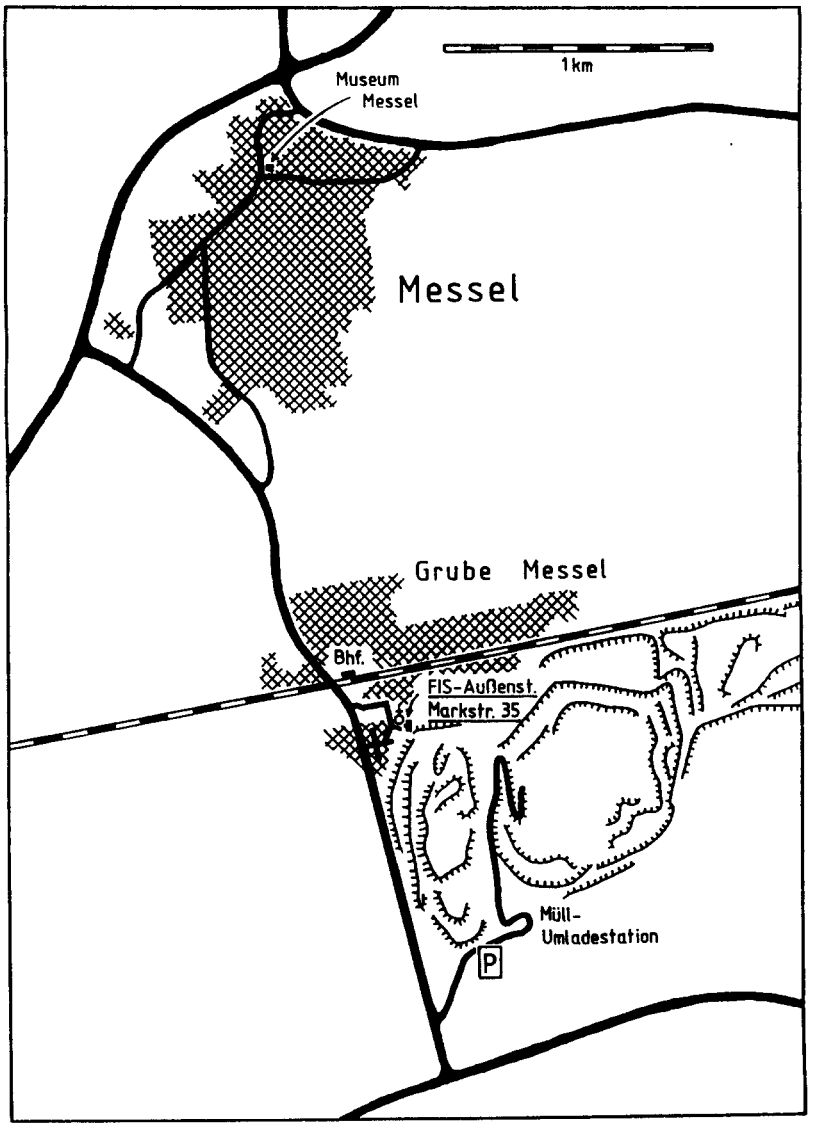
The Messel Pit fossil site nomination, as prepared by Land Hesse and the Government of Germany, provides the following justification for designation as a World Heritage natural property:

(i) **Contains examples of the major stages of earth's history and outstanding geological features** Messel Pit fossils are the remains of organisms from the middle Eocene strata dating back 50 million years. The Messel Pit fossil site demonstrates a vital and explosive evolution of mammals that mainly occurred during the Eocene. Few high quality sites are known to provide the opportunity to study this process, and at none of these sites are the fossils so outstandingly preserved or their habitats so extensively reconstructible in a wide variety of biotopes. The specimens provide information to decipher the history of the large subphylum of vertebrates. The finds embrace a wide spectrum of diverse Eocene life-forms unequalled by virtually any other site.

Note: A detailed justification, running to 40 pages, is provided in the original nomination highlighting points of palaeontological significance.

Lageplan „Grube Messel"





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WORLD HERITAGE NOMINATION - IUCN TECHNICAL EVALUATION

MESSEL PIT FOSSIL SITE (GERMANY)

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1. DOCUMENTATION

i) IUCN/WCMC Data Sheet (9 references)

ii) Additional Literature Consulted: Whittington H.B. & Conway Morris S., 1985. Extraordinary Fossil Biotas. **Phil. Trans. R. Soc.** 1-192; Gould, S.J. ed. 1993. **The Book of Life.** 256p.; Cowen R. 1995. **The History of Life.** Blackwell. 462 p.; Norman D. 1994. **Prehistoric Life.** Boxtree. 246 p.; Shrenk F. & Ernst K. 1993. Monument Grube Messel. Conference Proceedings. 2 vols; Joyce, E.B. 1994 in Geological & Landscape Conservation. Geol. Soc. p.507-573.

iii) Consultations: Eight external reviewers, German Government officials, local Museum research personnel.

iv) Field Visit: May, 1995. Jim Thorsell

2. COMPARISON WITH OTHER AREAS

Messel is one of over 300 geological sites identified in the UNESCO/IUGS/IGCP/IUCN Working Group report (1993) on potential World Heritage geological sites. This list does not provide, however, a basis for comparison. To attempt to provide a better framework to make comparative assessments, IUCN with support from the Australian Government, is sponsoring a geological theme study of earth's evolutionary history (to be available in September 1995). This discussion paper will provide one input into further meetings of a UNESCO/IUGS working group which will meet in Canada (October) and China (August 1996) to finalize the theme study.

Many existing World Heritage sites contain fossils but only one site (Australian Fossil Mammal site) is on the list for its fossil values alone. The Dinosaur Provincial Park (with 60 species of cretaceous dinosaur fossils) is on the list but in connection with two other natural criteria. The Burgess Shales, considered as the world's most singularly outstanding fossil site, is contained as part of the Canadian Rocky Mountain Park site. A number of other natural sites (eg. Ngorongoro, Grand Canyon, Los Glaciares) also contain important fossil resources that provide clues to the evolution of life.

Germany itself has unusually abundant paleontological sites. In addition to Messel, there is the Jurassic Solnhofen limestone and Devonian Hunsruck slate sites. The quarries that expose the Solnhofen site are exposed over a wide area of considerable scenic value. It also has a rich fauna including the famous bird-dinosaur *Archaeopteryx*. The deposits at Solnhofen, however, are from a much older period and are thus difficult to compare. Solnhofen's animals too were aerial and marine and are thus more likely to be represented in other contemporaneous deposits and hence less likely than Messel to provide unique information about an entire Tertiary community. They are also unprotected and open for public excavation. The Hunsrück slate site is even older and has exquisitely preserved fossils but its overall importance is rated lower than Messel as other sites portraying the early Devonian are relatively common.

In terms of fossil localities which provide a window into the Eocene Age, Messel is the best and most productive example discovered to date. The most obvious comparison would be the brown

coal fossil assemblages notably that of Geiseltal, also in Germany,but this site has not received the scientific attention that Messel has. There are some very important localities in Egypt, notably Fayum, which have yielded significant Eocene vertebrates including early primates and whales but Messel is still judged as pre-eminent in terms of richness. The nomination document also notes the Monte Bolca site in Italy which is not as diverse as well as the Green River formation in the western USA which does not offer the quality of specimen preservation that Messel does.

In contrast to other fossil sites that are marine in origin (for eg. the deferred Devonian fish site at Miguasha), and thus widespread, Messel can be considered as the single best "classic" locality "snapshot" of life as it was in the Eocene. It has been identified as one of the four most significant fossil sites in the world by several senior paleontologists and by the biologist David Attenborough. At this point in time it can reasonably be claimed that it is the "best property of its type".

3. INTEGRITY

As the Messel pit is the former site of an oil shale mine the land surface has been significantly disturbed. Paradoxically, if there had been no mine the scientific values of the quarry would have never been discovered! Once mining was discontinued in the late 1960's the pit was open to private prospectors. Many fossils were taken out and private collections now hold specimens worth up to $ 400,000 on the fossil market (eg. the only known tapir fossil). One collector resident in Switzerland has five specimens of different crocodile species not yet known in German collections.

The site was proposed as a refuse dump in 1971, a threat that then led to increased scientific exploration and public concern. This culminated in purchase of the pit by the government for DM35 mil. and its full protection as a cultural monument. A perimeter fence surrounds the site and a management plan is being prepared. A refuse dump is to be built nearby but this will be controlled and should pose no threat to the Messel fossils.

In conclusion, the Messel Pit is now adequately safeguarded and it is clear that the German Government has a serious commitment to its long-term maintenance as a site of scientific importance. Controls on excavation are in place and disturbances to the oil shale is limited. Although much material has been taken from the site the volume of fossil-bearing oil shale sediments is still massive and it is far from being depleted. A viewing platform overlooking the pit is also being provided to cater to public interest in Eocene Lake Messel.

4. ADDITIONAL COMMENTS

- Fossil sites, by their very nature are required to be excavated and specimens removed for scientific study. Thousands of fossils are removed annually from the site. The Committee may wish to note this in connection with paragraph 25 of the Operational Guidelines relating to movable properties.

- As noted in previous fossil site nominations, the International Union of Geological Sciences (IUGS) global data base on geological sites has passed the 2000 mark. Recognizing the great number of potential areas that may eventually come up for World Heritage listing, the Bureau, at its 18th session, requested a global study of the earth's evolutionary history. This study is currently underway with expert meetings planned for this year leading up to the World Geological Congress in 1996. Prior to that decision, however, the Bureau did recommend inscription of the Australian Fossil Mammal site as the case for its universal importance was abundantly clear.

- To assist in the evaluation of fossil sites, IUCN in 1994 developed an evaluation checklist. The ten questions on this list have proved helpful in providing indicative measures of significance. The results in summary form are provided in the attached Table.

- The Messel nomination once again brought out concern from some reviewers that such small sites, while geologically interesting, are still relatively obscure, scientifically esoteric and unthreatened natural phenomena. Certainly, most existing natural World Heritage sites are large with multiple values and dominated by natural processes. How will Messel, as a hole in the ground of less than 1 sq.km in size be perceived as a site of "outstanding universal value?" The answer to this is provided by the existence of natural criterion *i* and the fact that earth's history is mainly revealed in the hard evidence of the fossil record. As eloquently expressed in **Natural History** (6, 1994, p.55):

  "The awe-inspiring story of the evolution of life on earth is hidden in layer upon layer of sedimentary rocks. Over millions of years, sediments settled into these massive formations, which were compressed and then twisted and deformed by the immense forces of plate tectonics. The fossil evidence of life that survived these processes is rare and fragmentary. But when - with hard, diligent field and laboratory work, and luck - scientists do piece together a chapter of life's odyssey, the tale it tells rings true because it has the undeniable weight of deep time on its side."

  IUCN is in accord with this view with the proviso that, as underlined in the Operational Guidelines, World Heritage designation is not for all important sites, only the select few that are truly of international significance. Many geologists recognize this and a separate international convention providing recognition to the thousands of fossil sites that are not of World Heritage calibre has been proposed. (Joyce, 1994)

5. EVALUATION

The Eocene ("dawn of new times") Epoch (57-36 mya) was a remarkable period in the evolution of life on earth. This was the time when mammals became firmly established in all the principal land ecosystems. They also re-invaded the seas (eg. whales) took to the air (eg. bats). During this period of geological time North America, Europe and Asia were in continuous land contact and the partial explanation of current distribution patterns is provided by the fossil record of the Eocene.

The Messel Pit provides the single best site which contributes to the understanding of the middle part of this period. Messel is also exceptional in the quality of preservation, quantity and diversity of fossils. While most fossil vertebrate remains yield only fragments of bone material, Messel offers fully articulated skeletons and the outline of the entire body as well as feathers, hairs and stomach contents. Significant scientific discoveries have and are being made at Messel including studies of the evolution of echolocation in exceptionally well-preserved fossil bats and vital new data on the evolution of the horse. The fossils found here are providing a unique insight into an early stage of mammal evolution when many of the basic steps in diversification were being achieved. But mammals were not the only component of the fauna - birds, reptiles, fish, insects and plant remains all contribute to an extraordinary fossil assemblage. Clearly criterion *i*, as given in the justification section of the nomination summary, is met.

While IUCN would recommend the inscription of Messel, the Committee may, however, view this as premature in light of completion of the geological theme study in 1996. As it is almost certain that both the Eocene and the significance of Messel will be identified as a key time and an exceptional place in this study, the concern here is minimal.

6. RECOMMENDATIONS

The Bureau recommended that Messel be inscribed under natural criterion *i* and commended the Government of Germany for recognizing the scientific values of the quarry and for supporting the high standard of palaeolontological research that is being undertaken.

TABLE I

IUCN FOSSIL SITE EVALUATION CHECKLIST

MESSEL PIT

Q. Does the site provide fossils which cover an extended period of geological time? ie. how wide is the geological window?

A. One million years only but this is long for a freshwater lake environment. Also at a critical time near the Cretaceous/Tertiary boundary.

Q. Does the site provide specimens of a limited number of species or whole biotic assemblages? ie. how rich is the site in species diversity?

A. Very rich. Over 1000 species mostly insects and plants. Very comprehensive view of a lake and marsh ecosystem with fish, amphibians, birds, reptiles, bats and marsupials.

Q. How unique is the site in yielding fossil specimens for that particular period of geological time? ie. would this be **the** type locality for study or are there other similar areas that are alternatives?

A. Very unique. No other site in terms of age and lake/oil shale sediments is known. Many new species first described here.

Q. Are there comparable sites elsewhere that contribute to the understanding of the total "story" of that point in time/space? ie. is a single site nomination sufficient or should a serial nomination be considered?

A. No. Oil shale is confined to Messel Pit.

Q. Is the site the only or main location where major scientific advances were (or are being) made that have made a substantial contribution to the understanding of life on earth?

A. Yes. Very strong contribution to explaining paleogeozoology of Eocene and dispersal within ancient continent of Pangea. Many important biological discoveries (eg. role of bacteria in fossil diagenesis).

Q. What are the prospects for on-going discoveries at the site?

A. High. After only 15 years of serious scientific study over 1000 species already identified and many more new species expected.

Q. How international is the level of interest in the site?

A. Becoming widespread but mostly German researchers to date. Very low level of tourism.

Q. Are there other features of natural value (eg. scenery, landform, vegetation) associated with the site? ie. does there exist in the adjacent area modern geological or biological processes that relate to the fossil resource?

A. Minimal other natural values.

Q. What is the state of preservation of specimens yielded from the site?

A. Particularly high including many complete skeletons, stomach contents, feathers, skin, hair and bacteria.

Q. Do the fossils yielded provide an understanding of the conservation status of contemporary taxa and/or communities? ie. how relevant is the site in documenting the consequences to modern biota of gradual change through time?

A. Reconstruction of the 49 mil. year old lake ecosystem is still underway. Additional reference points are needed as is geochemical knowledge for assessing climate change. Direct connection from Eocene to today difficult to make but answers are unfolding (for example, relatives of South American ostriches are found in Messel).