



3/2007 ▶ Times of Change in Omani Oases ▶ Culture, Commerce and Image ▶ Faintly Falling Plaster ▶ The Limits of Growth ▶ Desert Dust over Europe ▶ Moving Like Worms: Without “Legs”



In this issue

Metropolises and Their Cultures

Culture is a solid factor affecting the appeal of a location. A key aspect of image policy is the need to present local history and architecture and the centres of commerce and culture in such a way that they also appeal to an international audience. Taking Berlin and Moscow as examples, ethnologists are studying how culture is turned into capital in metropolises. **Page 10**

Tracing the Footsteps of Prehistoric Giants

Sauropods were some of the largest land animals that ever lived. Despite the fact they were herbivores, these enormous dinosaurs could reach a weight of 50 tons. Now, researchers are trying to solve the riddle of how these immense organisms functioned and how dinosaurs were able to evolve to attain such a formidable size. **Page 16**

Desert Dust and the Continental Climate

The effects of Saharan dust on the climate and weather reach far beyond the region of North Africa. This has now been demonstrated by researchers, who tracked the path of a massive five-kilometre high cloud of dust as it travelled from Morocco to South and Central Europe. **Page 20**

Commentary

Matthias Kleiner

Our Word of the Year p. 2
Germany's Excellence Initiative: Benefitting science and society

Arts and Humanities

A. Bürkert, K. Hammer, E. Schlecht, J. Häser, S. Al Khanjari

Times of Change in Omani Oases p. 4
Changing land use strategies in remote mountain oasis settlements

Wolfgang Kaschuba, Alexa Färber, Cordula Gdaniec

Culture, Commerce and Image p. 10

Natural Sciences

Klaus Hinsch, Holger Joost

Faintly Falling Plaster p. 13
Acoustic-optical measuring enables remote detection of loose plaster

Martin Sander, Jürgen Hummel, Nicole Klein, Marcus Claus

The Limits of Growth p. 16

Jost Heintzenberg

Desert Dust over Europe p. 20

Engineering Sciences

Klaus Zimmermann

Moving Like Worms: Without “Legs” p. 24
How magnetic fluids can be used to copy the movement of a worm

Portrait

Rembert Unterstell

“There Are Two Hearts Beating in My Chest” p. 27
Torsten Doerst combines clinical work with pioneering basic research



Cover: Andreas Bürkert

Oases in Oman

A view of the Balad Seet oasis in the al-Hajar mountain range, which has been inhabited for over 2500 years. Researchers are studying the changing subsistence strategies in remote oasis settlements, looking at mountain oases in particular.

Times of Change in Omani Oases

For millennia, highly developed oasis farming, alongside fishing, has formed the basis of life for the sedentary people of Oman. Researchers take a deeper look at the changing land use strategies in remote mountain oasis settlements

By A. Bürkert, K. Hammer, E. Schlecht, J. Häser and S. Al Khanjari

A view of the Balad Seet oasis in the Jabal al-Akhdar massif in northern Oman.

Famed as the origin of frankincense, a major copper producer in ancient times, and the birthplace of the legendary trader "Sinbad the Sailor", who represents the phenomenal wealth of oriental merchants, Oman was barely accessible to foreigners until 1970. As an enlightened Islamic Sultanate, the country has since experienced an uninterrupted process of cultural and economic transformation. In former days, Oman was a country of nomads who bred the fastest camels in the world, of oasis farmers, fishermen and of seafarers, who were already trading with India on a regular basis, using their sturdy boats made of reeds, and later wood, in around 3000 B.C. Today the society's welfare is based predominantly on the oil industry and on services. The traditional oasis economy as the material basis and key formative element of Omani culture has taken a back seat, becoming an exotic peculiarity and a tourist attraction. In recent years, many of the oases that have become easily accessible via newly constructed tarmac roads have turned into "housing estates under trees", while remote settlements have become weekend residences or have been completely abandoned.

Recent interdisciplinary studies have made it possible to represent and evaluate the way in which remote mountain oases in Oman function and have highlighted opportunities for their development. The study presented here looked at the mountain oases of Maqta in the Jabal Bani Jaber mountain range (a small "scattered oasis" settlement 1050 metres above sea level), Al-'Ayn and Ash Sharayjah (two small core oases at an elevation of 2000 m a.s.l.) in the massif of the Jabal al-Akhdar, the small oasis of Al-Sawjarah, which has only recently been connected to the road network and public infrastructure, as well as Balad Seet (a large core oasis at 1000 m a.s.l.) in the northern Al-Hajar mountain range.

All of these sites are characterised by their use of the "Aini Aflaj" water supply system, a spring-fed canal system developed in Oman in regions with an annual precipitation of 100-200 mm, whose origins are



believed to date back to between 1000 and 500 B.C., as well as by intensive interaction between terrace crop farming and animal husbandry. Observations of grazing goats, periodic GPS collar tracking and feed intake studies showed that once or twice a day, the herds with often a few hundred goats and some sheep are taken to graze the sparse mountainous pastures surrounding the oases that provide over 50% of their total intake; in the evenings their diet is supplemented with high-protein fish, high-energy dates, kitchen leftovers and alfalfa. The terraces, which are many centuries old, have been built up over the millennia with great care using 10,000s of tons of wadi sediments. They are used intensively for crop farming, which is characterised by large surpluses of added carbon and nutrients coming mainly from livestock manure. Studies of plant morphology and molecular genetics have revealed that the local varieties of wheat grown as landraces on these terraces, which are currently disappearing rapidly, are unique worldwide. The newly discovered five varieties of bread wheat and four varieties of durum wheat emphasise the ancient function of these mountain oases as sanctuaries for genetic resources. Comparative fingerprinting studies with wheat accessions from the world's germplasm collection pro-

vided evidence for the ancient trade relations Oman maintained with all major countries in the region.

Fruiting date palms are a common sight in many of Oman's mountain oases. Facing page: The impressive hanging oasis terraces on the steep slopes of the Jabal al-Akhdar massif in northern Oman. This aerial photograph was taken from a small remote-controlled airplane.

The first example is the territory of Maqta which extends over an area of about 25 square kilometres. To the present day, the central settlement with its 59 stone buildings, which are predominantly used for storage, retains its importance for Maqta's about 200 semi-nomadic inhabitants with their herds of sheep and goats as well as for the 16 terrace systems, fed by 22 tiny springs, which cover a total area of just 4.5 hectares. Due to below-average precipitation during the period studied (2002-2004), many cultivated terraces were abandoned and one of the ancient varieties of wheat discovered there has now become extinct. As a result of its isolation and the precarious water supply, this oasis settlement is acutely in danger of being abandoned completely, in spite of state infrastructure aid and transfer payments.

Irrigated farming in Maqta started only about 600 years ago. Prior to



this, the springs and pastures were used periodically by nomadic herdsmen with their flocks. This is also visible in the archaeological record which does not show settlement remains but several tombs dated to the of Bronze Age and Iron Age (3000-600 B.C.). Famous are the limestone-built towers on the Shir plateau which were discovered in 1992. Due to comparisons with similar structures elsewhere on the Arabian Peninsula they could be dated to the 3rd millennium B.C. However, they were probably not only used for burials but also as markers in the landscape. They are situated on the Shir plateau where four main wadis originate and probably once were monumental territorial markers for the nomads.

Very close to the settlement of Maqta it was possible to find an undisturbed area of sedimentation in a depression where a 20 metres deep cut could be made for climatic studies. Such studies are most important for Oman to investigate whether the dramatic alterations in the settlement history over time could be partly explained by climatic changes. The sedimentation profile reaching over 18,000 years back into the Pleistocene era was used as a palaeo-climate record after successful radiocarbon dating of mollusc shells, luminescence analyses of quartz minerals and the evaluation of pollen diagrams. In contrast to earlier periods, when shifts of the Indian Summer Monsoon were reflected in large alterations of the moisture regime, the data gained from the profile provided evidence of only minor climatic changes since the tower tombs were built.

A second example: due to their spectacular location on the steep mountain slopes, the terraces on the Jabal al-Akhdar massif are famous as "Hanging Gardens" far beyond the borders of Oman. GIS-based analyses of high-resolution aerial photographs made with a small, remote-controlled airplane and ground measurements on the thousands of plots, some of which are as small as a single square metre, allowed a representative assessment of carbon and nutrient flows at the village level. The farmers who live

in the settlements of Al-Ayn and Ash Sharayjah cultivate a total area of 2.4 hectares as rose gardens (used to distil rose water of a very particular quality) and 10 hectares of terraces for pomegranates, walnut trees, limes, alfalfa, barley and onions for their own subsistence and for sale. According to the oases' inhabitants, in the past decade a third of the original area of terraces has been gradually abandoned, as a result of the increasing shortage of water. The farmers blame this

electric washing machines have become commonplace in many of the small mountain villages. A switch to (certified and thus marketable) organic farming methods, as would appear possible without much difficulty from a cultivation point of view due to the very sparing use of mineral fertilisers and the almost total absence of pesticides to date, would open up new marketing opportunities for the products from the oases, keeping the hard work in the gardens worthwhile. Levying entry



On the road with two donkeys: Transporting tools and liquid nitrogen for the conservation of soil samples to the study site. Right: A steep staircase leads to the Al-Sawjarah oasis in northern Oman. Facing page, above: A rope ladder hangs into a 20-metre sedimentation profile used as an 18,000 year old local climate record. Facing page, below: A neglected date palm grove in the north Omani town of Bahla.

on the steady decline in precipitation that has taken place over the past few decades, but 30-year old photographs of the area indicate that the perceived water shortage is more likely due to the rapid construction of new settlements on the high plain of the Saiq plateau and the accompanying intensive watering of domestic gardens coupled with an extension of tree cultivation on the terraces. The recent rapid growth of tourism will increasingly become another reason for the occurrence of water shortages. But the oasis dwellers themselves also use more water today than they did just 30 years ago as toilets, showers and



fees to the villages or for guided tours in the gardens by locals familiar with the area could also enable villagers to earn additional income from tourism.

The third oasis settlement of Al-Sawjarah is also located on the Jabal al-Akhdar massif. Six stone houses and a few goat stables snuggle up under a rocky ledge right on the mountain slope, overlooking a narrow, dry valley where walnut, pomegranate and peach trees grow. Due to the very low yield of the only spring in the village, just 0.7 cubic metres an hour, the farmers gave up cultivating plants requiring intensive irrigation such as wheat or fodder plants some years ago. The village, which today has a population of just 50, only became accessible by motor vehicles in 2004, when a gravel road from the main asphalt road was built. The last part of the journey to the village through the dry valley still has to be completed on foot, with a climb up large stone steps. Once their last inhabitants leave, the ancient buildings are likely to fall into ruin rapidly, as so many have done already, unless

they are preserved as a cultural and historical treasure serving as a museum village.

One final example: The oasis settlement of Balad Seet, with a current population of 600, on the western slopes of the Jabal al-Akhdar massif has – as proven by archaeological finds – been in constant use since the second Iron Age (around 1100 B.C.). Due to the large watershed, the dozen springs close to the oasis settlement still yield sufficient water even after several years of drought to allow dates and fodder to be grown, as has been revealed by regular measurements. Studies of the age of the water using tritium and sulfurhexafluoride as tracers suggest that the rain water seeps through the limestone and dolomite massif for five to six years before finally emerging at the oasis. This comparatively reliable water supply makes Balad Seet stand out among many other oases, in particular in comparison to Maqta, both in terms of the settlement history as well as its future prospects for development. The constant construction of new houses, the modernisation of old buildings and the installation of sanitary facilities as well as the connection of Balad Seet to the road and mobile telecommunications network make this village increasingly attractive for Omani weekend dwellers and individual tourists. An indiscriminate expansion of tourism in Balad Seet is likely to be accompanied by the same problems that have been observed elsewhere and were described above. This makes it all the more important to share the data collected on the biophysical functioning of Omani oases and their settlement history with the institutions responsible for national planning and political decision making.

Authors are: Prof. Dr. Andreas Bürkert and Prof. Dr. Karl Hammer, Universität Kassel and Universität Göttingen, Dr. Jutta Häser, German Protestant Institute of Archaeology in Amman, Jordan, Dr. Sulaiman Al Khanjari, Sultan Qaboos University, Muscat, Sultanate of Oman

Contact: Prof. Dr. Andreas Bürkert, Universität Kassel, Steinstraße 19, 37213 Witzenhausen