Dendrochronological Research in South Mustang

-B. Schmidt

Introduction

In different areas all over the world, where boreal, temperate and arid climate zones prevail, dendrochronological data nets are being set up for dating purposes and climatic and ecological studies.

Tree ring research has widened its horizons more and more during its development.

F. Schweingruber (1988) describes this branching out clearly in his book Tree Rings and demonstrates the possible connections with other fields of studies.

The dating of wood and timber specimens of particular historical value plays a large roll within this science. Archaeological wood finds and timbers from historical structures and settlements should be considered foremost. Sculptures, paintings on wooden panels or even antique furniture can be of value to the dating process.

In connection with geological queries, one can date for example, the former meandering of a river with the help of chronologically arranged wood or timber finds from gravel pits along its banks. Wood finds in moors enable one to better understand the dynamics of moor growth and its development in prehistoric times.

Cooperation between different areas of research is of great significance. The dendrochronologist can be supplied with a greater range of wooden specimens for dating purposes, that are advantageous to their research with regard to climatic and ecological analysis.

General information about the construction of tree ring calendars

The achieved width of a single tree ring during a growth period can be described as the result of various influences, that partially correlate with one another. One can quite often see, even without the help of a microscope, that the width of a single tree ring varies from year to year. The

fluctuating climatic conditions each year are responsible for their difference. The dendrochronological dating method is based on this phenomenon. The sucession of narrower and wider tree rings is often so distinct, that one can speak of tree ring patterns. In the case of trees that

1) are the same age
2) that have built more than 50 rings
3) that are of the same wood type
4) and that grew in the same area,

one can observe a clear conformity in their patterns. The curves of trees that grew in different areas show therefore less conformity with one another. When one wishes to date the tree ring curve of a particular wood specimen, whose age is unknown a so called reference tree ring curve is necessary. This curve must at least date back to the time in which the specimen grew. The plotting of such reference curves has been a main concern of dendrochronology since its beginnings. Here lies the key to the sucessful dating of material.

Since trees generally rarely reach an age of more than 200 to 300 years, one can merely plot a reference curve from living trees for this period. The desired extension of such a curve can be achieved through "bridging". Older and older generations of trees (for example timber specimens from houses, castles and monasteries) must be sought out. The younger end of a tree ring curve to be dated must overlap and correlate with the older end of the reference curve for accurate dating. This is called "bridging". (fig. 1)

Two requirements must be met when using the dendrochronological method to date wooden specimens:
1) a complete reference curve is necessary, that at least dates back to the time when the specimen in question grew.
2) and the curve of the specimen to be dated must correlate so closely with the reference curve, that it can be accepted as synchronous.

One cannot expect to find perfectly correlating curves of trees that are the same age, because of the manifold influences upon their growth over a one year period. Whenever curves are compared, the dendrochronologist must clarify whether the correlation is accidental or not. This decision can be made much more easily with the help of mathematical calculations, yet it cannot replace the actual overlapping of curves on a viewing table.
The progress that dendrochronology has made in the last few years can mainly be put down to the use of modern measuring and calculating devices. Computer programs are of course also used to compare and synchronize curves.

The development of several tree ring calendars for western Europe

Since the beginning of the 1970's dendrochronological research has especially focused on extending the absolute "oak chronologies" for western Europe. Taking into consideration the regional climatic differences, dendrochronologists have already been able to correlate 1000 years of "oak chronologies" for Hessen (Germany), southern Germany (Huber, v. Jazewitsch, John, Wellenhofer; 1949) and western Germany (Hollstein; 1965). The analysis of recent oak trees from different areas in northern Germany have not yet resulted in a satisfactory overlapping with other curves. Further research with greater amounts of test material has shown however, that tree ring analysis could be put to use, even in this area (Bauch, Liese, Eckstein; 1967). Due to further research more and more tree ring

chronologies, for example from northern Ireland (Baille; 1977), southern England (Hillam; 1980), southern Denmark (Bartholin; 1973), Mecklenburg (Germany) (Jährig; 1972), Weserbergland (Germany) (Delorme; 1972) and northern Switzerland (Schweingruber, Ruoff; 1979) could be added to the list. Early investigations of oak finds from gravel deposits along the Donau and Main rivers were also promising.

In 1972 laboratory work was begun in Cologne. The main point of focus there was the examination of oak tree trunks from gravel deposits along the banks of the Weser river between the villages of Hameln and Rinteln. Another source of material came from moor areas, where Rhine river tributaries once flowed (Schmidt; 1973, 1975, 1977).

Holocene dendrochronology has made remarkable advances since the first PACT symposium Titled " 14^c and Archaeology". The U.S. bristelcone pine series was extended back to 6700 B.C. in 1983 (Ferguson and Graybill; 1983). Just one year later the Belfast tree ring laboratory succeded in closing the gap in the west european "oak chronology", which now reaches back to 5289 B.C. (Pilcher et al.; 1984. The German "oak chronology" researched by the laboratory in Goettingen in 1987 was extended back to 6255 B.C. (Leuchner, Delorme and Höfle; 1987). Due to the cooperation between the tree ring laboratories in Cologne and Hohenheim, the German tree ring chronology reaches back to 7237 B.C. (Becker, Schmidt; 1990).

The accuracy of this holocene tree ring record, which is the most one extensive in the world, has been confirmed by high precision radio carbon dates.

Early dendrochronological results from the southern Mustang region

During the last two campaigns (March 1989 and October 1992) about 400 wooden specimens were collected to aid in the construction of a tree ring calendar for south Mustang.

A newly established field laboratory in Jomsom (fig. 2) improved our working conditions (in October 1992). The specimens taken from the forests near Thini and numerous houses and ruins between Marpha to the south and Dzarkot (Jharkot) in the north could be analized there.

Fifteen pine trees taken from a forested area near Thini were analysed. Thereafter, a tree ring curve for the years 1992 back to 1804 could be plotted (fig. 3).

The pine from the old ruined monastery in Muktinath proved suitable for extending this tree ring curve, in which the "bridging" method was used. The correlation between their curves and the ones plotted from living trees can be seen in the diagramm (fig. 3). According to these finds, the wood used in the construction of the monastery (the youngest tree ring before being chopped down) was felled in 1906. The oldest tree ring from these pine specimens (growth period of the trees) dates back to 1768. The calendar can therefore be extended back to this time.
A calendar spanning 538 years was constructed with the help of the 267 specimens, that have been dated up to this time. It is now complete between the years 1992 and 1455 (fig. 4).

As seen in figure 3, we were able to construct a chronology from living trees (drilled specimens), that reached back to 1804. Since we weren't been

able to find any older suitable material/trees to date, we used, in addition to the specimens from the monastery in Muktinth, numerous ones from a joiners workshop in Thini and others from the roofs of houses in Marpha and Thini.
With the help of these specimens, we have been able to set up a chronology that spans 285 years. Exact dating was made possible by the chronologies constructed from living trees. Consiquently, we were able to extend the calendar back to 1697.
As shown in the diagram (fig. 5) the wooden specimens taken from a house in Kagbeni (The Red House), as well as the finds from the ruins in Garab Dzong / Old Thini (fig. 6)), made it possible to extend the tree ring calendar back to the year 1455.
The tree ring calendar has already helped answer questions about an important time span of archicetural and settlement history. A specimen from the foundations of the kings palace in Dzarkot (felled in 1512) could only be dated after these first analyses.

Several of the timbers samples taken (in October 1992) from the ruins in Garab Dzong could also be dated. Two specimens (fig. 6), for example, from the foundations of the ruins, that jutted out of the upper part of the plateau, could be absolutely dated because of this. The youngest tree ring (felling year) of both specimens (dendronr. 061, 062) dates from 1533. The fact that these samples were taken from the foundations of the ruins, one can most probably say, that construction was begun in 1534. The rest of the material analyzed to date is all younger. As shown in the diagram, construction also took place in 1779 (dendronr. 042, 027, 028, 037).

Wooden specimens taken from the castle in Kagbeni and Dzarkot can now be dated absolutely (fig. 7). The dates shown here do not allow for a better interpretation as yet, seeing that the material was chosen exclusively for dendrochronolocical use. This also applies to the dating of the samples taken from the houses in Kagbeni (The Red House) and Dzarkot (Palgon Thakhuri) (fig. 5 & 8).

This chronology now offers new dating possibilities when researching architectural and settlement history in this area.
The tree ring calendar will certainly be further refined and most probably legnthened, when more material is dated in the future. A greater number of specimens are needed for the planned climate analyses.

Fig. 1: From: Schweingruber (1988). The bridging method. The fluctuation in the width of tree rings (narrow and wide rings), that occur because of varing climatic conditions, is quite similar in trees of the same age.

Fig. 2: The area of dendrochronological research in southern Mustang: form Muktinath to Tukche.

Fig. 3: Two synchronous tree ring curves: a) a curve plotted from samples of living trees, that dates from 1992 back to 1804 and b) a curve of various timbers taken from the monastery in Muktinath, that date from 1906 back to 1768. The dated timbers from the monastery extend the chronology (an example of the bridging method) back to 1768.

Fig. 4:This diagram represents the period from 1455 to the present. It was constructed with the help of samples taken from living trees and timbers.
n. Chr. = A.D.

Fig. 5: The various ages of timbers form different

parts of the Red House represent the stages of construction.

Fig. 6: The time span represented by dendrochronologically dated samples from the ruins at Garab Dzong (Old Thini). Early results show, that the settlement existed between 1533 and 1779.
n. Chr= A.D.

Fig. 7: The first dated samples from the castles in Kagbeni and Dzarkot

Fig. 8: Dzarkot, Palgon Thakhuri House - An example of how a house is dated. All timber used in the construction was felled in 1779. Construction was most probably started one year later.
n. Chr. A.D.

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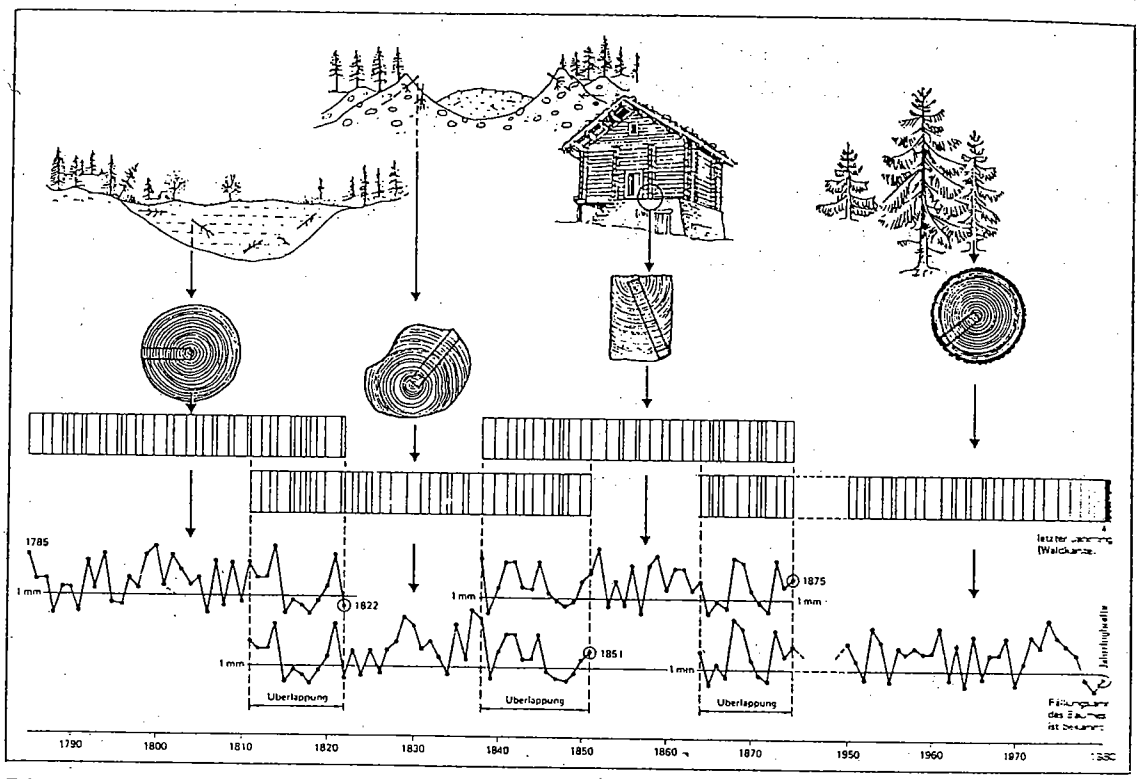
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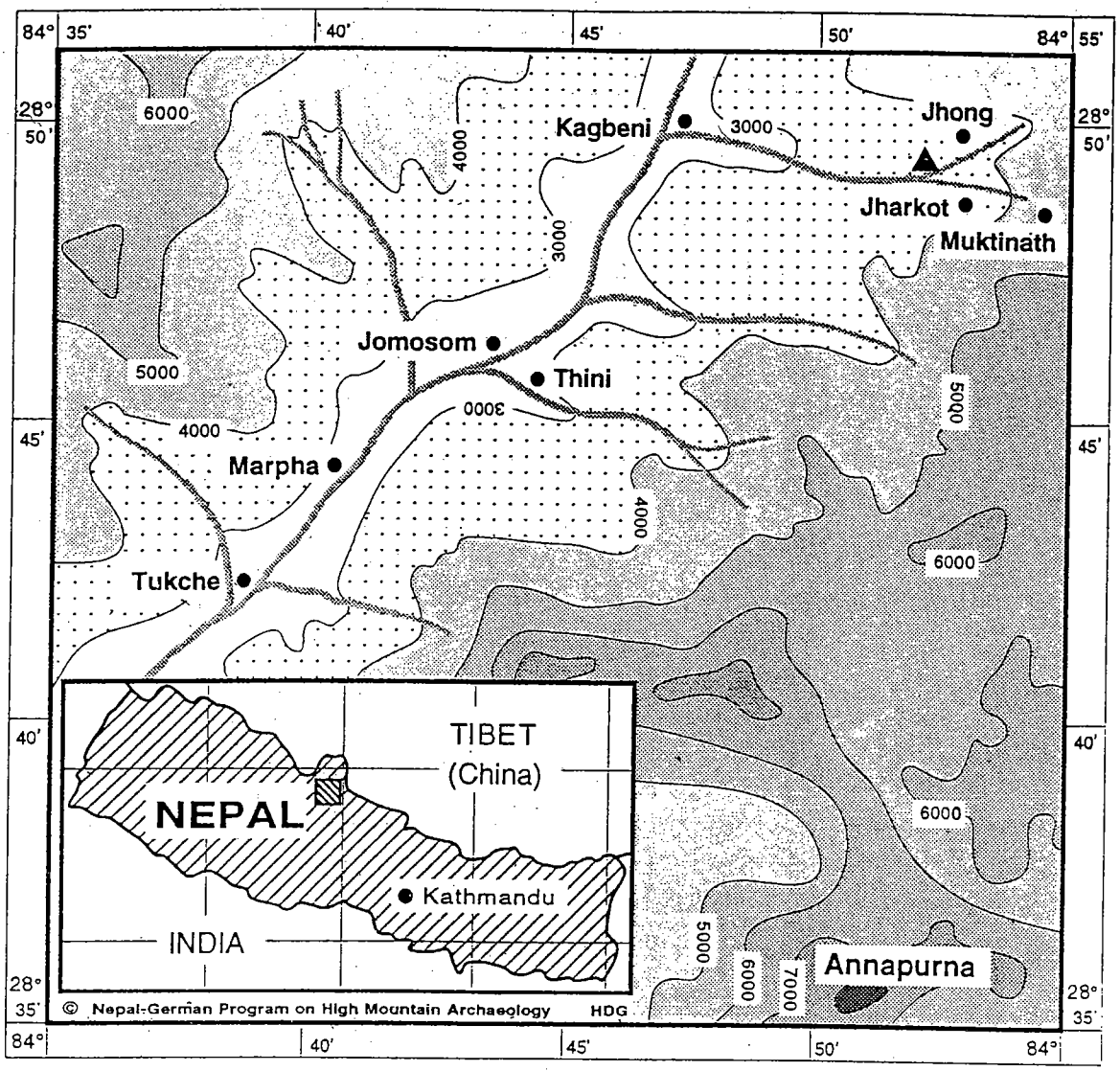
Fig. 1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Kagbeni
Jhong
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Muktinath
Jomosom
Thini
Marpha
Tukche
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(China)
NEPAL
Kathmandu
INDIA
Annapurna
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© Nepal-German Program on High Mountain Archaeology HDG

Fig. 2

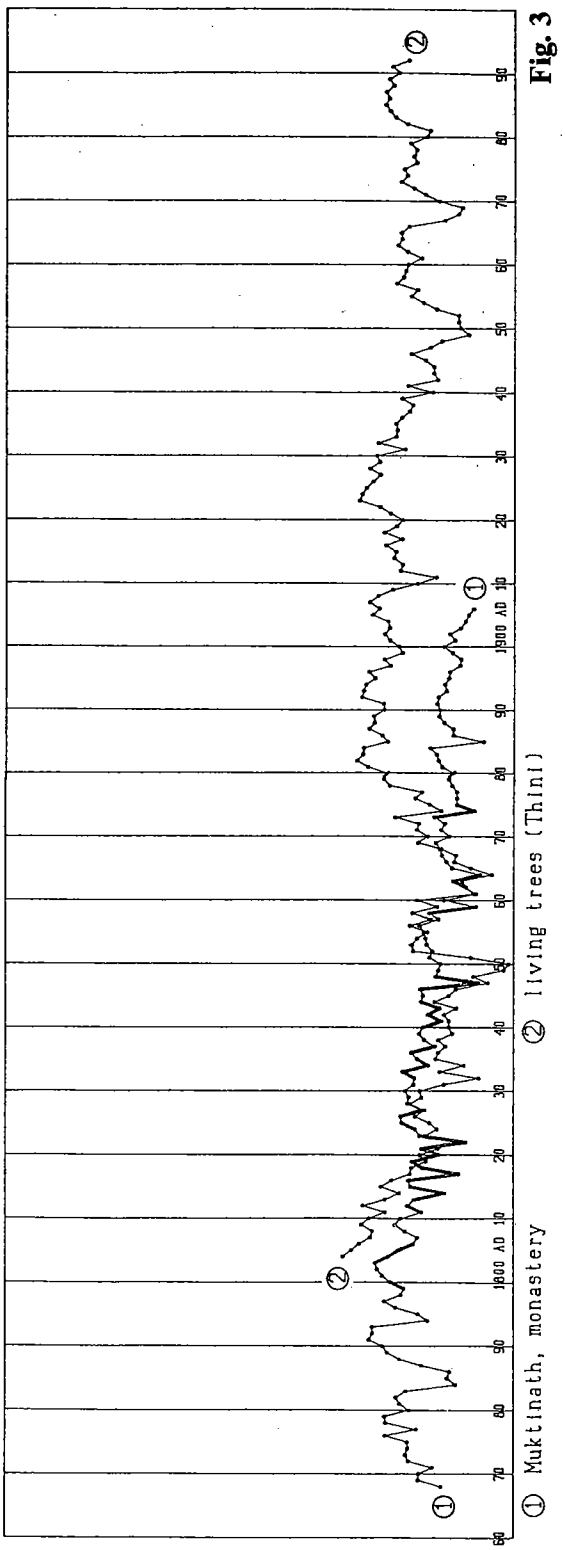
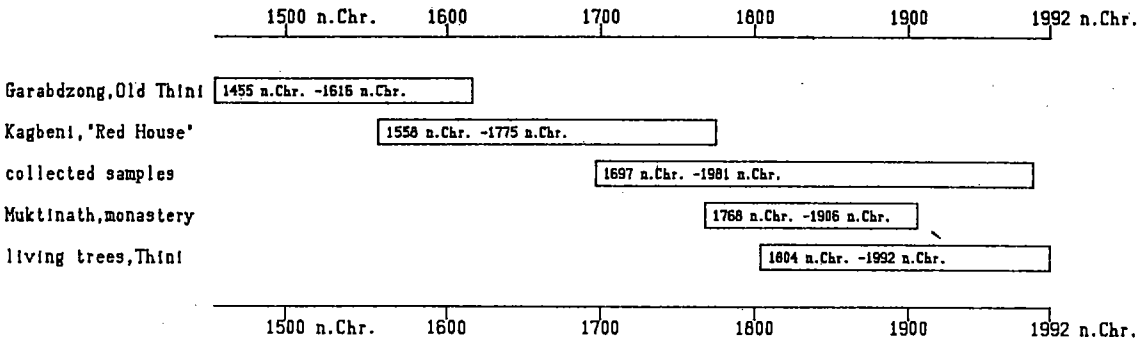


Fig. 3


1500 n.Chr.
1600
1700
1800
1900
1992 n.Chr.
Garabdzong,Old Thini
1455 n.Chr. -1616 n.Chr.
Kagbeni,'Red House'
1558 n.Chr. -1775 n.Chr.
collected samples
1697 n.Chr. -1981 n.Chr.
Muktinath,monastery
1768 n.Chr. -1906 n.Chr.
living trees,Thini
1804 n.Chr. -1992 n.Chr.
1500 n.Chr.
1600
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1992 n.Chr.

Fig. 4

Kagbeni, 'Red House'

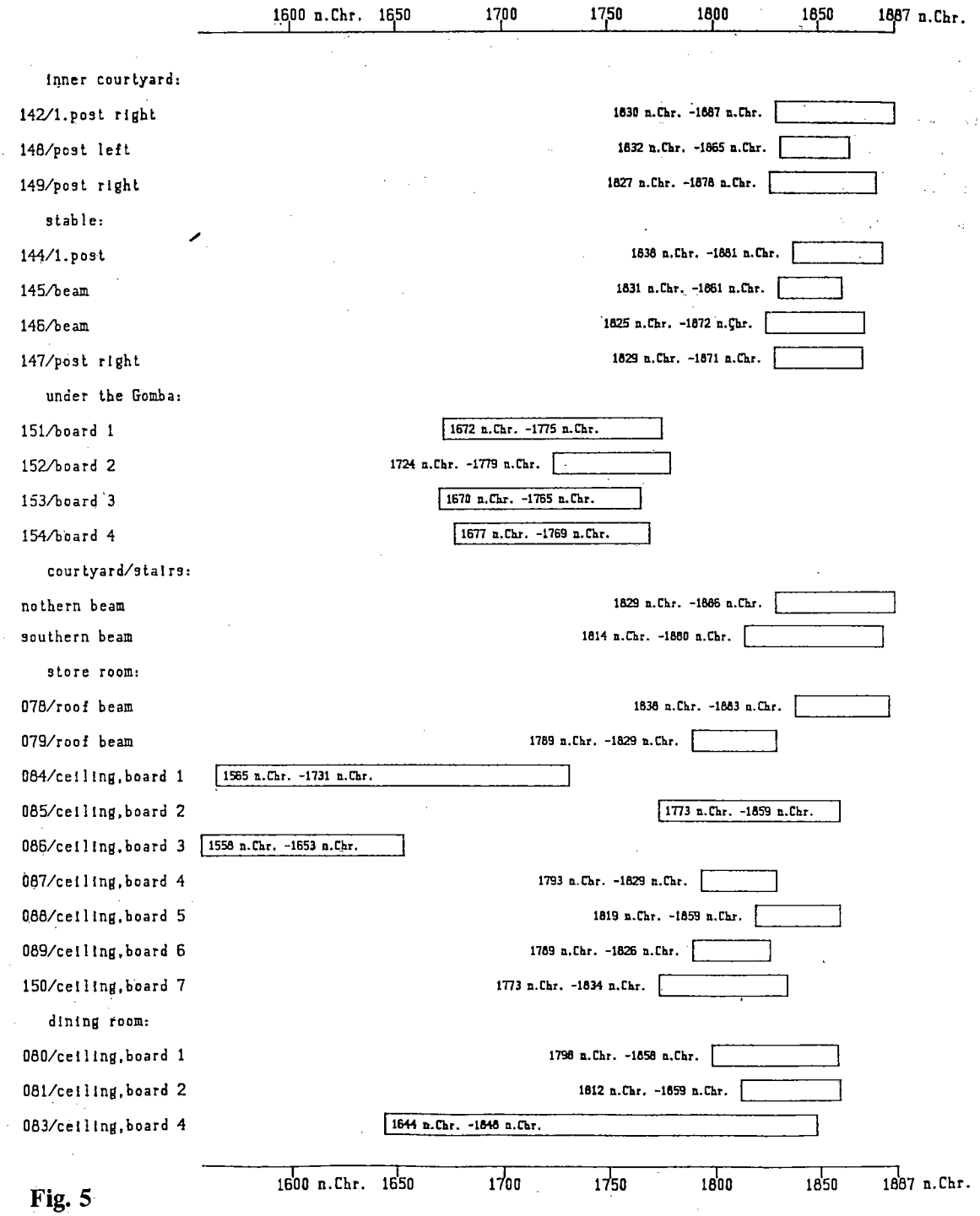

Fig. 5

Garab Dzong / Old Thini

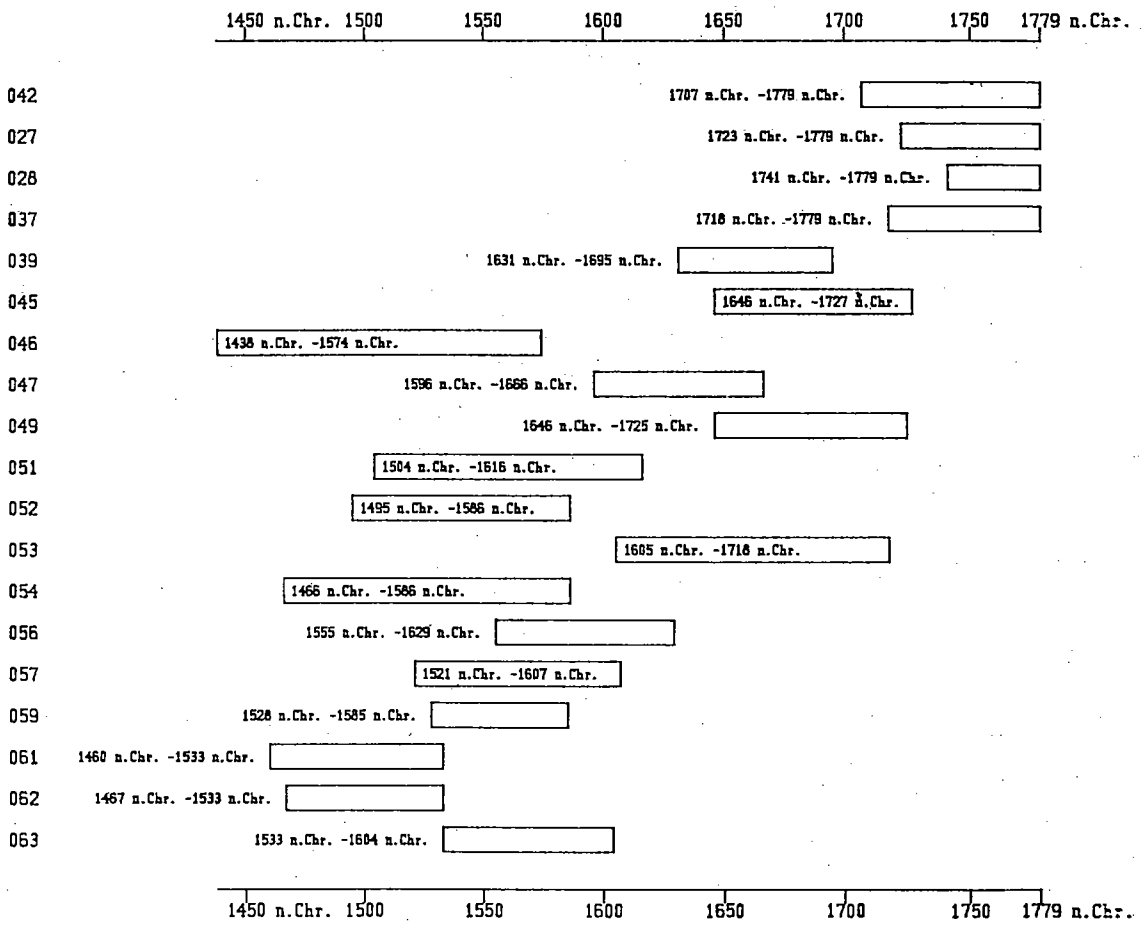

Fig. 6

Castles in Kagbeni and Dzarkot

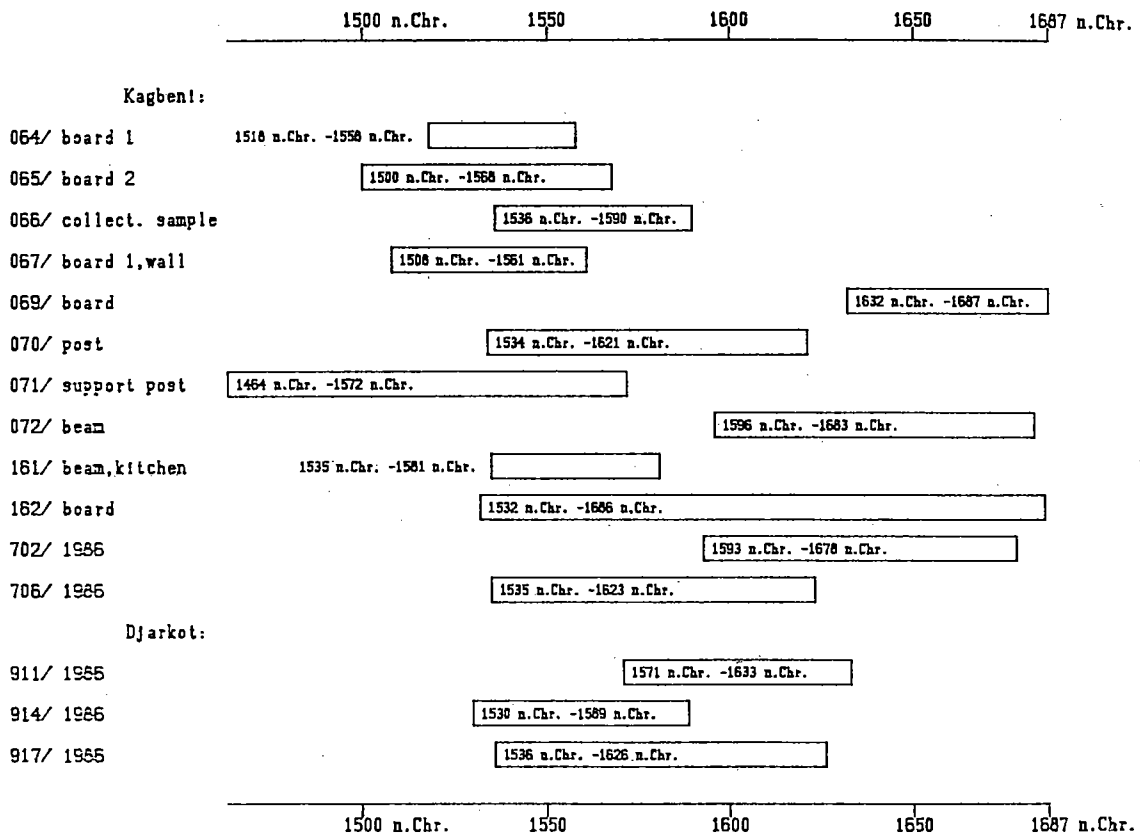

Fig.7

Dzarkot, house of Palgon Thakuri

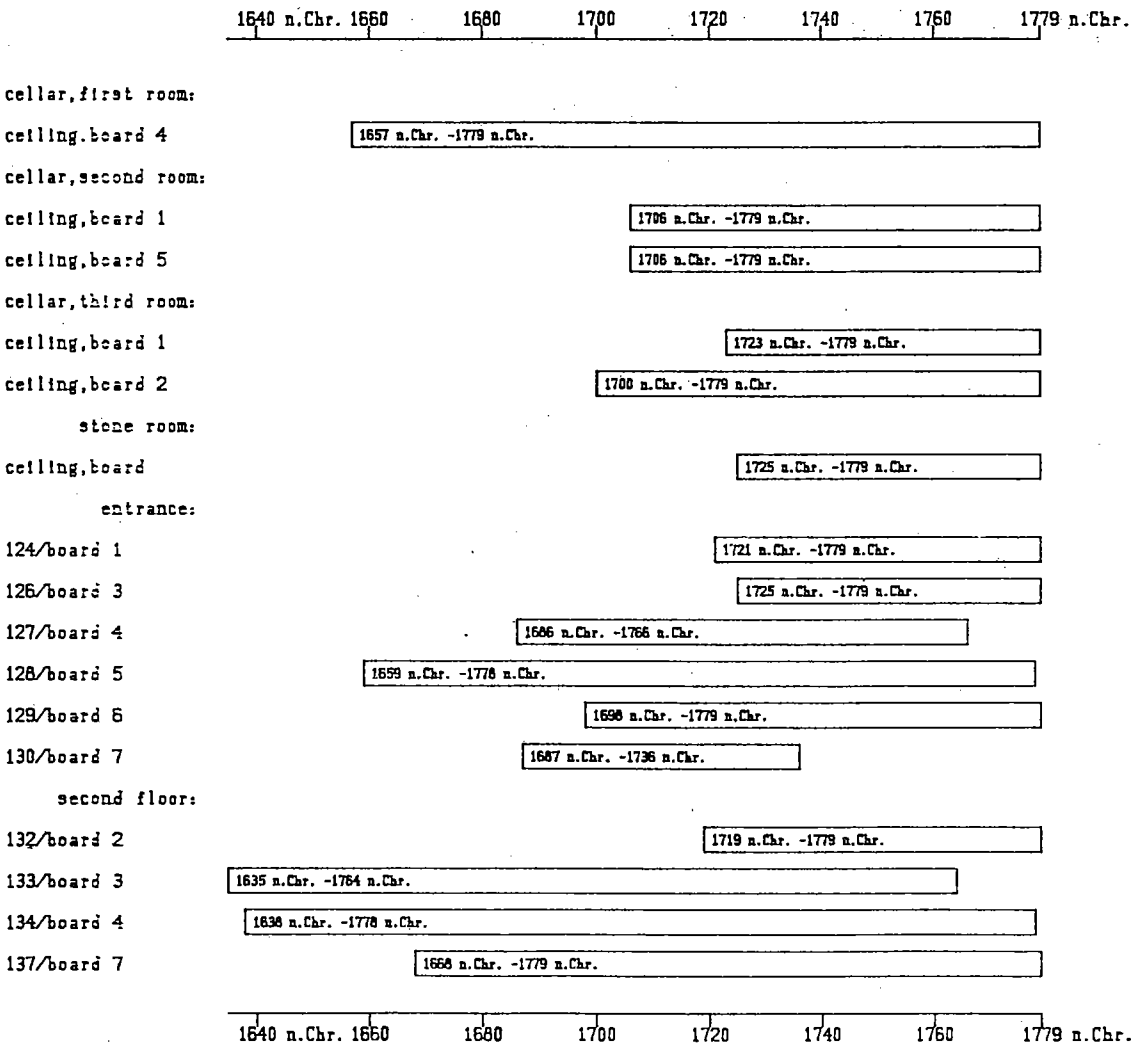

Fig. 8