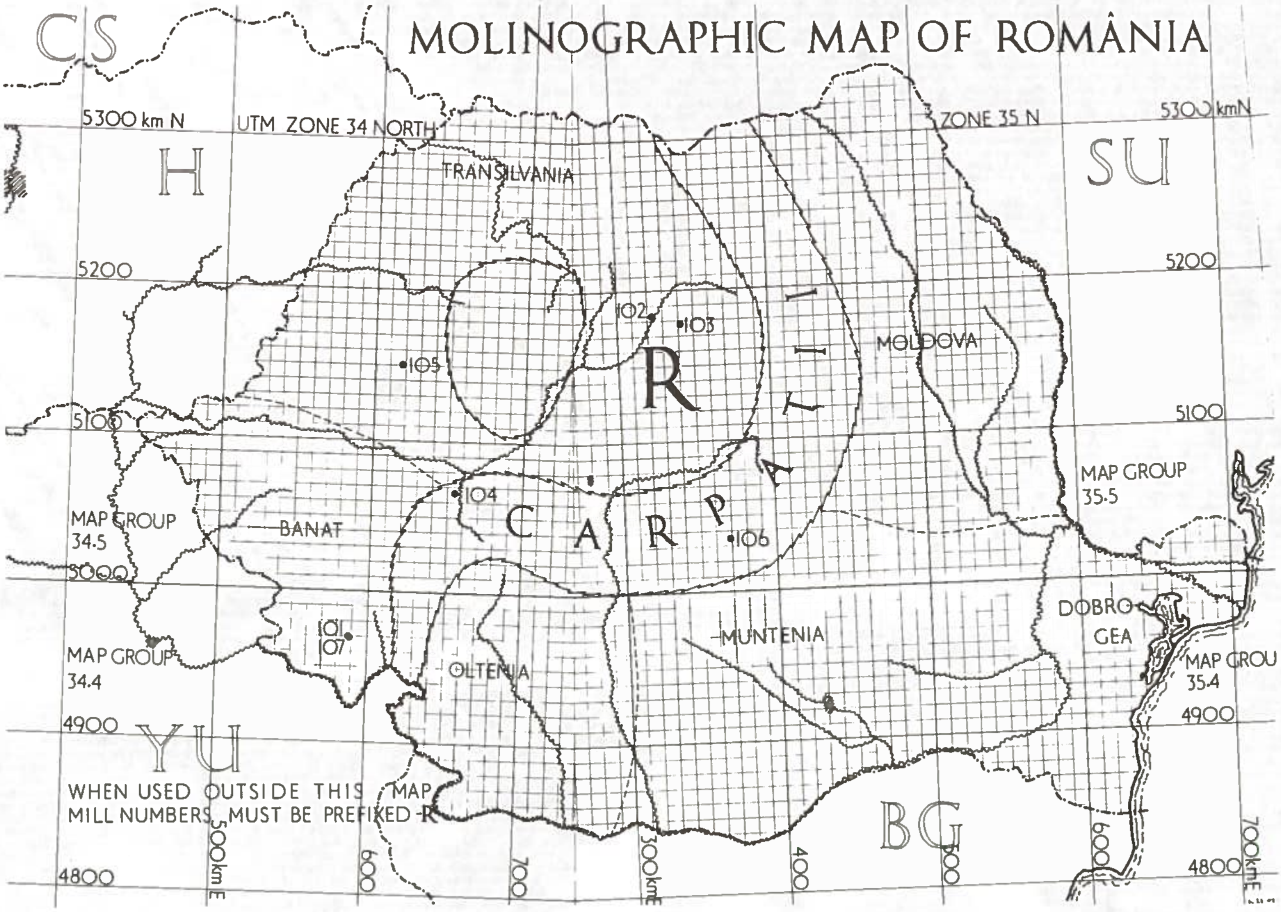

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Where nothing else is stated illustrations are supplied by the authors; photographs by M. Juga, drawings by R. Terchak.

Fig. 32.01 (leading photograph) R-106-Moeciu de Sus, Judeţul Braşov, UTMn 35/369/5035. A so-called dirstă, a fulling mill composed of a hammer-walk, a fulling-drum as well as a vîltoare - a whirlpool (seen in the foreground, and referred to in the discussion). Note the morticed arms of the breastshot bucketwheel.

Fig. 32.02 (above) The Molinographic Map of România, here to scale 1/5 M (map to scale 1/2.5 M, see fig. 32.09). The mills mentioned in this Paper are indicated on the map.

Fig. 32.03 (frontispiece, opposite) R-104-Dobîca, Judeţul Hunedoara, UTMn 34/655/5066. Undershot paddlewheel with only one rim (like the Dutch undershot mills) and morticed arms. Now in the Museum for Agricultural Technique, Sibiu, 35/278/5077.

Fig. 32.04 (right, centre) Cornel Irimie, Ph.D. Born 1920. Ph.D. on Historical Science, Sociology, Ethnology. Scientific Director of the Open Air Museum of Ancient Rural Technology of Romania, in Sibiu. Has worked for some years on the study of Romanian watermills.

Fig. 32.05 (right, bottom) Corneliu Bucur. Born 1943. M.A. (History) from University of Cluj. Assistance Curator with the Open Air Museum in Sibiu. Has studied horizontal mills in Banat, Romania.

Notes:

1) Constantin Daicoviciu: Istoria Romăniei (History of România), Vol. 1, 1960, P. 255-268.
D. Macrea & T. Tudor, ibd. P. 397 - 399.

2) Herodot: Historiae 4, 93, from Istoria Romăniei, Vol. 1, 1960, P. 223 - 224.
Arrianus: Anabasis, Vol. 1, 3 - 4, P. 228 - 229.
Strabon: Geographica, Vol. 7 - 3, 13, P. 257.

3) Legenda Sancti Gerardi, Chapter 8 in Scriptores Rerum Hungariae, Vol. 2 from Istoria Romăniei, Vol. 2, P. 40 note 1.

4) Documente privind Istoria Romăniei veacul (century) 11 - 13. Series C, Transilvania Vol. 1, P. 5.

5) Stefan Pascu: Mestesugurile din Transilvania pîpăîn secolul al 16-lea (century), Bucuresti 1954, P. 26.

CHAPTER 32

R R

TYPOLOGY, DISTRIBUTION, AND FREQUENCY OF WATER-MILLS IN ROMÂNIA IN THE FIRST HALF OF THE TWENTIETH CENTURY

by

CORNEL IRIMIE

&

CORNELIU BUCUR

The fertile soil and favourable climate of Romånia have promoted husbandry as early as Neolithic times.

Technical development of agricultural implements has for centuries taken priority within the social structure of the societies occupying this area.

Numerous archæological finds[1], and written sources[2] from the Getic-Dakic and Roman cultures, and later from the Middle Ages, bear witness to this fact.

The hand stones of the primitive farming communities must certainly have seen changes before the grinding of cereals from culture crops was trusted to the powers of Nature; first of all the power of the streams. When it became possible to transmit waterpower to the upper, movable runner - be it through a simple or complex system - the way was open to a considerable increase in productivity, thus meeting the greater demand for food by the population. This increase was greatly facilitated by the increased size of mill stones, the major element in the new plant.

Our efforts to fix the date of this development stage of agricultural technology on Romanîan soil must mainly rest on written sources, since conclusive archæological proof of these plants is still missing, although we should not ignore the same train of development in neighbouring cultures.

The Holy Legend, "Legenda sancti Gerardi", dating from the beginning of the 11th century AD, mentions in the villages of the present Banats Handstones (rîşniţe) turned by hand, and used for grinding cereals [3]. A deed of gift dated 1169 records, among other tradesmen in a Transilvanian village, four millers ("molenari")[4], presupposing the existence of a mill. In the same historical Romånian province, a document from the 12th century records other installations utilizing running water, such as tanning hide and fulling woollen cloth[5].

COMMENTS on

Typology, Distribution, and Frequency of Watermills in România in the First Half of the Twentieth Century.

Floating Mills on Boats in România.

Windmills in Dobrudscha, România. Distribution and Typology.

Jespersen: (introducing): Before we start I will just briefly tell you that the windmills are situated in this area (Dobrudscha) cut off by the Dunarea (Danube) and so that area is rather flat, and consequently served by windmills. The other part of România as you see on the map further along is very lavishly served by watermills of various types.

All three papers were then presented in German by Mr. Irimie, since the other two authors - regrettably - were not present. The presentation was accompanied by slides. (applause)

Jespersen: Thank you very much indeed Mr. Irimie, Vielen Dank, Herrn Irimie, for the most interesting and instructive presentation of these three papers. As I said at the beginning of these Sessions, I cannot strongly enough urge the future connection with Eastern Molinologists, since it is obvious that what we know and think is the whole truth - is just a corner of it, geographically, and molinologically. We must know much more of what goes on in the East: there are such large territories, which are not at all surveyed, and from which from literature we know very little. It so happens - I don't know whether people are scared to go inside mills - but I have noticed that very many people write about mills, but for some reason or other are reluctant to go inside. They don't show photographs, they don't describe - at least not accurately - what goes on in the house, and so we will have to guess, and very often we make the wrong guess. We have seen from several papers here a thing that has been my opinion for many years: the close interrelation between the shaping of wind- and watermills. In an area where the windmill is in the majority such as in the Western countries, notably Nederland - and north and south of it, we find the wind superiority giving overdrift not only in the windmill, but also in many of the watermills. Adversely so when we get to areas such as Great Britain, Magyar, Polska, România, and so on where the watermill has been in majority: it will infect as it were also the windmill, and also give it underdrift. I don't think we have seen a single two-step geared windmill in this paper of Mrs. Rusdea's with overdrift, they have all had underdrift.

Wailes: In order the (four) observations are as follows: the decorated meal orifice and the stone vat is also known in Hungary/Magyar, and not unconnected with the fertility cult. The caliper brake you saw on one of the slides as well as the solid based post mills - some of them, with a post - are very near in appearance certainly the caliper brake to some I have seen, and photographed in Öland (S). The paltrok - post mills - I think we can best call it that (yes, I agree) I have seen in Germany/Deutschland, and I think Mr. Hirsjärvi will bear me out that there are probably some of which we have seen photographs in Russia/CCCP, and finally in the paper there is a drawing of a vertical stamping oil mill whose arrangement in drive is identical with the beetling machines that I have seen in Scotland within the last two years.

Jespersen: There is one type of mill - if you can at all call it a mill - that has not been mentioned: I believe Mr. Irimie has shown me on an earlier occasion a very interesting type of mechanism which can best be translated and described as a "Whirlpool" or "Wirbelkorb".

Irimie: Piuă, steară or vîltoare are the Romanian words.

Jespersen: It is a huge basket made out of pieces of wood standing roughly at 80° to the horizontal. Water is admitted through a trough to one side and it will of course escape through the intervals between the sticks. But some of it will remain like a rotating inverted cone inside the "basket". Then the cloth is put in the basket, and by the movement in the rotating water you get a certain fulling action. It is in my opinion the simplest form for a mill you can imagine - if you can at all call it a mill: it is gearless it is wheel less, yet you do something to the material inside the "machine". It is just like a transistor,a device without any movable parts! (see fig. 32.01).

Wailes: An unsuccessful turbine washing machine was marketed under virtually that principle ! (laughs)

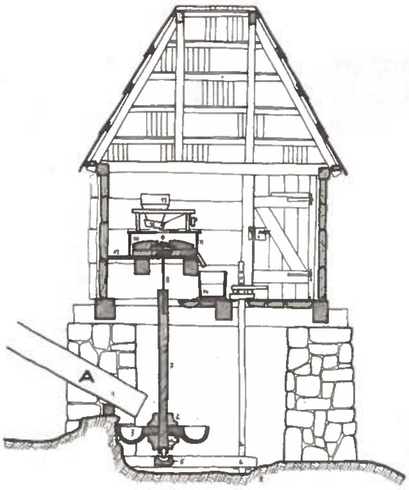
Jespersen: I have seen photographs of these machines working in România, obviously they work successfully there !

Avitsur: The same in Greece/Hellas and Yugoslavia: two kinds of fulling: fulling by stamps and by hammers, that is dry-fulling, and in this basket or box is the wet fulling.

Jespersen: Well, I don't know at all if this can be included within the field of Molinology, but I thought we should at least mention it, because waterpower is certainly used, and a certain mechanical process is accomplished. Personally I would include it within Molinology, because it does include waterpower, and does a mechanical process. That it does so without incorporating any moveable parts is to me as a technician only an advantage !

We have two more papers that we have not had time to go through (Chapters 29 and 31); neither of the two authors have been here: Mr. Kenneth Major unfortunately could not come, and Henryk Joost from Polska sent his paper in, and I would like to say it here that apart from the language which needs adjustment, it is the only paper which in all possible ways and manner met with the wishes issued by the Editor and this is one very good reason why we wholeheartedly accepted it: all was there, and, in such a form that we could xerox it and send it out to the participants right away, and I would vote that to the next Symposium, if the papers could be presented in that way, and xeroxed directly, it would save the editorial staff a tre-

Fig. 32.06



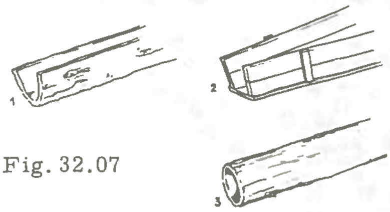


Fig. 32.07

Fig. 32.06 Longitudinal section through a horizontal mill, scale ca. 1/100.

1) Trough, see different types in fig. 32.07.
2) Spoon-shaped horizontal waterwheel.
3) Spoon ~ căuce.
4) Hub ~ bucium.
5) Foot-step bearing.
6) Tentering mechanism.
7) Wooden stone spindle.
8) Iron do.
9) Rhynd ~ părpăriță.
10) Runner stone.
11) Vat.
12) Shoe.
13) Bin.
14) Flour box.
15) Stone hurst.

Fig. 32.08 Horizontal mills in Rudăria Valley (R-101 & -107), UTMn 34/587/4970.

Notes:

6) ibd. Istoria Romăniei, Vol. 2, P.60.

7) From documents we know that in
12th cent. 26 mills were known
14th cent. 159 mills were known (of these 10 with 2 and 6 with 3 waterwheels).
In 14. cent. 20 villages had each 2 mills, another 33 had 3 or more mills, the number is not given precicely.

(continued in page 425)

South of the Carpathians the first written source known is a diploma by the Johannitter Order[6] from 1247 AD. As no archæological finds and no written sources concerning mills are found prior to the 12th century, we are led to assume, meantime, that the new method of disintegrating cereals in agriculture originated in the 12th century. We may take it, however, that the new invention was used several decades prior to written records.

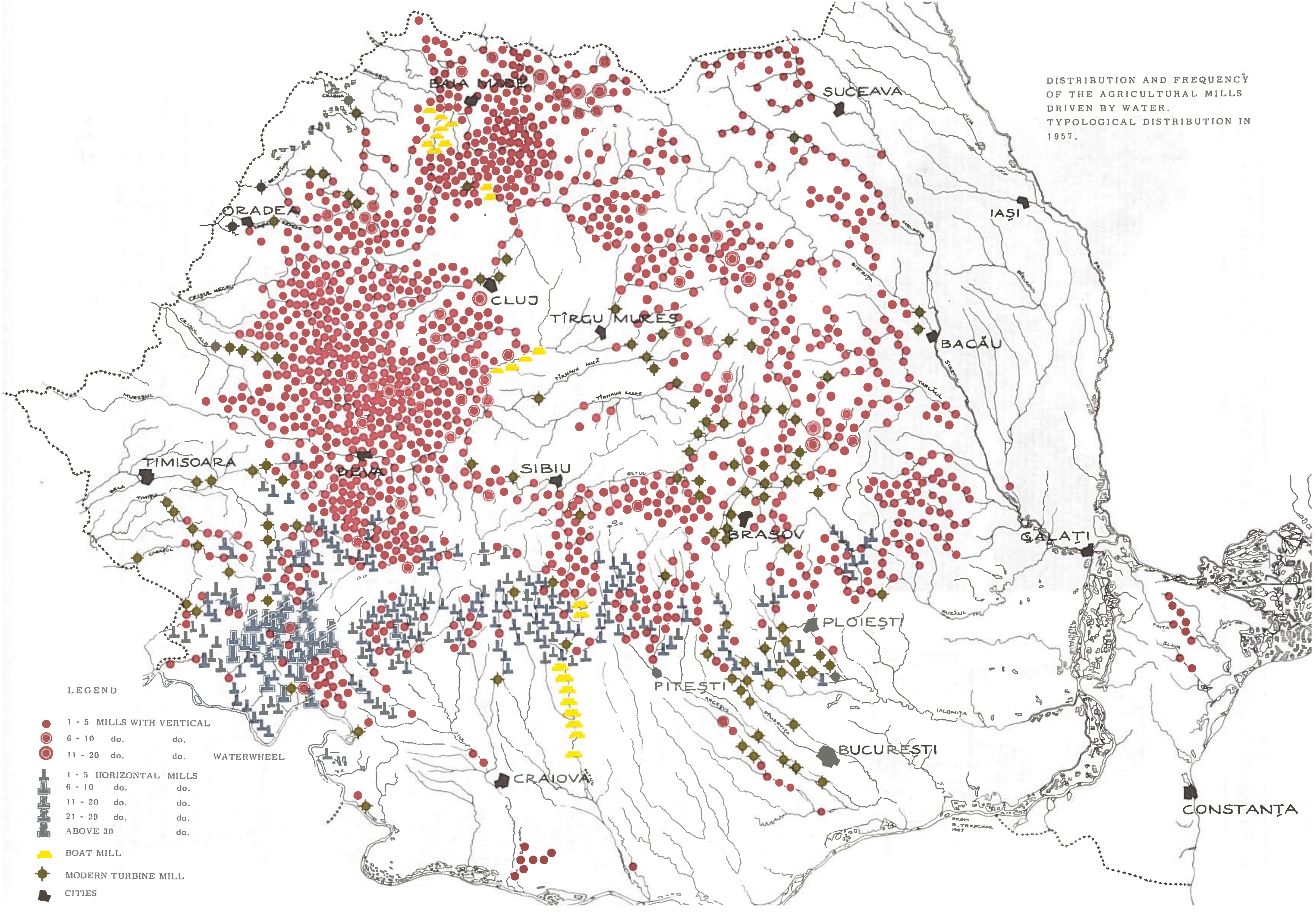
In the following centuries[7] the development in grinding technique followed the general advance of feudal law, reaching a peak in the 19th century and the beginning of the following century and forming one of the standards of valuation in the agricultural community. Also the ingenuity revealed by the different technical solutions and the material expression of spirit of invention in the Românian farmer greatly contributed to this development.

Statistical Tables from the end of the 19th and the beginning of the 20th centuries recording the "Milling Trade of România employing the forces of Nature" give the impression that the watermills were dominating the recorded number of 9398 forming 92.8% of the total of traditional mills[8] (apart from the oil mills).

The ever increasing industrialization of Românian society through the following decades led to a slow, but certain decline; the mills were outdated. To-day we can only consider the retention of a few technical as well as architectural traditional monuments of this era in the valleys of the Carpathians incline.

On the occasion of the establishment of the Museum for Agricultural Technology, beginning - for all practical purposes - in 1963 in the picturesque Deembrava Sibiuleri[9], a statistical analysis was made from the extensive files of the State Committee for Waterways in România, and it was found that in 1957 a census was taken of all

DISTRIBUTION AND FREQUENCY OF THE AGRICULTURAL MILLS DRIVEN BY WATER. TYPOLOGICAL DISTRIBUTION IN 1957.



(continued from page 423)
No doubt the number of mills in 13. cent. was far greater than 26, and in 15. cent. higher than 159, yet the relative figures are significant (cf. Stefan Pascu in Istoria Romăniei, Vol. 2, P. 25).
As the statistics above are informative for Transilvania, so is a document from 1421 A. D. referring to 15 villages of the Monastery Cozia with 12 mills. (cf. Documente privind Istoria Romaniei, veac. 13 - 14 (cent.) Ser. B, Tara Românească (Walachei) P. 76).

8) Poul Stahl: La force motrice des moulins traditionels en Roumanie à la fin du 19-e siécle et au debut du 20-e siécle, in Au 7-e Congrés International des Sciences anthropologiques et ethnologiques, Institut d'ethnographie et de folklore de l'Academie de la Rep. Pop. Roumaine, P.43.

9) Cornel Irimie: Das Museum der bäurlichen Technik, Aktualität, Grundsätze, Thematisches Profil und Ausstellungsplan, in Cibinium, Vol. 1, Sibiu 1966.

Fig. 32.09 (left) Molinographic Map of România to scale 1/2.5 M (cf. fig. 32.02 with UTM-grid). The legend is printed on the face of the map.

Notes:

10) Cornel Irimie: Statistische Erhebungen über das Netz der bäurlichen technischen Anlagen mit Wasserantrieb auf dem Boden Rumäniens, in Cibinium, Vol. 2, 1967 - 8 (in print).

11) Beitrage zur Typologie der bäurlichen Industrieanlagen Rumäniens, in Études d'ethnographie et de folklore, Bukarest 1960.
Beitrage zur Erforschung der Baurnindustrie in den ethnographischen Zonen der Süd-karpaten, in Forschungen zur Landeskunde 1966, nr. 9/1, P. 91 - 110.

12) Valeriu Butură: Die siebenbürgischen Turbinenmühlen, in Ethnographica, Brno, Vol. 1, P. 19 - 26.
Paul Stahl, op. cit.
Cornel Irimie: Beitrage zur Typologie .....

waterways in the country, with all their mills and their types, siting, waterflow and efficiency.

Grouping this material in the historical provinces, and within these into river basins, tributaries, and local areas, allowed a determination of the distribution and frequency of all types of plant, including the traditional watermill (see fig. 32.09).

The distribution of a total of 5518 waterpowered installations in 2005 communities may be tabulated as follows[10]:

	type of plant	plant total	Siebenbürgen	Banat	oltenien Muntemia	Moldau	Dobrudt	Donebeck
1	cereal mills	4509	2914	605	625	242	14	110
2	oil mills	30	24	5	1	-	-	-

Eleven years after this census was taken several of the mills mentioned 1957 had fallen into disrepair and others had converted to more up-to-date prime movers.

Due to the industrial development only about 80% of these mills remain today. This assumption of the further increasing decline of such plant has been checked by field survey and ethnographical research.

By comparing field data with the statistical census it has been possible to determine the typology on strictly scientific grounds[11]. It became clear from the agro-technological peculiarity of each unit that the gearing and lay-out system of the water mill was decided by the mechanical structure of the oil mill.

I. The Cereal Mill

The sparse written sources referring to watermills at the beginning of the second millenium hardly allow a judgement as to which type of mill was adopted first.

We have based the chronological order and also the typological division of these installations upon the following criterion: the extent of the transmission mechanism between waterpower and the runner stone. Consequently the different types of waterwheels can be determined through their positioning and subsequent construction:

1. Mills with horizontal wheel ("ciutură"[12]) (fig. 32.06).

This mill could be regarded as the simplest type of cereal mill using running water. They are most frequent in the hilly country near the Carpathians which is characterized by small streams with a steep gradient and where agriculture as well as milling is totally dependent on a local, rural economy.

mendous amount of work, and everyone could read the papers in whatever English it would be and in our case we could have saved two or three months' work at the preliminary stage by that !

(Advertising briefing Friday morning - 16-05-69 - at 08 30).

(Advertising the Portuguese film for Friday).

Skilton: This is the resolution I have drafted for submission to the appropriate Departments of the Government in London in respect of the Water Resources Act which we were discussing the other day, it says: (see page 152).

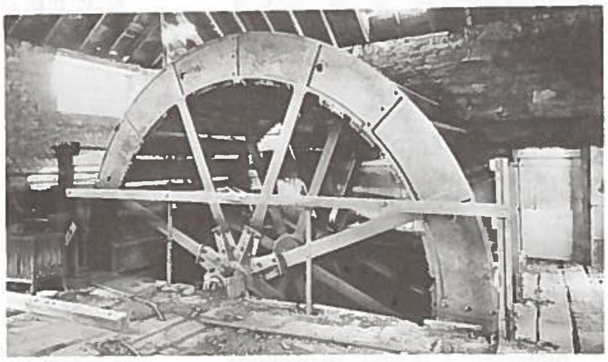
Jespersen: To Mr. Skilton: thank you very much for having prepared this draft resolution, I suggest that we have it typed and signed by black ink or red ball point pen to secure reliable facsimile reproduction in the Transactions. The original will go to the Ministry, we hope with some positive result.

Wailes: I want some information from the delegates; I have 23 slides of mills on which no information as far as I know has been published. I can't tell you anything about them, so they will take perhaps a quarter of an hour to show, but if anyone knows about or is prepared to do anything about them, I shall be very grateful. Not one of them has been mentioned in this Symposium or the previous Symposium, nor have I come across so far any printed material on them. (Chapter 50)

Jespersen: I think we shall be very interested to see these slides. There is nothing more inspiring and challenging than to see things you don't understand or don't know, hoping that maybe one day you will come to see it. I would like to record my personal experience from Scotland; it's about nine years ago; it ended rather tragically, unfortunately, but I had seen these so-called beetling plants where you beetle the linen cloth after weaving. I first saw a mill in a very dilapidated state, most of the beams had been thrown out, and I could just see from the foundation roughly how the lay-out was. Then later I saw a mill with a little bit more in it, I saw the beams in position, and the initial drives, but I couldn't see how it had worked. And finally - by the kind co-operation of the manager (Mr. Murray) of the firm - I saw one mill (GB-37/418-Ruthven Works) with two large plants, the largest I have seen driven by waterwheels, side by side, in a partly workable condition. The plant - I'm very sorry to report - has later been dismantled, although I wrote to the National Trust for Scotland, and they replied in a very positive way, but somehow or other, due to the vandalism caused by boys, the firm (Lumsden & McKenzie) decided to tear down the plant. It was interesting in that there were two waterwheels. The two plants, although identical, had a 35 HP and a 70 HP waterwheel, and you might at a casual inspection wonder why that was so? However, the gearing on the big waterwheel was about 20-30% higher, and I judged that the large wheel was for periods with plenty of water, and so the plant would work faster and the increased loss due to friction would mean little or nothing compared with increased output. Luckily I saw this 1000 m^2 plant just in time and had it recorded photographically (fig. 32.10 -.11 -.12 -.13)

As this appears to be the last real Session that we have, I would like to thank you maintaining good order, for not having spoken too loudly even through very long presentations. I was sitting down at the far end of the room at one time or other listening to a very long paper, and I came to think - sans comparaison, otherwise - of Mr. P.G. Wodehouse who once lets Mr. Psmith (the P, however, is not sounded) attend a political meeting. And at one time or other a call came from the back of the hall: "Louder please" and someone else chips in with a "- yes and funnier !" (prolonged laughs)

Thank you very much.



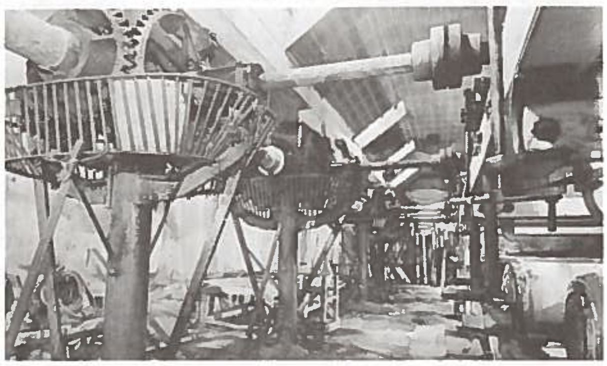


Fig. 32.10 (left, top) GB-37/418-Ruthven Beetling Works, River Almond, Perthshire, Scotland. Nat. Grid 308 km E // 725 km N.
The lade (mill-race) arriving at the wheel-house (centre). Two plants, each holding 16 beetling frames, were situated on either side of the lade.

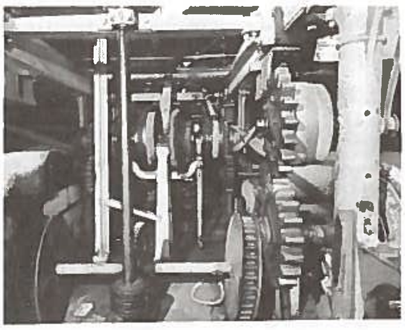
Fig. 32.11 (left, centre) As above: Wheel /418.1 on the left of the lade (looking downstream). This wheel was 35 hp while its twin opposite (behind the camera) developed 70 hp.

Fig. 32.12 (left, bottom) As above: Plant /418.1 (below the roofs seen in fig. 32.10). The line shaft drove the wyper shaft of the beetling frames through bevel wheels 32:46. In plant /418.2 (on the right of the lade) the gearing was 50:50, and the c. 40 % higher speed of the beetles must have exhausted the double power of the waterwheel .2 (70 hp as against 35 hp).

Fig. 32.13 (below) As above, but seen between the two sets of beetling frames in each row: the auxilliary gear, turning the cloth-drums, and moving them sideways simultaneously.

This magnificent plant was demolished 1963 - 5 despite efforts to save it.

Notes:
see page 428.



On the same river course, and in the vicinity of the same community several "rîșnițe" - as these low-output mills are called - are strung like pearls on a string. The distance between the mills is determined by the gradient; the steeper the flow the smaller the distance from mill to mill. (fig. 32.09)

According to the 1957 statistics, the 885 plants of this type are distributed like this: 509 in Banat, 304 in Oltenien and Muntenien, 29 in Transilvania, and 43 in Moldova[13].

The mechanism of the turbine-mill is quite simple: the runner stone is fixed at the upper end of the upright wheelshaft, and a little above the lower end of this shaft are fixed the concave-convex spoons or ladles ("căuce", "făcău"), which are driven by the water jet. The torque will then be transmitted by the upright shaft direct to the runner. At the lower end, a pointed stone is mortised into the wheel shaft as a journal; the free end of the journal fits into a hole in a somewhat larger stone bearing. The bearing stone in turn is fixed into a horizontal beam, bedded in the tail race. Water acts as a lubricant and also cools the journal and bearing which might otherwise heat with the constant rotation. The bearing beam is pivoted at one end while the other is supported by a vertical rod carried into the stone floor, where tentering of the runner can than be effected, i.e. adjusting the distance between the mill stones to suit the desired quality of grinding.

The system of water supply to the mills may be classified into the following types:

a) Mills with simple water supply through a hollowed trunk, cut length-wise in half (often in streams of low run-off).

b) Mills supplied through an open trough made of boards (see fig. 32.072) (in streams with greater run-offs).

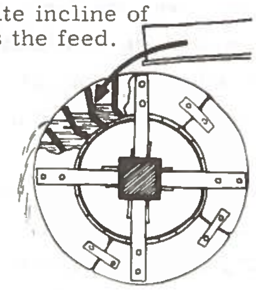
c) Mills supplied through a well or penstock ("buton")[14] (fig. 32.073) as a means of exploiting a very restricted run-off. The penstock is made by a hollowed trunk. At the exit the trunk-tube is fitted a soft wood plug - of varying bore. In this way it is possible to adjust the size of jet to the available run-off, maintaining at all times the maximum head and thus the same jet velocity. This water supply system is employed in small streams where the run-off does not allow the use of the other systems of troughs.

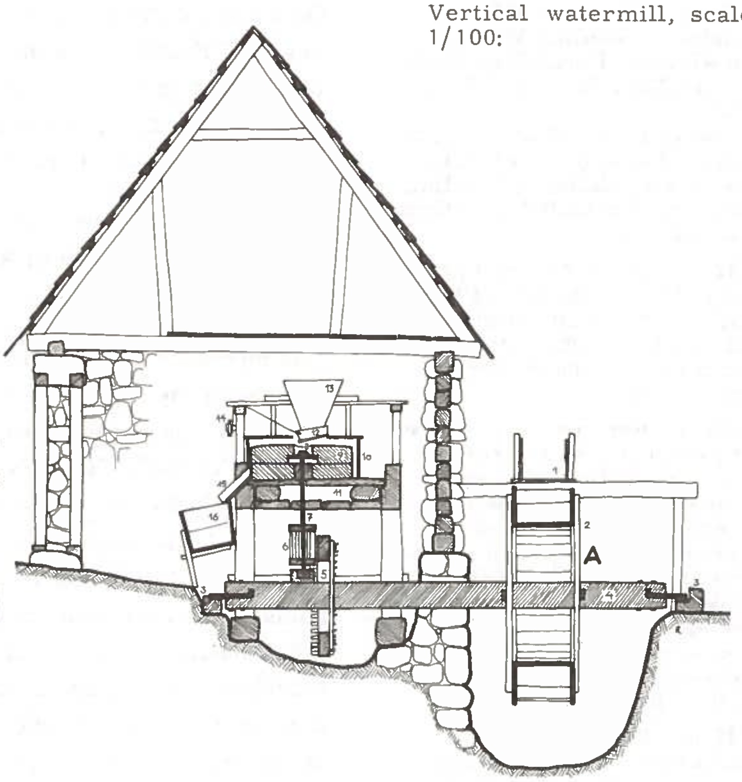
Although the traditional form of this mill has only one wheel, certain social, commercial, and historical conditions developed mills on streams with greater water supply equipped with two or three ladle wheels with as many pairs of stones; each unit operating independently of the others.

Fig. 32.14 (below) Overshot waterwheel.

Fig. 32.15 (right) Cross section through mill:
1) Trough.
2) Waterwheel (overshot).
3) Bearings.
4) Waterwheel shaft.
5) Pitwheel.
6) Wallower = stone nut ~ ritzel.
7) Iron stone spindel.
8) Rhynd ~ părpălîţă.
9) Runner stone.
10) Vat.
11) Stone hurst.
12) Shoe.
13) Hopper.
14) Knob to regulate incline of shoe, and thus the feed.
15) Flour box.

Vertical watermill, scale ca. 1/100:





Notes:

13) Cornel Irimie: Statistische Erhebungen über das Netz der bäurlichen technischen Anlagen mit Wasserantrieb auf dem Boden Rumäniens, in Cibinium Vol. 2, 1967 - 8 (in print).

14) Herbert Hoffmann: Un dispozitiv de amelioare a edmisiei la mori "butonul", in Cibinium 2 (in print).

15) See note 11).
Nerej, un village d'une region archaïque Monographie sociologique dirigée par H. H. Stahl, Bibliothèque de sociologie, ethnique et politique, Sociologie de la Roumanie, Bucuresti, 1940.
Cornel Irimie & Ion Frunzetti: Unele obiecta de uz casnic si instalatii de industrie tărănească, Hausrat und bäurliche Industrieanlagen, in Die Volkskunst im Tal des Jiu, Bucuresti 1963, P. 82 - 135.
Valeriu Butura: Das Stadium der bäurlichen Industrieanlagen in dem Westkarpaten, in Revista de etnografie si folclor, 1964.
Paul Stahl: La force motrice ... op. cit.

16) Cornel Irimie: Statistische Erhebungen .... op. cit.

2. Mills with vertical waterwheels[15)].

Figures from the same statistics show the geographical distribution over the historical provinces of this equally traditional type of mill. Its development is explicable from the better run-off available, and its lower frequency as compared with the turbine-mill explicable by the higher output of the more advanced mill. From boths points of view the two types of mills are counterparts.

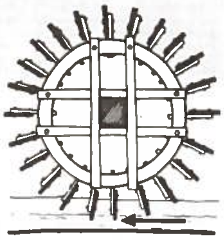
Out of the 3450 (+ 35) plants with vertical waterwheels and traditional pattern, 2787 (+ 23) were situated in Transsylvania, 272 (+ 12) in Oltenia, 239 in Moldova, 74 in Banat, 64 in the Dunarea (Danube), and 14 in Dobrudscha[16)]; the figures in brackets ( ) refe to boat mills in the statistical material. The boat mills use the sam type of waterwheel, but have structural peculiarities segregating them from the other mills in this category.

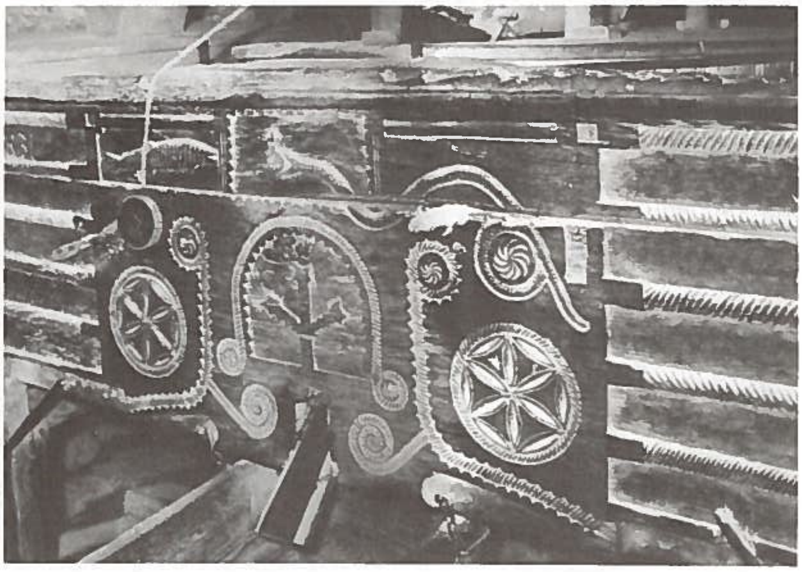
The vertical watermill has other differences from the horizontal mill, apart from the orientation, size, and construction of the waterwheel and its shaft. Already in the early examples of vertical mills we meet new elements heralding a more advanced level of watermill technology. These additional elements comprise two (in the bank mill), or four (in the boat mill) elements connecting the horizontal waterwheel shafts to the vertical stone spindle; making one or two gear steps by which the revolutions of the waterwheel may be increased at the runner stone.

Because of the number of sub types varying widely in form, in turn

Fig. 32.16 (below) Undershot paddlewheel.

Fig. 32.17 (right) R-102-Mill at Reghin, Judeţul Mures. UTMn 35/324/5183. Traditional motives carved on the face of the hurst: rope - serpent - fish - star - sun-wheel - &c. Date 1831.





caused by the location of the mill - on the bank or on a boat - it will be necessary to analyse the mill in its relation to the building housing it, and also to consider the waterwheel itself (mills with "alvan") separately.

a) Mills with vertical wheels placed on river banks.

This group of mills is characterized by the fixed relation of the waterwheel to the building in which the mill is installed: the wheel is at level with the house, this being necessitated by the horizontal position of the main shaft, the main element in the mechanism of transmission. On this shaft, and inside the mill is fixed a cogwheel engaging with a lantern pinion (crîngul) on the upright stone spindle. This spindle is adjustable in a vertical (axial) direction to regulate the distance between the millstones and thus control the quality of grinding.

The waterwheel, or wheels - where two or more pairs of stones are placed in the same mill - are more often situated outside the mill, rarely inside; and each wheel may be operated independently.

The plan of the building changed through time, mainly due to the increase in efficiency resulting in a greater output, whereby a larger community could be supplied. This in turn required constant supervision. The operative of the mill became a specialist; milling became a trade. And so alongside the old mill with only one room for the grinding process, newer mills developed, holding an additional room where the miller could live - even with his family.

Water supply for this group of mills falls into two sub categories: Mills with overshot wheels (fig. 32.14 -.15) were driven by close-bucketed wheels composed of two parallel wooden shrouds

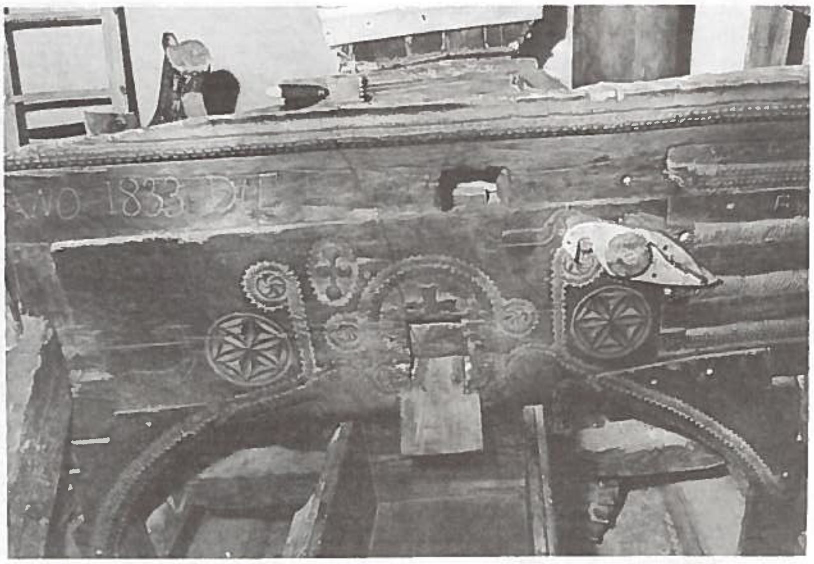


Fig. 32.18 R-105-Mill at Fînaţe, Judeţul Bihor. UTMn 34/618/5150. Now in the Open Air Museum in Sibiu, 35/278/5077. Another example of a carved hurst front.

joined to the wheel shaft. Boards join the shrouds forming buckets ("cupe"). Water is conducted to the top of the wheel in a wooden trough of the same width as the waterwheel, and resting on poles. The trough discharges a powerful water jet into the topmost bucket.

Mills with undershot wheels (fig. 32.16).

In areas where the head of water does not allow the installation of overshot wheels, paddle wheels ("cu aripi" or "lopeţi") are employed. This type of wheel is composed by a wooden rim, around the periphery of which is placed a number of floats ("lopeţi") at regular intervals. The steeply inclined, narrow trough is placed below the wheel, with the floats nearly touching the floor of the trough. The waterflow - greatly accelerated through the incline of the trough - hits the floats with great impact, and thus sets the whole mechanism in motion.

It is of interest that the inside of the milling plant is often decorated and dated. In the Museum for Agricultural Technology in Dumbrava Sibiului are exhibited examples of such carvings in the front beams of hursts ("fruntarul") displaying extraordinary artistic effort and dated 1831, 1833, 1848, and 1877[17] (fig. 32.17 -.18 -.19)

b. Boatmills with vertical waterwheels[18] (fig. 33.01..).

Boatmills are found in much smaller numbers, on the larger, tranquil rivers of the lowlands where the current is steady but slow, and where the popular spirit of invention has reached furthest within the field of milling technology.

The advanced technology of this mill is characterized by a two-step gear involving two cog wheels and two "crînguri", increasing the speed from the slow revolutions of the waterwheel to the fast rotation of the stone spindle, the third shaft in this gear train.

Notes:

17) Corneliu Bucur: Mühle und Fallwasserrohr aus dem Dorf Fînaţe in Monumente der Volkskultur im Museum der bäurlichen Technik.

18) Herbert Hoffmann: O etapă interesantă in dezvoltares mecanismelor de măcinat: Moara plutitoare, comunicare prezentata la sesiunea ştiinţifică a Muzeelor din România, Bucureşti 1965. (An interesting stage in the development of the boat mill). From the Scientific Meeting of the Museums in România 1965, Transactions.
Paul Stahl: La force motrice ..... op. cit.

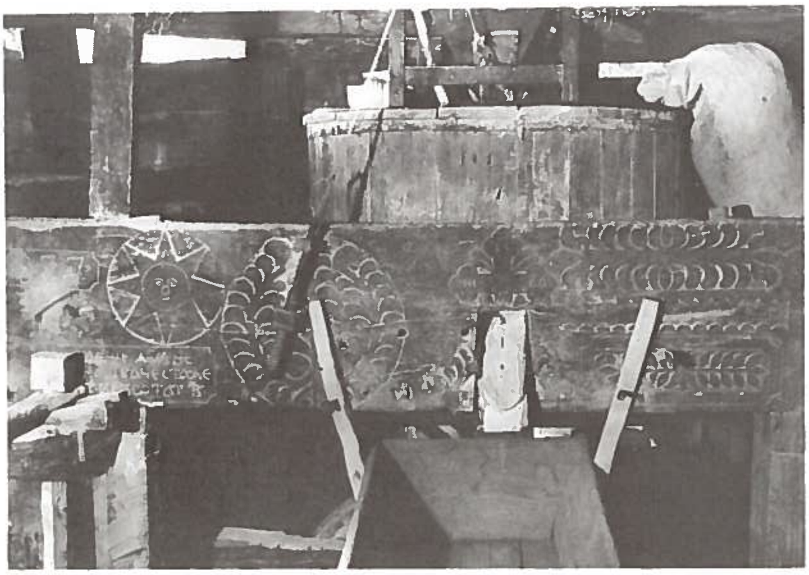


Fig. 32.19 R-104-Mill from Dobîca, 34/655/5066, now in the Open Air Museum of Sibiu, 35/278/5077. This front carving is somewhat coarser than the two earlier examples. Date 1877 and just below the date (left) is seen the lighter staff, identical in principle to the one found in DK-76-Kaleko Møllle, visited by the Symposium.

The large waterwheel is fixed between two ships. The house ship carries the load of the entire plant, including the weather-protecting house; the one end of the waterwheel shaft is also supported here. The shaft ship has to support the outer end of the shaft and to maintain balance to the whole structure. The waterwheels comprise several wooden rims with a diameter up to 4 m. They are up to 6 m broad, and the rims are connected by radial boards acting as floats or paddles.

The undershot waterwheel is turned by the current striking the lower floats. To stop the mill, a pole is shot between the floats below the water, controlled from the inside of the mill by a rope and pulley.

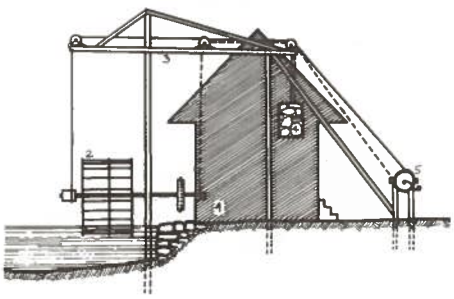
This type of plant is often moored at the river bank; the large boat or ship being anchored by heavy ropes. The mooring place is carefully chosen at a point on the river where the natural current is accelerated by a local increase in gradient, or the current is increased by artificially narrowing the watercourse above the mill.

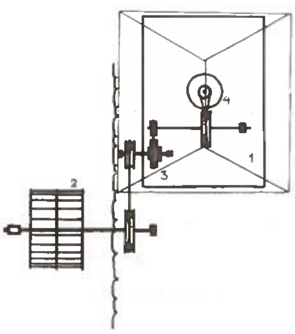
When seeking a suitable mooring place it is often necessary to let the boat loose from the bank, allowing the mill to float down the river. It is then often a tedious job to re-tie the mill at the bank.

c) Mills with an elevating mechanism (German: Panstermühlen), "alvan"[19].

The spirit of invention of the people has solved several problems arising from unfavourable topographical conditions for exploitation of the prime movers of Nature; in our case the peculiarities of the river system. Some of the solutions show great technological skill, e.g. the water supply through penstocks. These solutions are distributed more or less through the ethnographical zones whereby the

Fig. 32.20 - .21 (below) The alvan ~ Panstermühle, where the waterwheel is elevated to suit the fluctuating level of the river; the mill stones remain stationary. This is the last step before the whole mill goes afloat on the boat mill (see next paper).





Notes:

19) Cornel Irimie: Statistische Erhebungen .... op. cit.
Paul Stahl: La force motrice ..... op. cit.

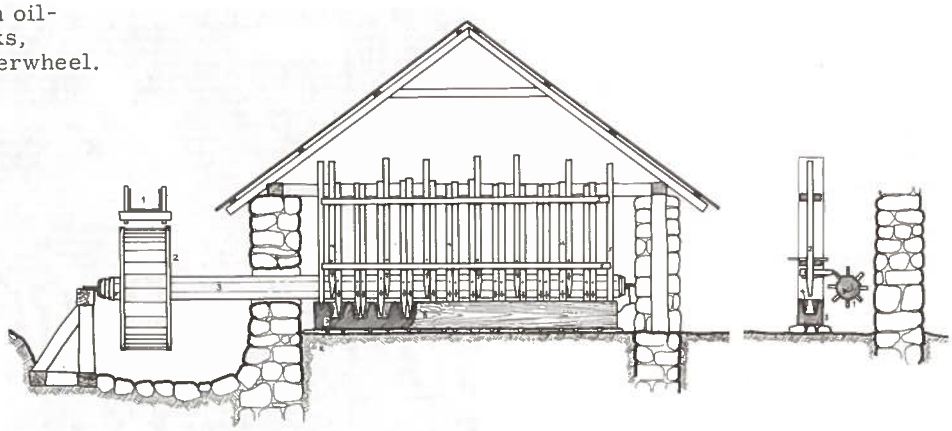


Fig. 32.23 Section through oil-mill with 24 vertical stocks, driven by an overshot waterwheel. Scale ca. 1/100.

A 1) Trough.
2) Overshot waterwheel.
3) Wyper shaft.
4) Stocks.
5) Frame.
6) Trough.
7) Pot ~ oală.

B 1) Wyper shaft.
2) Stock.
3) Trough.
4) Pot ~ oală.

local characteristics are retained. The mills with elevating mechanism (alvan) join this pattern of agricultural technology. They were developed in the beginning of the 19th century, and they represent a special innovation within this field of milling technology. It is characterized by the relation between the mill building and the waterwheel,quite different from all earlier descriptions of mills. The alvan combines the technical advantages of the permanently fixed vertical watermill with those of the boat mill in that their wheels accept water whatever the level in the river, as does the boatmill.

The alvan mill is built on the river bank, but the waterwheel is not at a fixed level in the mill, but may be raised and lowered to suit the fluctuations of the water level of the river by means of pulleys. This elevating mechanism is also used to start and stop the mill. Otherwise the gearing and construction of this mill is identical to the boat mill, therefore no further description appears necessary (fig. 32.20 -.21).

II. Oil Mills [20)]

The need of the population for foodstuffs has changed through history as a direct consequence of the development of the technology of production and processing, which in turn depended on the advance in plant engineering.

It is difficult, if not impossible, to ascertain when, and under what circumstances oil was pressed for the first time from oily crop, and when this process was operated by waterpower instead of human energy.

The direct sources of information - and the archæological - appear rather incoherent in this case, and the written sources are not very helpful either.

It is established that up to feudal times primitive plant existed, powered by hand or foot. It consisted on one or more elements, depending on its scale of production, either for a single family, or for a community.

Note:

20) Valeriu Butura: Pivele de ulei din Transilvania (Oil Milling in Transilvania) in Revista Muzeelor 2, 1965, 2. Gheorghs Bodor: Presele de ulei în Muzeul etnografic el Moldovei (Oil pressing in the Ethnographical Museum in Moldovei), from the Scientific Meeting of the Museums of Romania, 1964, Transact. Herbert Hoffmann: O tipologie a instalaţiilor de tescuit uleiul în România, in Cibinium, Sibiu, 1966 (A Typology of Oil Pressing Plant in Romania).

Below is reproduced the list of Romanian watermills mentioned in this paper, and marked on the map fig. 32.02.

VANDMØLLE
ROMÂNIA
NUMBER LIST

PAGE
GRID UTMn
NR R-100 R-124

number	name of mill	parish	county	grid reference
R-100				
101	Rudăria (upper)			34/587/4970
102	Reghin			35/324/5183
103	Orşova			35/341/5170
104	Dobîca			34/655/5066
105	Fînaţe			34/818/5150
106	Moeciude Sus			35/388/5035
107	Rudăria (lower)			34/587/4970
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Because of the different functional demands by the technological processes, during the 18th, 19th, and 20th centuries this trade developed into a seasonal trade employing two types of plant; initially powered by Man, and later by water.

It is this later stage of development which is of interest to us. Like the cereal mill, the oil mill also took its inspiration from Medieval implements. They were enlarged, and more units were incorporated in a mill, powered by the flowing water.

The two most frequent types of oil mills are:

a. Oil mills with stamps ("săgeţi") (fig. 32.22).
b. Oil mills with hammers ("maie") (fig. 32.23 -.24 -.25).

Both types of mills are characterized by an overshot waterwheel, the shaft of which runs into a building, where wipers are mortised and wedged home in 4 symmetrical planes. Also common to both types is the trough ("cupe"), a massive block of wood with one or more pits cut in the top, in which the raw material (the oil seed) is placed. The difference between the two types is in the actual crushing mechanism. In the former case (oilmills with stamps, or "săgeţi") we find - depending on the number of pits - two to twenty square-cut 1.5 - 2.5 m long stamps placed, individually or in pairs, in a vertical guide frame. About 0.75 m from the lower end of the stamp, and covered with metal to prevent excessive wear, are mortised wiper cogs corresponding to the wipers on the waterwheel shaft. By the rotation of the shaft, the stamp is raised by the wiper, and when released it descends on the oil seed in the pit, and crushes it.

In the other type of oil mill, large wooden hammers replace the stamps. The wipers on the waterwheel shaft lift the hammer heads by depressing the hammer tails, like a tilt hammer. When released, the hammers fall into the oil trough, as described above.

By their variety of form, the skill shown in their construction, and the technical knowledge displayed in their design, these mills show themselves to be the products of a farming community in our country where almost every farmer must have had a very solid technical and artisan skill.

To maintain these material records of the history of the Românian People steps have been taken to protect and preserve them; partly through necessary care "in situ", and partly by transfer of representative specimens to the ethnographical open air museums. Among these museums, the Museum for Agricultural Technology in Dumbrava Sibiului will be foremost in the immediate future.

UTMn 35/278/5077

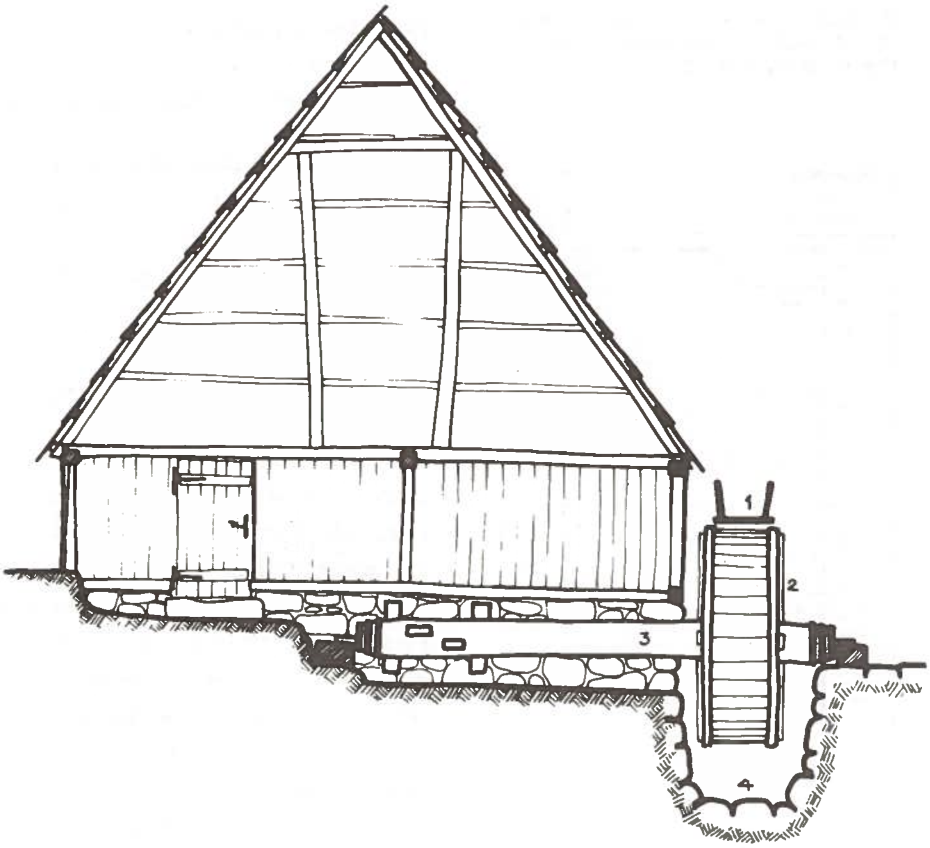

Fig. 32.23 Oilmill with "hammers". Scale ca. 1/100. Cross section showing water-wheel and main shaft:

1) Trough.
2) Overshot waterwheel.
3) Wyper shaft.
4) Tail race.

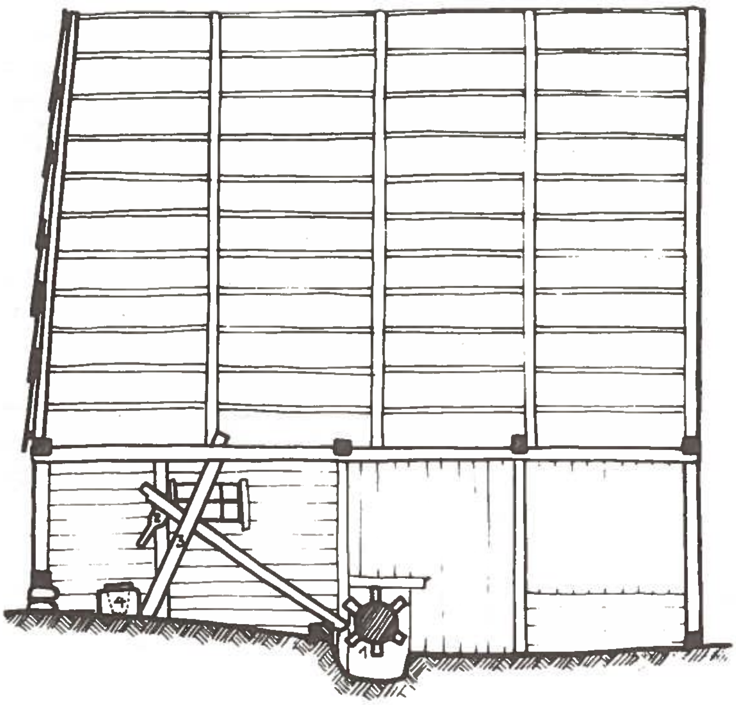

Fig. 32.24 Longitudinal section through same mill, showing oil hammers:

1) Wyper shaft.
2) Hammer.
3) Frame.
4) Pot.

Fig. 32.25 (below) Oil press with four hammers:

1) Wyper shaft.
2) Hammers.
3) Frame.
4) Trough.
5) Pots ~ oală.