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# SOME DIFFERENCES BETWEEN DISTRIBUTING AND BRAIDING CHANNELS

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ABSTRACT

The individual channels of a distributary system develop floodplains that are independent of the parent streams, whereas the channels of a braided system do not develop separate floodplains. With respect to sediment load, bank cohesion, discharge, and slope, the Namoi-Gwydir distributary system does not resemble braided systems.

The channel patterns of braiding and distributing are sometimes equated and related to similar fluvial processes. This paper proposes a morphological definition for distributaries that will distinguish them from braided streams. Several arguments are presented which suggest that braided and distributary channels are distinctly different with respect to causative fluvial factors.

## DESCRIPTION AND DEFINITION

The American Geological Institute (1962) defines a distributary as "An outflowing branch of a river, such as occurs characteristically on a delta. A river branch flowing away from the main stream and not rejoining it". Fairbridge (1968: p. 92) links distributing with deltas, and Stamp (1961) adopts a similar attitude. Fairbridge and Stamp use the term 'anabranch' to describe break-away channels that rejoin the parent stream, which is the definition given by Jackson (1834: p. 79). Fairbridge (1968), who refers to anabranches as "secondary channels in a broad plain of braided channels", would appear to associate anabranches with braiding streams. The several definitions for distributing and

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anabranching are in some cases contradictory, and in others not mutually inclusive.

The first point that should be noted about channel systems with outflowing branches is that they occur within two major situations, inland and deltaic. There are several differences between the outflowing channel systems in the two situations (Lane, 1957; Riley, in prep.). In the following discussion specific reference is made to inland distributary systems, but there is strong evidence to suggest that the discussion applies equally well to deltaic distributaries.

The inland distributary systems of eastern Australia, and in particular, the Namoi-Gwydir system (Fig. 1) are characterized by bifurcating streams that in some cases rejoin and in others do not. There is a whole spectrum of sizes in the bifurcating channels and the distances they flow before rejoining other channels. More often

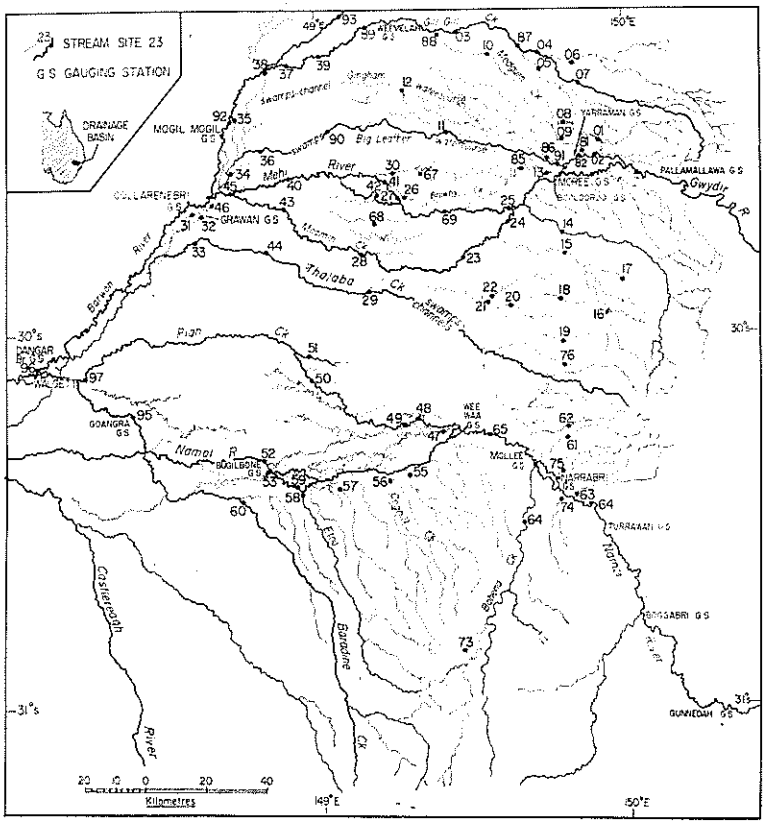


FIG. 1 — The Namoi-Gwydir distributary system.

than not one stream dominates the system, and this is referred to as the parent, from which all other channels offtake.

One notable feature about the outflowing streams (referred to as distributaries for the time being) in eastern Australia is that they are capable of developing their own floodplains. Cutoffs, point bars, and meander scrolls can all be found in association with the individual distributaries. In general, the literature on braided channels does not refer to such floodplain features as being associated with the individual channels of these systems.

Any irregular, non-destructive disturbance to the flow of a stream is dampened out within three or four meander wavelengths (see literature on laboratory flumes, e.g. Friedkin, 1945). Hence, in a distributary channel the turbulence at the offtake will have little influence on the distributary three or four wavelengths downstream. Consequently, apart from the input of sediment and water, distributaries that are longer than four times their own wavelengths may be expected to develop floodplains that are independent of the parent stream. In braided channels the individual reaches are seldom more than ten times longer than they are wide, and thus the turbulence at the offtake will have a strong influence on the entire reach.

One other feature seems to distinguish the Namoi-Gwydir distributary channels from braided streams – namely, the tendency for the channels and parent stream to be separated from each other (except at offtakes) when flows in the parent are high. Only for flows greater than bankfull in the parent channel does the flow in distributary channels merge overbank with parent channel flow. On the other hand, the bars in braided streams are generally well below bankfull stage, and high flow in the braided stream will submerge the bars (Leopold *et al.*, 1963: p. 284).

## AN ALTERNATIVE DEFINITION OF DISTRIBUTING

The various definitions of distributing cited above all agree that a distributary is an outflowing branch. The distributary channels may rejoin the parent channel or each other in a manner similar to braided channels, but they do not have to do so. The main factors that distinguish braided and distributary channels are that the latter are capable of and do form floodplains independent of the parent channel and are much longer, relative to their widths and wavelengths, than individual reaches of braided channels. In general the distributing and parent channel do not amalgamate at flows below bankfull, whereas high flows in braided streams often overtop the bars and submerge the braided patterns.

The preceding discussion suggests that a distributary channel has four major morphometric characteristics which, consequently, may be used to identify a stream as a distributary. A distributary is defined as a stream which:

(a) is an outflowing branch of a river;
(b) is developing a floodplain independent of the parent stream;
(c) does not merge overbank into the flow of the parent stream when parent stream flow is below bankfull;
(d) as a unit channel has an approximate length greater than four of its own wavelengths or 40 times its width.

The definition implies that the morphology of the distributary is independent of the parent except for the influence exerted by the sediment and discharge contributed by the parent channel. The two ways by which the parent can influence the distributary are through the inputs and through lateral migration and destruction or capture of the distributary channel. Parent streams which incise will reduce or even cut off the water/sediment input and may cause abandonment of the distributary.

The proposed definition does not have any environmental connotations. The distributary may be part of a deltaic system or an inland system.

Another implication of the definition is that distributary channels may themselves be braided. There are examples of braided distributary systems, the most common examples being found on alluvial fans. The very existence of braided distributary systems suggests that the factors that contribute to braiding are not the same as those that contribute to distributing.

Anabranches are defined herein as distributaries that rejoin the parent channel, as originally defined. The term has no meaning for braided channels except where the braiding channels are part of a distributary network.

## PROCESSES OF DISTRIBUTING AND BRAIDING

Fahnestock (1963) considers that an abundant bed load, together with erodible banks and a fluctuating discharge, are necessary conditions for braiding. Brice (1964) concurs with Fahnestock, whereas Leopold and Wolman (1957) reject excess of total load as a cause of braiding and suggest that slope is the dominant factor.

The Namoi-Gwydir distributary system (Fig. 1) is composed of meandering channels. The average median diameter of bed and

bank sediment for 65 sites in the system is 0.019 mm and 0.014 mm respectively, and the mean weighted percentage of silt clay (Schumm, 1961) is 52 percent. The channel banks are clearly cohesive, and in many cases so are the beds.

Bed load is not abundant in most of the streams of the Namoi-Gwydir. While there are no direct bed-load measurements for the area, the high sinuosities of the streams, the clayey nature of the beds, and the small percentage of coarse sediment in the beds of the large streams suggest that bed load is small. Estimates of bed load using the Meyer-Peter equation also suggest small rates of bed-load transport.

Channel reaches whose slopes ($S$) and discharge ($Q$) lie above the regression line

$$S=0.013Q^{-0.44}$$

are braided according to the classification of Leopold and Wolman (1957), whereas those reaches plotting below this line are meandering.

A relation developed by Ackers and Charlton (1970), which separates meandering and straight channels, may also be used to classify the channel pattern of streams. Their analysis showed that, for natural streams, meandering channels lie above the line

$$S'=0.0009Q^{-0.21}$$

where $S'$ is the straight line slope.

TABLE 1 — Bankfull discharge and bed slope at gauging stations on the Namoi-Gwydir distributary system.

| *Station* | *Discharge** ($m^3/s$) | *Slope‡* ($m/km$) |
|---|---|---|
| Boolooroo | 520 | 0.36 |
| Moree | 304† | 0.56 |
| Weemelah | 87† | 0.06 |
| Mogil Mogil | 133 | 0.125 |
| Grawan Creek | 203† | 0.39 |
| Dangar Bridge | 203 | 0.15 |
| Wee Waa | 174 | 0.119 |
| Bugilbone | 107 | 0.91 |
| Goangra | 75 | 0.18 |

* Estimated from the 1.58-year discharge (annual series).

† Estimated from the stage–discharge curve and from a field estimate of the bankfull position.

‡ Measured from a dumpy level survey of bed profile over a one-kilometre reach.

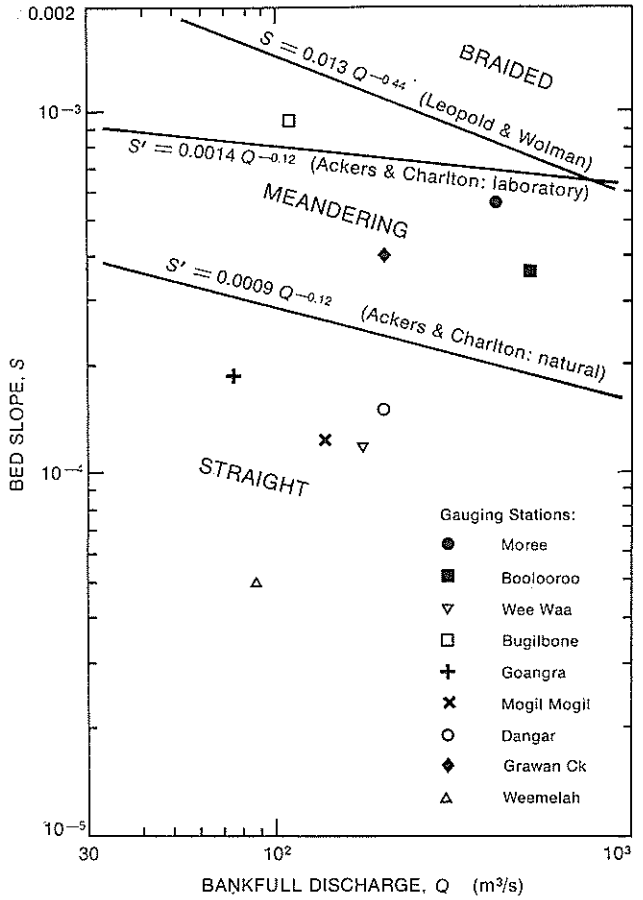


FIG. 2 — The slope–discharge classification of channel pattern compared with the Namoi-Gwydir system.

Although the relation of Ackers and Charlton agrees with the classification of Leopold and Wolman, most straight channels considered by Leopold and Wolman are classified as meandering by Ackers and Charlton's relation. Ackers and Charlton (1971: p. 193) attribute the discrepancy to a category of straight channels having cohesive bed sediments, and their argument is supported by Henderson (1961). Ackers and Charlton examined channels in a 'live bed' condition, whereas Leopold and Wolman also examined those in a threshold condition.

The nine gauging stations in the Namoi-Gwydir distributary system (Table 1) plot below the Leopold and Wolman line (Fig. 2) – hence, the channels are classified as meandering. Five of the gauging stations, even after correction for straight line slope, plot below the second line of Ackers and Charlton. Either the Ackers and Charlton line is not generally applicable, or the Namoi-Gwydir streams are not in a live-bed condition.

With respect to slope and bankfull discharge, the Namoi-Gwydir streams are unlike braided channels.

## DISCUSSION

The mechanisms that give rise to braiding are not well known, and even less so are the factors that are important in braiding. However, the literature does suggest that bed-load excess, non-cohesive banks, slope, and discharge are important factors. With respect to these four factors the Namoi-Gwydir streams are not braided and are not influenced by the factors that appear to contribute to braiding.

There is the possibility that the factors which control the braided pattern are other than those indicated. If so, then the distributary and braided patterns may be related. However, the distinct morphological differences between braiding and distributing do suggest a difference in controlling processes.

## CONCLUSION

Distributary channels differ from braided channels with respect to morphology. In the past there has been a tendency to equate the two channel patterns. A definition for distributing has been suggested which, it is hoped, will specify with some degree of accuracy the nature of distributing channels.

An examination of an inland distributary system, the Namoi-Gwydir system, has shown that with respect to load, bank cohesion, slope, and discharge, it does not resemble braided channels, and that the processes which lead to braiding do not necessarily lead to distributing. The author is investigating the nature of the processes that contribute to distributing.

## ACKNOWLEDGMENTS

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