

GURNELL

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discussion of such concepts as vorticity, confluence and diffluence, divergence and convergence. This is beyond the aim of the present article which was to introduce the idea of a thickness chart to a wider audience. If even a corner of the veil of incomprehension (which often covers even simple discussion of them) has been lifted then I shall be well satisfied.

ACKNOWLEDGMENT

The author is grateful for the helpful criticism of the referees and Dr p. K. Mitchell who read the initial drafts of this article.

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A NOTE ON THE CONTRIBUTION OF FOG DRIP TO STREAMFLOW

By ANGELA M. GURNELL
Department of Geography, University of Southampton

INTERCEPTION of precipitation by vegetation is usually considered to constitute a water loss. Little attention has been given to horizontal interception and fog drip and, in general, consideration of this topic has been confined to arboreal interception rather than to that by shorter vegetation. Penland (1963), Ward (1967) and Merriam (1973), in discussing the literature on horizontal interception, illustrate these points and show, not surprisingly, that most of the work on fog drip has emanated from a few areas of the world where fog provides the dominant form of precipitation.

The present paper considers the impact of fog drip on streamflow during one week in February 1975, in a small catchment in the New Forest, Hampshire, where fog is a rare weather type. Although the predominant vegetation within the watershed is heathland, with only small, isolated patches of mixed woodland, streamflow peaks can be recognised, which the author can explain only as a catchment response to fog precipitation.

THE CATCHMENT

The study catchment is approximately 1.5 km² in area and is directly underlain by Barton clay, with a capping of Barton sand and plateau gravel on the interflues. The stream network is fed by seepage from marshy areas which are mainly submerged by a discontinuous cover of standing water during the winter months. The areas of standing water expand and contract rapidly in response to precipitation conditions, and the combination of these large marshy areas with the impermeable sub-soil, lead to a very sensitive streamflow pattern, with rapid response to precipitation.

The extent of the marshy area during the period of fog is shown in Fig. 1. The area of standing water on 27 February (shading 2), and a week later after heavy rainfall (shading 3), indicate regions of the catchment which had a soil moisture content at, or very near, field capacity during the study

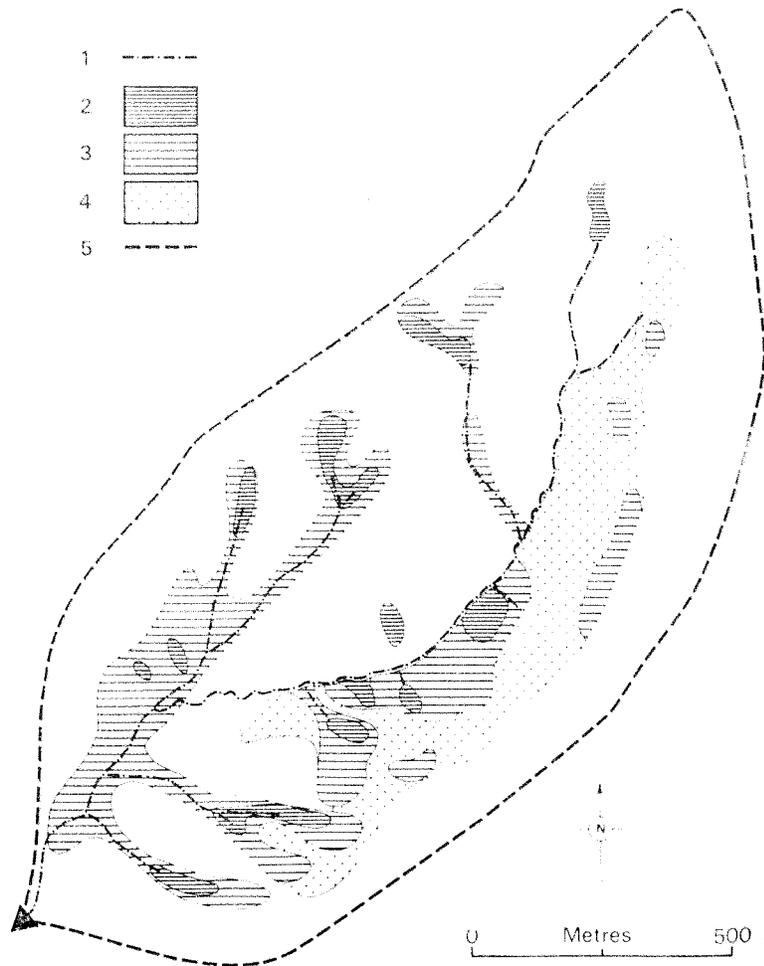
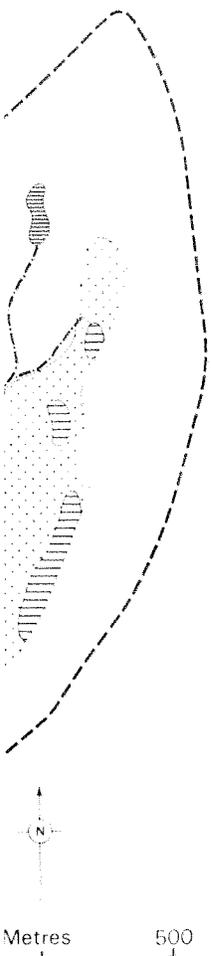


Fig. 1. Areas of high soil moisture content. 1. Stream network on 27 Feb; 2. Marshy land under standing water on 27 Feb; 3. Additional marshy area under standing water on 6 Mar; 4. Area with high soil moisture content but no surface water; 5. Watershed

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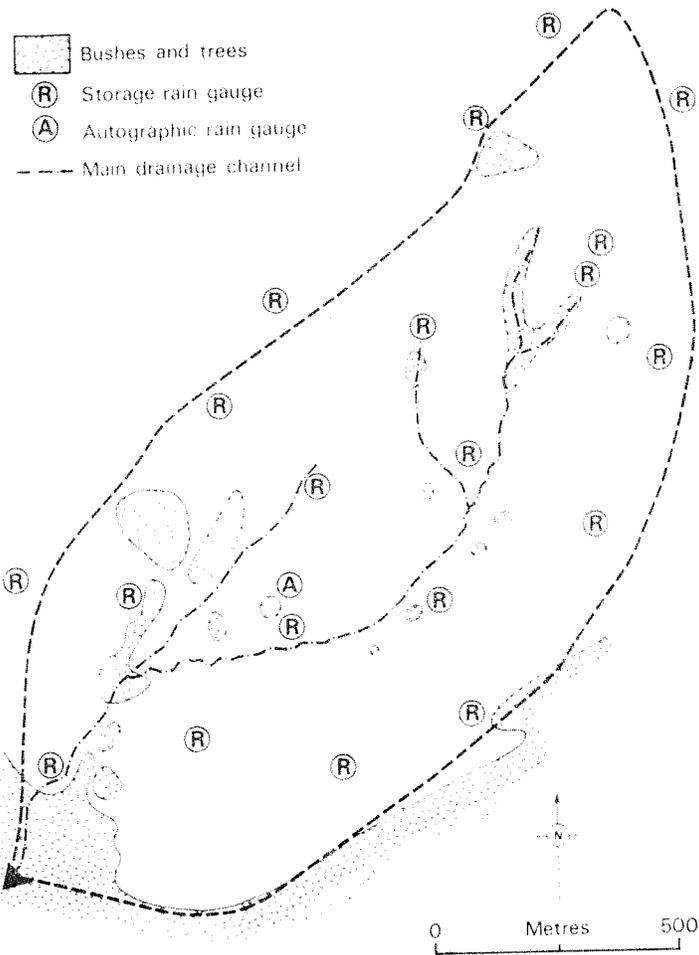


Fig. 2. The location of woodland in relation to the main drainage network

period. These areas, because of their high soil moisture content, could respond quickly to variations in precipitation in the form of transitory flow into the stream network. Further large areas of the catchment (shading 4) were also saturated during the period of fog, although no large pools of water appeared on the surface. The proximity of the areas of high soil moisture content to the drainage network on 27 February (shading 1) is indicated in Fig. 1. The areas of woodland within the watershed are shown in Fig. 2, and a comparison of Figs. 1 and 2 illustrates that these wooded areas were generally located in regions of relatively low soil moisture content during the study period.

WEATHER AND STREAMFLOW

The amount of fog was not measured by the author but its time of occurrence was noted; the records from the meteorological stations at Hurn

TABLE 1. Records related to mist and fog conditions at Hurn and Boscombe Down climatological stations. Boscombe Down (126 m ASL); Hurn (10 m ASL)

Date		Boscombe Down				Hurn			
		12	18	00	06	12	18	00	06
Feb.	1	haze	haze	haze	haze	—	—	—	—
21-22	2	—	—	—	—	—	—	—	—
	3	—	0-0	—	trace	—	0-0	—	0-0
	1	haze	haze	fog	fog	haze	haze	fog	fog
22-23	2	—	—	f/f/th	f/f/th	—	—	f/f/th	f/f/th
	3	—	—	—	—	—	0-0	—	—
	1	fog	haze	mist	fog	haze	haze	fog	fog
23-24	2	f/f/th	—	—	f/f/th	f/f/th	—	—	f/f/th
	3	—	trace	—	0-0	—	—	—	—
	1	haze	haze	haze	haze	haze	haze	mist	mist
24-25	2	f/f/th	—	—	—	f/f/th	—	—	—
	3	—	0-0	—	0-0	—	0-0	—	0-0
	1	haze	haze	haze	mist	haze	haze	mist	mist
25-26	2	haze	haze	—	—	—	—	—	—
	3	drizzle	—	—	0-0	—	0-0	—	0-0
	1	haze	haze	haze	haze	haze	smoke	mist	fog
26-27	2	—	—	—	—	—	—	—	f/f/th
	3	—	0-0	—	0-0	—	0-0	—	0-0
	1	haze	haze	haze	haze	haze	haze	haze	haze
27-28	2	—	—	—	—	f/f/th	—	—	—
	3	—	0-0	—	0-0	—	0-0	—	0-0

1 Present weather
f/f/th fog/ice fog/thick haze
2 Past weather
3 Precipitation in mm

and Boscombe Down verify these observations (Table 1). A rain-gauge network (Fig. 2) consisting of 20 weekly storage gauges and an autographic gauge monitors precipitation in the catchment but no fog meshes are attached to these gauges. The autographic gauge recorded no precipitation during the study week, while the highest catch in any of the storage gauges was 1.15 mm.

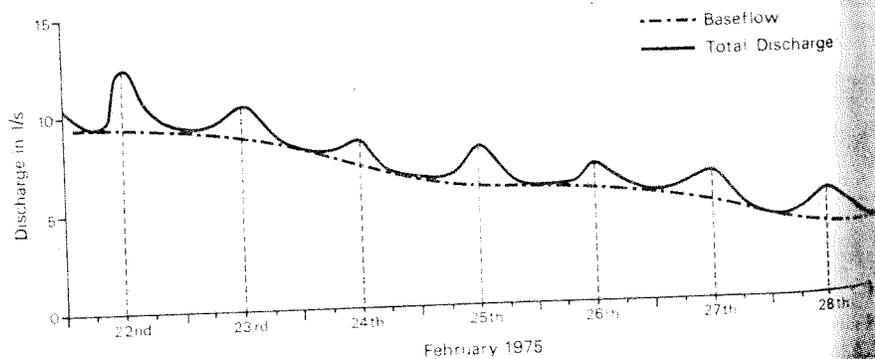


Fig. 3. Stream hydrograph during the study period

Clearly, the streamflow record for the seven day period from 22 to February shows marked, although small, peaks (Fig. 3), extending approximately 12 hrs, with a maximum occurring around mid-day. Similar peaks have been observed during a more recent period of fog but the re-

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TABLE 3. Ra part of th

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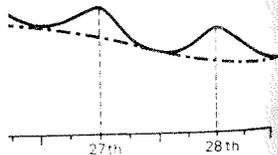
irn and Boscombe Down
0 m ASL)

Hurn		
18	00	06
---	---	---
0.0	---	0.0
haze	fog	fog
---	fif/th	fif/th
0.0	---	trace
haze	fog	fog
---	---	fif/th
0.0	---	0.0
haze	mist	mist
---	---	---
0.0	---	0.0
haze	mist	mist
---	---	---
0.0	---	0.0
smoke	mist	fog
---	---	fif/th
0.0	---	0.0
haze	haze	haze
---	---	---
0.0	---	0.0

in mm

e 1). A rain-gauge net-
fog meshes are attached
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ge gauges was 1.15 mm.

--- Baseflow
— Total Discharge



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ty period from 22 to 28
Fig. 3), extending over
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od of fog but the results

have yet to be analysed. This concurrence of fog periods and streamflow peaks suggests a causal relationship between the two, and the available information (Table 1) indicates a lag of approximately 6 hours between maximum fog formation and hydrograph peak.

TABLE 2. The approximate amount of the fog discharge

Date in Feb.	Amount in litres
22	52 400
23	38 950
24	20 200
25	48 100
26	28 850
27	40 400
28	52 200

Table 2 lists the magnitude of the flow peaks (i.e. volume of water in excess of baseflow). Only small amounts of water are involved, the largest being approximately 52 m³ on 22 February. It is a simple process to relate the area under each hydrograph peak to the rate of fog drip necessary over specific areas of the catchment, for certain lengths of time, to achieve such increases in flow. Table 3 gives the result of such analyses for fog drip for 3

TABLE 3. Rate of precipitation (in mm hr⁻¹) required over a given time period and a given part of the catchment to give required fog discharge peak. Shadings refer to Fig. 1

Date	Shading 2		Shading 2 and 3		Whole catchment	
	3 hr	6 hr	3 hr	6 hr	3 hr	6 hr
22	0.472	0.236	0.084	0.042	0.012	0.006
23	0.351	0.175	0.053	0.027	0.009	0.004
24	0.182	0.091	0.028	0.014	0.005	0.002
25	0.433	0.217	0.077	0.039	0.011	0.005
26	0.260	0.130	0.039	0.020	0.006	0.003
27	0.364	0.182	0.065	0.033	0.009	0.004
28	0.470	0.235	0.084	0.042	0.012	0.006

and 6 hr periods, over different areas of the catchment. All the figures included in Table 3 are compatible with results obtained by Merriam (1973), in wind tunnel experiments. Evapotranspiration losses under high humidity conditions in winter are likely to be negligible, so that Table 3 gives an indication of the total as well as effective fog drip necessary to cause the observed streamflow peaks.

CONCLUSION

The results indicate that fog drip from grasses and heather, in addition to direct fog precipitation onto the water surface, can cause fluctuations in streamflow. These fluctuations were particularly noticeable in the catchment described, as a result of the impermeable geology of the area and the sensitivity of the large areas of marsh land under conditions of saturation. The presence of a 90 deg V-notch weir allowed the measurement of these slight fluctuations in streamflow. The recorded discharge peaks could not be attributed to fog drip caused by woodland interception because the soil moisture conditions beneath the trees were relatively dry during the study period. The only solution to the problem is to suggest a mechanism of fog

drip from short vegetation, leading to a streamflow peak via translatory flow from marshy areas after an approximate lag of 6 hrs.

ACKNOWLEDGMENTS

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SCOTTISH SNOW SURVIVALS - SUMMER 1975

By P. C. SPINK

Ulceby, South Humberside

ONCE again the winter wind pattern (January-May) determined the volume and number of snow-beds which survived into the 1975 summer. This, together with lower mean temperatures and greater precipitation totals than in 1974, as shown in Table 3, resulted in many more beds, particularly on the Cairngorm plateau. Thanks to a higher percentage of westerly and north-westerly winds than in 1974 there were some unusually large south-east facing snowfields. Yet there was little, if any, north facing snow to be seen by mid-summer. Towards the end of July the northerly faces of the Cairngorm massif were virtually and unusually without snow.

Comparative analyses of the 1975 winds for Dyce and Benbecula with those of 1974 show some interesting features (Table 1). Compared with 1974 the total number of days with wind speeds in the range 22-33 kt and those with 34 kt or more was slightly greater. In 1974, April was a calm and cyclonic month with warm days. In 1975, however, April was (see Table 2) a month of westerly and southerly winds with much drifting of snow in the low temperatures at high levels. The blizzard of 7 April was notable and to the inclement weather of this month can be added the increased frequency of high wind speeds. These facts in part account for the unusually large amount of snow at Site B above Loch Avon which was still to be seen in June and also the immense size of the handsome snowfield above Loch Etchachan on Ben McDhui.

It will be seen from Table 2 that, as in 1974, January was the outstanding month for high windspeeds, mainly from the south, south-west and west. Westerly to north-westerly winds were frequent in the period March to May. In 1974 the frequency of these directions was only 35 per cent of the total incidence. It will be noted that May was also a windy month, with 1975 recording 21 occasions with speeds over 22 kt from a north-west direction.

	February		March		April		May	
	22-33	34	22-33	34	22-33	34	22-33	34
Dyce	17 (145)	1	31 (13)	0	6 (0)	6	36 (21)	0
Benbecula	267 (278)	18	54 (65)	0	17 (1)	17	42 (47)	0

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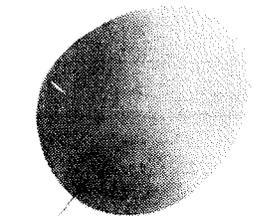
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Cover photographs by K. Hall

Cumulonimbus building up in the St. Elias Range around Mt. Logan. View from a nunatak on the Juneau Icefield, Alaska, looking northwest on 10 September 1975

The Editor welcomes contributions and correspondence on all aspects of weather and meteorology, but the responsibility for opinions expressed in articles and correspondence rests in every instance with their respective authors. All material submitted for publication should be typed double-spaced, on one side of the paper only and with wide margins. Brevity and lucidity are encouraged. Potential authors may find the article by D. E. Pedgley entitled 'Writing for *Weather*' (in *Weather*, 27, pp. 294-299) of some value. For guidance in setting out tables, references, etc., authors should consult *Preparation of papers for the Quarterly Journal*, copies of which may be obtained from the Editor. Authors are entitled to 10 free copies of the issue containing their published article.

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