Fragmentation of Pottery in the Ploughsoil

Field walking has been traditional activity in Britain since the turn of the century. Given the large numbers of amateur archaeological societies spread countrywide, aside from the annual summer excavation, the major activity of these societies usually in the winter has been to walk areas within their regions fairly regularly if not systematically. It is normal, for example, to have special areas where sites are known and rewards will be commensurately high. Such sites therefore become celebrated and often the focus of summer excavation. There is no doubt but that the archaeological data base of Britain has been greatly increased by these activities especially in those areas which are unsympathetic to aerial photography. Very occasionally, on the other hand, a region is subjected to organised and systematic field walking and the resultant picture achieved over a period of years is dramatic. Such an example is provided at Chalton Manor Farm in Hampshire (Cunliffe 1973) where the evolution of a landscape is postulated primarily from data achieved from interim field walking by the owner and by organised groups. It is upon one of the sites discovered by field walking, and which has not been excavated, that the following analysis is based.

A Bronze Age hillbrow site was located by pottery distribution on Camel Down in Hampshire (O.S. 739180) in 1968, Despite the intensity of occupation of this general region through all periods, on this particular site there were virtually no other intrusive pottery sherds at all. Nonetheless the concentration and quantity of material recovered indicated either a long term or very large Bronze Age settlement.

The field area of Camel Down was brought into cultivation in 1951 when the scrub and small trees were cleared with a bulldozer. Originally it was a typical stretch of unimproved downland devoted to sheep and cattle grazing. From 1951 to 1968 it was cultivated for cereals, root crops and regrassed at intervals, approximately one third of the time under cultivation and two thirds under intensive grazing. The cultivation machinery was relatively light. In 1968, however, it was brought into continuous and intensive cultivation and the basic economy of Manor Farm changed to an arable regime. The agricultural history of the area for the period 1968-88 is presented in Table 1 below.

Table 1 Cultivation Record of Camel Down 1968-1988

	Agricultural Process				
	Plough	Cultivator	Roller	Drill	Harrows
Frequency	x21	x42	x42	x21	x21

Ploughing normally took place in September with a multi-shared turn-over plough to an average depth of 200 mm. The creation of fairly deep furrows necessarily increased the surface area of the land and exposed any pottery brought to the surface to frost action and general weathering during the ensuing winter period. Spring cultivation was carried out with the standard multi-tined chizel plough which brought the soil into a levelled seed bed. The depth of tine penetration into the soil averaged 150mm. The spike harrow completed the process and after sowing the heavy roller compressed the seed bed and thus increased tillering of the crop. The roller used weighed two tonnes across a 5.0m width. The agricultural processes to which the greater pressure per square metre of the tractor itself must be added, is undoubtedly severe both in terms of friction and pressure. Ironically in terms of survival of pottery sherds all the agricultural processes take place at critical times of the year. Autumn ploughing brings the sherds to the surface and spring cultivation strikes them immediately after the ravages of frost action. In the case of the very coarse pottery of the Iron Age, with its high percentage of inclusive material like calcined flint, a winter's exposure is enough to break down the fabric to the point where any movement will bring about immediate disintegration.

With the discovery of the sherd scatter on Camel Down in 1968 a group of experienced walkers were brought in to walk the area in the late autumn. Several kilos of pottery sherds were collected from the surface. These were the typical late Bronze Age pottery of the area. The clay fabric, probably from the local 'clay with flints' cappings to be found on top of many of the chalk Downs, with flint inclusions had been fired light red at a temperature of c. 900 degrees C. Kilns of this period have so far not been isolated but in all probability they were of the simple updraught variety. Their very absence suggests the kilns may have been of the Sevrier type (Bocquet and Cowen 1975; Andrieux 1976).

In the late autumn of 1978 the same area was again walked with another group of experienced field walkers and several more kilos of sherds of the same type were collected. Both collections were, of course, kept separate but surface examination indicated considerable differences between them. So different were they that it was decided to carry out a very simple, even simplistic, analysis.

The results of this analysis, which are recorded below in the form of the basic data in the index and the calculations therefrom in Table 2, although they have already been published as an interim statement (Reynolds 1982), inspired a further exercise in field walking after the passing of another decade. The objective, therefore, is to present the results of three field walking exercises spanning twenty years of intensive arable agriculture from 1968 to 1988 (Table 1).

The early surveys of 1968 and 1978 can best be described as typical group field collections of pottery identifying the presence of a particular site and bringing back an homogeneous collection of sherds. Comparatibility between the surveys is virtually impossible to establish. Indeed, standardisation of surveys at all, while desirable, is beyond the reality of field walking itself. So much depends upon ground and light conditions and the perception and ability of the members of the group. Sufficient to observe that on the occasions of the 1968 and the 1978 surveys there was an abundance of sherds present on the plough surface and that an arguably representative sample of those sherds was collected and brought back to base. In order that the analysis of these collections should be non-selective, each was placed in a cloth bag and gently agitated. A scoop was inserted and a quantity extracted and placed on simple kitchen scales. Rough parity of weight was achieved as can be seen in Table 2. The third field survey was an entirely different exercise. The objective was to collect a quantity of sherds from the ploughsoil surface to replicate the above sampling procedure. In the event, on a perfect day for field walking, excellent lighting conditions, the ploughsoil having recently been subjected to heavy rain, three very experienced field walkers managed only to collect as a totality a sherd weight of c. 650grams within the space of an hour. Undoubtedly it would[d] have been possible to collect more in a longer time. In effect, six traverses were made across the known site. Less experienced field walkers would most likely have failed to locate the site at all. Yet with the knowledge of its existence, it was quite remarkable how the site was still defined by the pottery scatter difficult though it was to isolate. There appeared to be quite distinct limits spanning no more than two or three metres distinguishing presence and absence of sherds.

Table 2 — Sherd Analysis

	1968	1978	1988
No. of Sherds	95	280	323
Total Sample Weight	887.75 gms	885.63 gms	649.06 gms
Mean Weight	9.35 gms	3.16 gms	2.01 gms
Total Area	63,220mm^2	78,268mm^2	53,266mm^2
Mean Area	665.48mm^2	279.53mm^2	164.91mm^2
Standard Deviation	+/-258.88mm^2	+/-188.80mm^2	+/-146.89mm^2
Weight/mm^2 mean	0.0130	0.0103	0.0102
Standard Deviation	+/-0.0040	+/-0.0033	+/-0.0039

Subsequently the three samples were analysed. Each sherd was weighed on a scientific balance to two places of decimals, its area calculated in square millimetres and the weight divided by the area to determine weight per square millimetre. These data are recorded in Appendix 1. Further calculations determined the mean weight and area of sherds from each sample and the standard deviations of the mean area and weights per square millimetre. All these results are presented in Table 2. Finally all the sherds were drawn to record their precise shapes, the results being presented in Figures la, b, and c. The visual comparison is both the easiest to appreciate and most persuasive of the argument for monitoring fragmentation. Certainly it is clear that the distribution about the mean is somewhat skewed but no more than one would expect from such subjective collections.

It would seem that the question of sherd lamination through frost action for this type of pottery is minimal as the weight per square millimetre and standard deviations of same clearly demonstrate. The sherds are actually being broken up by the agricultural cultivation process. Similarly from the mean areas and weights of the sherds from the three samples the fragmentation is apparently slowing down if only because the size being reached in the third sample is reaching an optimum survival size given the present generation of agricultural machinery. Undoubtedly the larger sherds in the third sample are at physical risk but the hypothesis that their subsequent fragmentation may not alter significantly the overall results of the third sample seems probable. However, if this is the case, it will make field observation even more difficult than that recorded above. The survey scheduled for 1998 might well determine optimum survival size of pottery sherds but the results in all liklihood will prove to be entirely academic. Given this rate of fragmentation field walking could well be by then part of the archaeological heritage. There may well come a point at which degradation or fragmentation of the pottery sherds makes casual observation in the sense of field walking virtually impossible. The pottery, indestructible however fine the particles may become, will still be in the soil. Its isolation and identification might only be made by laboratory analysis of soil samples. Yet one suspects that this rate of degradation is, in fact, a particularly and peculiarly modern phenomenon. The highly sophisticated modern farming system, dependent as it is upon the utilisation of agro-chemicals, is especially severe upon the soil and its structure. In order for the agro-chemicals to be most efficient and, therefore, economic, the organic levels of the soil are reduced to between three and seven percent. This naturally reduces the particle size of the soil, the by-product being the threat of erosion across all arable regions. Similarly because of the reduction of particle size the soil itself becomes more abrasive. It is not really an idle observation that the soil is almost an irrelevance to modern farming in that any similar medium would adequately serve. However, in terms of pottery survival and, therefore, site locations, the situation is further exacerbated by the earlier and earlier cultivation times as plant hybridisation develops increasingly successful varieties of cereals. The winter months when wildly fluctuating temperatures in the soil are the norm, it is not unusual to see ploughs, both turn-over and chizel, discs, rollers and power harrows working hard to produce a fine tilth for early cereal planting. The sheer power of the latest generation of farm machinery pulverises the soil and with it all the material therein. This is in direct contrast to the recent past when ground conditions played a much more significant role in the timing of cultivation. Indubitably the damage is severe but its severity is relatively limited in time to the last decade or so. If the predicted withdrawal from marginal lands, made attractively profitable only by agro-chemicals, where many archaeological sites previously unthreatened have been laid waste, actually comes about, the results of this survey and the study of sherd movement in the ploughsoil (this volume) may provide useful parameters against which archaeological evidence may be recorded and analysed.

Bibliography

Andrieux, P. 1976 — Essai d'un four de potier reconstitue du type de Sevrier (Bronze Final), Etudes prehistoriques No 13, 37-40

Bocquet, A. & Cowan, — Le four de potier de Sevrier, Haute Savoie (Age de Bronze Final) Etudes prehistoriques No 9, 1-6

Cunliffe, B.W. 1973 — 'Chalton, Hants : The Evolution of a landscape', Antiquaries Journal, Vol. LIII, Pt.2

Reynolds, P.J. 1982 — 'The Ploughzone', Festschrift zum 100 jahringen Jubitaun der Abteilung Vorgenschischte der Naturhistorischen Gessellschaft, Nurnberg e. V. 315-341

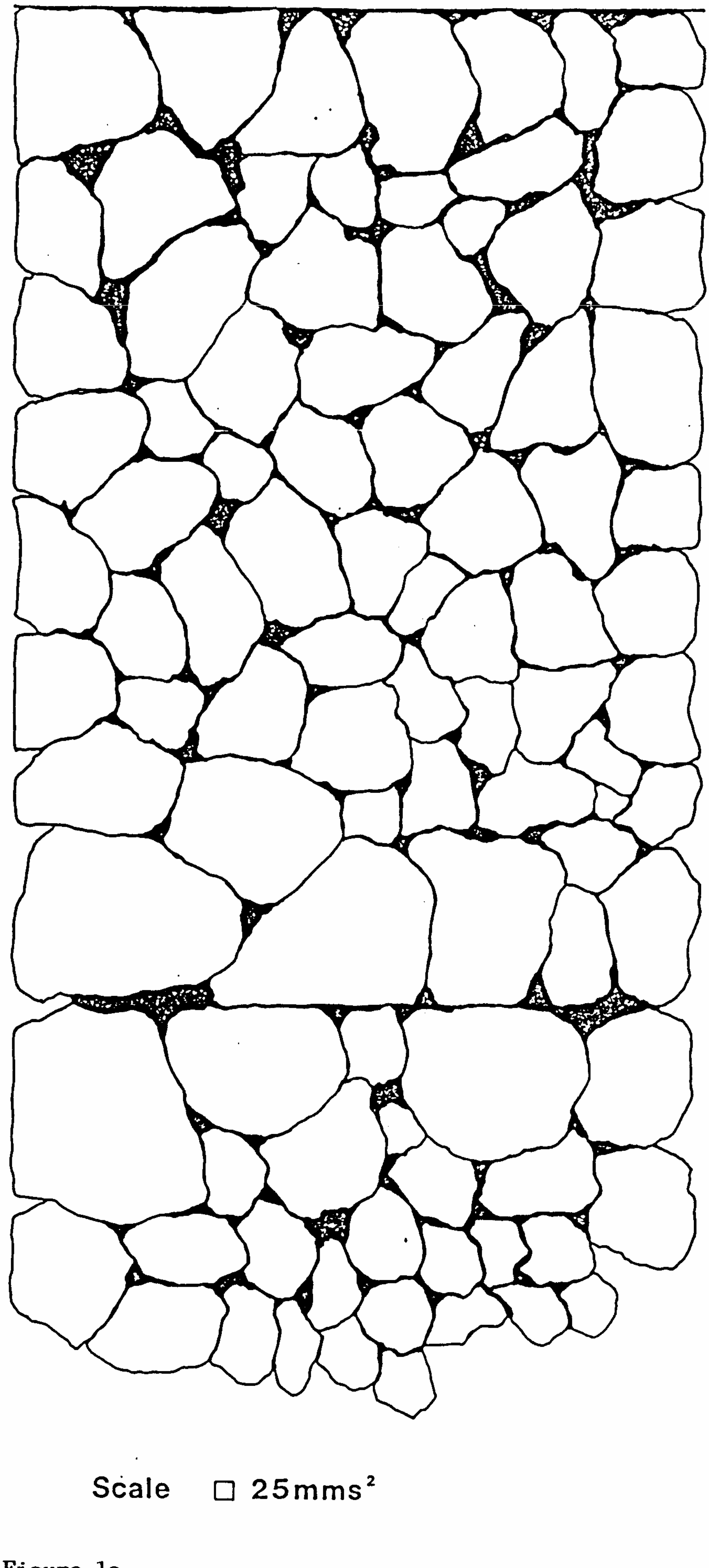

Figure 1a

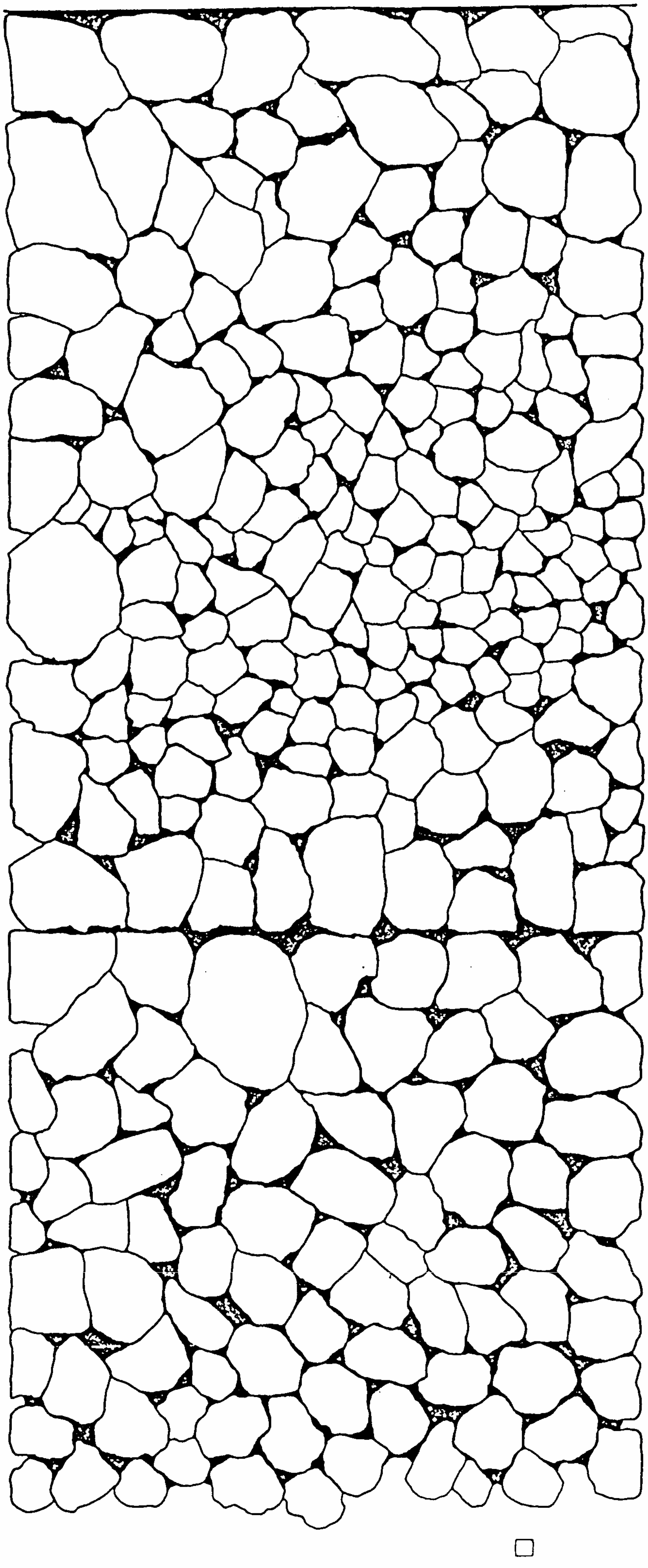

Figure 1b

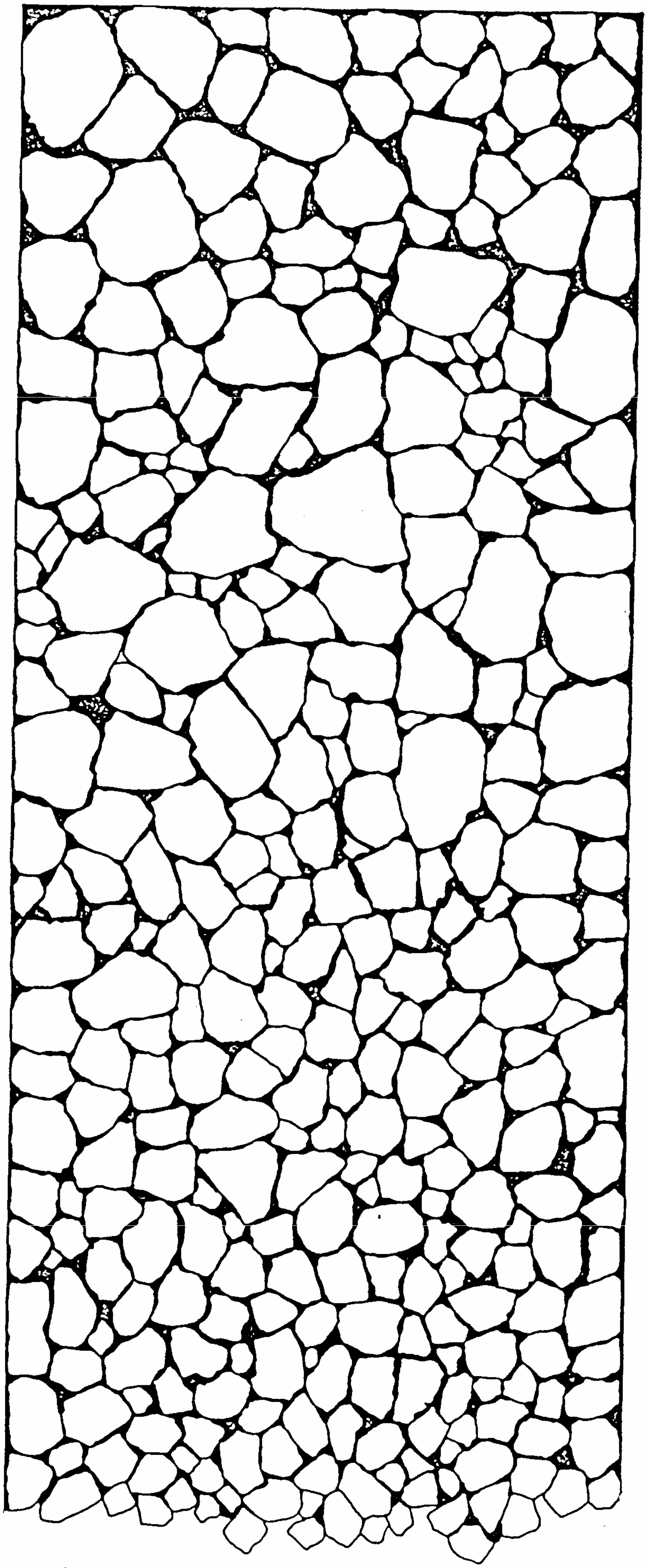

Figure 1c

Weight in gms	Area mm^2	Weight per mm^2	Weight in gms	Area mm^2	Weight per mm^2	Weight in gms	Area mm^2	Weight per mm^2
28.89	2652	0.011	24.40	1364	0.018	3.14	312	0.010
2.36	328	0.007	9.41	872	0.011	1.37	144	0.010
8.34	808	0.010	10.29	1004	0.010	7.09	524	0.014
2.93	360	0.008	5.44	376	0.015	3.34	300	0.011
19.84	1988	0.010	4.96	492	0.010	15.68	708	0.022
6.75	508	0.013	12.68	812	0.016	9.90	740	0.013
38.92	1448	0.027	4.06	344	0.012	2.61	240	0.011
6.21	340	0.018	7.93	412	0.019	7.55	580	0.013
10.47	864	0.012	1.68	188	0.009	2.60	268	0.010
7.77	564	0.014	5.49	416	0.013	4.22	448	0.009
2.27	224	0.010	3.64	356	0.010	2.49	236	0.011
8.34	660	0.013	9.30	668	0.014	8.89	676	0.013
10.33	912	0.011	4.25	436	0.010	9.74	632	0.015
4.30	344	0.013	10.27	860	0.012	5.82	516	0.011
10.15	728	0.014	15.83	1112	0.014	17.41	1080	0.016
2.14	244	0.009	11.87	896	0.013	7.80	536	0.015
2.94	324	0.009	1.45	68	0.021	15.24	720	0.021
34.87	2388	0.015	10.53	1020	0.010	13.99	932	0.015
10.25	780	0.013	3.17	348	0.009	24.19	1000	0.024
43.48	1780	0.024	20.80	1380	0.015	3.18	304	0.011
4.79	440	0.011	4.12	444	0.009	11.66	732	0.016
1.34	268	0.005	7.72	696	0.011	7.58	476	0.016
5.26	248	0.021	14.02	908	0.015	9.72	648	0.015
9.36	424	0.022	1.85	300	0.006	8.19	404	0.020
4.83	432	0.011	2.40	248	0.010	6.04	516	0.012
6.62	644	0.010	11.10	1052	0.011	11.82	836	0.014
14.69	860	0.017	4.14	520	0.008	10.88	752	0.015
28.82	1272	0.023	2.70	284	0.010	2.82	204	0.014
2.62	220	0.012	1.92	212	0.009	8.20	680	0.012
1.98	544	0.004	8.17	596	0.014	8.97	700	0.013
8.07	528	0.015	8.00	596	0.013	9.39	772	0.012
15.49	1132	0.014	9.23	776	0.012			

1978

Weight in gms	Area mm^2	Weight per m^2	Weight in gms	Area mm^2	Weight per mm^2	Weight in gms	Area mm^2	Weight per mm^2
8.35	860	0.010	4.04	476	0.009	4.55	520	0.014
2.39	188	0.013	11.31	688	0.016	2.06	184	0.011
7.33	596	0.012	2.55	260	0.010	5.65	384	0.015
1.79	208	0.009	1.46	140	0.010	3.02	312	0.010
7.27	468	0.016	1.07	108	0.010	1.15	212	0.005
1.01	108	0.009	0.99	142	0.007	3.27	256	0.013
1.86	196	0.010	0.48	76	0.006	2.02	232	0.009
11.31	812	0.014	2.28	220	0.010	5.03	320	0.016
2.80	264	0.011	3.40	308	0.011	1.64	124	0.013
5.48	596	0.009	1.92	188	0.010	1.24	152	0.008
7.15	376	0.019	1.46	156	0.009	1.46	104	0.014
7.63	620	0.012	4.55	316	0.014	4.33	208	0.021
2.35	204	0.016	2.39	236	0.010	9.91	468	0.021
0.81	116	0.007	0.97	116	0.008	0.58	96	0.006
1.43	280	0.005	0.66	104	0.006	0.35	64	0.006
0.62	92	0.007	1.46	96	0.015	0.99	1 96	0.005
1.62	216	0.008	0.98	104	0.009	1.88	124	0.015
19.55	820	0.024	3.63	272	0.013	10.60	712	0.015
3.10	312	0.010	6.00	452	0.013	11.00	360	0.031
1.62	180	0.009	5.28	328	0.016	2.39	200	0.012
1.87	164	0.011	1.06	124	0.009	4.85	420	0.012
1.15	144	0.008	2.23	280	0.008	2.75	280	0.010
10.97	704	0.016	14.61	1134	0.013	3.16	264	0.012
6.66	452	0.015	1.08	140	0.008	2.93	300	0.010
4.00	272	0.015	2.10	168	0.013	1.39	84	0.017
0.44	44	0.010	4.22	364	0.012	1.18	128	0.009
1.59	168	0.010	0.40	84	0.005	3.45	284	0.012
1.31	148	0.009	0.87	120	0.007	1.23	192	0.006
2.71	296	0.009	1.05	152	0.007	1.86	142	0.013
2.27	236	0.009	0.88	100	0.009	5.66	480	0.012
2.55	216	0.012	0.40	56	0.007	1.87	240	0.008
1.04	136	0.007	1.32	172	0.008	1.42	88	0.016
1.46	160	0.009	1.92	164	0.011	2.39	240	0.001
3.47	372	0.009	1.11	116	0.009	4.19	420	0.009
5.41	452	0.012	5.31	412	0.013	0.56	104	0.005
4.33	356	0.012	1.61	172	0.009	4.25	328	0.013
10.31	680	0.015	3.58	512	0.007	8.05	616	0.013
2.08	240	0.008	2.33	244	0.009	3.30	332	0.001
5.36	384	0.014	1.26	160	0.008	1.69	618	0.009
1.54	618	0.008	6.55	560	0.011	1.59	188	0.008
3.64	364	0.025	4.79	388	0.012	3.20	340	0.009
3.45	248	0.014	0.72	104	0.007	1.29	120	0.001
3.04	284	0.010	1.87	144	0.013	0.26	60	0.004
0.81	116	0.007	0.93	88	0.010	3.00	340	0.009
0.44	68	0.006	0.81	140	0.006	0.92	136	0.007
1.17	152	0.009	1.19	120	0.019	7.29	612	0.014
1.74	216	0.008	1.43	156	0.009	4.94	428	0.011
2.67	296	0.009	1.03	108	0.009	0.62	84	0.007

1978 (cont)

Weight in gms	Area mm^2	Weight per mm^2	Weight in gms	Area mm^2	Weight per mm^2	Weight in gms	Area mm^2	Weight per mm^2
2.06	164	0.012	3.32	368	0.009	1.88	200	0.009
3.42	320	0.001	7.51	536	0.001	5.23	448	0.011
3.19	340	0.009	3.49	316	0.011	2.49	288	0.008
0.95	160	0.006	3.33	300	0.011	2.03	288	0.007
4.01	432	0.009	5.34	492	0.011	4.49	300	0.015
2.33	280	0.008	1.81	284	0.006	2.65	320	0.008
3.19	268	0.012	0.82	128	0.006	0.81	84	0.009
1.67	232	0.007	1.44	116	0.012	0.33	56	0.006
1.54	188	0.008	1.55	100	0.015	2.13	248	0.008
0.97	108	0.009	2.06	264	0.008	0.81	88	0.009
1.06	112	0.009	0.43	84	0.005	2.02	196	0.010
3.09	264	0.011	2.00	176	0.011	8.29	516	0.017
2.54	372	0.007	2.15	180	0.012	0.78	124	0.006
0.08	104	0.008	2.67	320	0.008	1.31	128	0.010
4.41	360	0.012	21.27	1400	0.015	5.02	544	0.009
6.07	516	0.012	2.11	256	0.008	3.33	316	0.010
3.46	352	0.001	2.84	272	0.010	2.34	256	0.009
6.26	460	0.013	5.19	400	0.013	7.80	552	0.014
5.04	356	0.014	1.78	292	0.006	4.20	312	0.014
1.15	232	0.005	0.56	80	0.007	0.88	132	0.006
1.42	168	0.008	0.79	116	0.007	5.81	392	0.015
1.91	248	0.007	19.58	1124	0.017	2.43	232	0.010
0.79	124	0.006	0.82	128	0.006	0.77	88	0.009
1.25	164	0.007	0.67	108	0.006	1.53	168	0.009
4.91	428	0.011	0.62	88	0.007	7.46	716	0.010
5.11	400	0.013	0.40	68	0.006	0.45	88	0.005
1.49	212	0.007	2.81	288	0.010	12.41	760	0.016
4.80	484	0.010	6.57	504	0.013	6.17	456	0.013
3.56	312	0.011	3.85	264	0.014	3.34	336	0.010
3.91	412	0.009	2.88	280	0.010	0.64	108	0.006
0.89	472	0.002	2,85	292	0.010	3.17	252	0.012
2.50	232	0.011	3.12	388	0.008	2.73	276	0.010
1.16	128	0.009	0.89	88	0.010	0.79	116	0.007
0.68	100	0.007	0.69	100	0.007	1.36	124	0.006
0.83	152	0.005	1.66	140	0.012	0.70	88	0.008
1.42	156	0.009	0.92	96	0.009	1.31	164	0.008
1.67	184	0.009	2.20	200	0.011	1.89	188	0.010
7.15	500	0.014	5.45	480	0.011	3.22	352	0.009
0.91	156	0.006	0.86	104	0.008	1.01	132	0.008
2.70	344	0.008	3.90	352	0.011	5.15	420	0.012
3.21	320	0.010	4.56	472	0.009	1.02	136	0.007
6.96	540	0.013	3.63	348	0.010	2.30	260	0.009
1.30	168	0.007	2.36	268	0.009	4.89	468	0.010
6.44	456	0.014	2.90	372	0.008	4.58	360	0.012
2.46	340	0.007	1.16	184	0.006			

1988

Weight in gms	Area mm^2	Weight per mm^2	Weight in gms	Area mm^2	Weight per mm^2	Weight in gms	Area mm^2	Weight per mm^2
2.39	108	0.022	3.93	375	0.011	0.09	28	0.003
5.30	390	0.014	3.41	257	0.013	4.21	402	0.011
11.81	837	0.014	2.93	336	0.009	8.30	687	0.012
4.41	370	0.012	17.96	481	0.037	3.19	279	0.011
13.79	585	0.024	2.82	336	0.008	10.28	848	0.012
11.47	688	0.017	13.77	523	0.026	10.92	502	0.029
11.03	517	0.021	8.07	531	0.015	8.38	592	0.014
9.78	560	0.018	8.11	442	0.018	6.85	456	0.015
5.41	524	0.010	4.58	380	0.012	7.90	379	0.021
4.60	344	0.013	6.69	499	0.013	7.09	520	0.014
5.18	508	0.010	4.11	460	0.009	6.87	408	0.017
5.46	484	0.011	5.59	407	0.014	6.48	414	0.016
5.93	582	0.010	5.07	493	0.010	6.95	402	0.017
6.00	395	0.015	5.03	345	0.015	3.61	398	0.009
3.60	378	0.010	5.12	288	0.010	5.80	410	0.014
4.72	263	0.018	2.84	301	0.009	4.77	230	0.021
2.46	272	0.009	3.04	311	0.010	3.93	258	0.015
3.81	297	0.013	3.17	334	0.010	4.19	263	0.016
3.33	282	0.012	3.26	348	0.009	3.25	216	0.015
3.99	226	0.018	3.19	273	0.012	3.58	150	0.024
3.09	256	0.012	2.23	245	0.009	2.63	273	0.010
2.21	245	0.009	2.35	236	0.010	2.10	174	0.012
2.20	208	0.011	3.08	193	0.016	2.52	196	0.012
2.17	234	0.009	2.51	247	0.010	2.52	189	0.013
2.72	164	0.017	2.56	207	0.012	3.07	190	0.016
2.57	148	0.017	2.09	213	0.010	2.52	231	0.011
2.42	240	0.010	2.07	212	0.010	1.93	195	0.010
2.36	230	0.010	2.05	204	0.010	2.53	167	0.015
2.55	249	0.010	2.05	154	0.013	1.88	244	0.008
2.43	153	0.016	2.73	223	0.012	1.86	170	0.011
2.18	158	0.014	1.91	178	0.011	1.94	163	0.012
2.26	214	0.011	1.90	165	0.012	3.00	203	0.015
6.46	382	0.017	2.71	160	0.017	2.49	203	0.012
2.28	179	0.013	2.63	257	0.010	1.87	248	0.008
1.68	257	0.007	2.10	278	0.008	1.33	286	0.005
1.85	144	0.013	2.33	246	0.010	1.98	195	0.010
1.84	188	0.010	1.82	309	0.006	0.84	165	0.005
0.23	29	0.008	0.23	37	0.006	0.41	92	0.005
0.11	26	0.004	0.15	28	0.005	0.18	38	0.005
0.27	42	0.007	0.12	27	0.004	0.11	20	0.006
0.14	16	0.009	0.11	27	0.004	0.18	29	0.006
0.10	30	0.004	0.20	25	0.008	0.27	28	0.010
0.13	24	0.005	0.03	4	0.008	0.33	28	0.012
0.60	15	0.004	0.21	24	0.009	0.12	25	0.005
0.07	20	0.004	0.12	29	0.004	0.25	29	0.009
0.16	16	0.010	0.30	45	0.007	0.51	40	0.013
0.26	41	0.006	0.18	27	0.007	0.15	28	0.005
0.29	31	0.009	0.34	52	0.007	0.28	34	0.008
0.31	41	0.008	0.31	36	0.009	0.05	10	0.005

1988 (cont)

Weight In gms	Area mm^2	Weight per mm^2	Weight in gms	Area mm^2	Weight per mm^2	Weight in gms	Area mm^2	Weight per mm^2
0.34	48	0.007	0.14	27	0.005	0.40	55	0.007
0.41	51	0.008	0.35	59	0.006	0.33	36	0.009
0.20	29	0.007	0.32	27	0.012	0.39	49	0.008
0.30	46	0.007	0.60	54	0.011	0.39	54	0.007
0.22	27	0.008	0.42	39	0.011	0.43	44	0.010
0.17	35	0.005	0.39	58	0.007	0.44	54	0.008
0.38	41	0.009	0.43	39	0.011	0.18	28	0.006
0.40	31	0.013	0.55	52	0.010	0.18	45	0.004
0.40	47	0.009	0.21	28	0.008	0.31	32	0.010
0.23	24	0.010	1.90	217	0.009	1.89	229	0.008
1.95	260	0.008	0.56	67	0.008	0.63	56	0.011
0.70	94	0.008	0.69	58	0.012	0.52	61	0.009
0.31	42	0.007	0.49	54	0.009	0.39	36	0.011
0.16	48	0.003	0.56	59	0.010	0.42	37	0.011
0.49	86	0.006	0.58	72	0.008	0.63	62	0.010
0.65	58	0.011	1.00	108	0.009	0.80	94	0.009
0.71	74	0.010	0.77	58	0.013	0.44	259	0.002
0.40	46	0.009	0.24	30	0.008	1.97	104	0.019
2.25	152	0.015	1.83	124	0.015	2.42	165	0.015
1.33	178	0.008	1.07	121	0.009	2.09	136	0.015
1.37	142	0.010	2.13	154	0.014	1.77	140	0.013
1.68	127	0.013	2.08	177	0.012	1.86	144	0.013
1.60	108	0.011	0.63	48	0.013	2.22	146	0.015
1.81	134	0.013	2.07	157	0.013	2.18	189	0.011
1.84	162	0.011	1.07	127	0.008	1.72	163	0.010
1.76	195	0.009	0.81	87	0.009	0.84	106	0.008
1.36	128	0.011	0.68	77	0.009	0.78	53	0.015
0.76	102	0.007	0.97	97	0.010	1.12	94	0.012
1.69	144	0.012	2.15	222	0.010	1.14	182	0.006
0.19	74	0.003	1.27	114	0.012	1.11	128	0.009
1.53	178	0.009	0.33	55	0.006	0.99	92	0.011
1.26	124	0.010	0.60	135	0.004	1.56	148	0.010
1.59	102	0.015	0.23	67	0.003	0.66	58	0.011
1.50	152	0.010	1.23	104	0.012	2.00	167	0.012
1.63	104	0.012	1.22	133	0.009	0.26	28	0.009
1.25	173	0.007	1.18	143	0.008	0.86	92	0.009
0.44	86	0.005	1.00	82	0.012	0.59	68	0.009
1.44	165	0.008	1.26	183	0.007	1.11	114	0.010
0.87	104	0.008	0.97	69	0.014	0.80	100	0.008
0.51	62	0.008	1.47	127	0.011	1.23	164	0.007
0.70	65	0.011	1.14	158	0.007	0.66	75	0.009
1.98	144	0.014	0.88	94	0.009	1.63	120	0.013
1.26	116	0.011	1.02	98	0.010	1.10	65	0.018
0.53	61	0.009	1.35	103	0.013	0.62	64	0.010
0.76	69	0.011	1.30	121	0.011	0.66	88	0.007
1.10	104	0.010	0.97	75	0.013	1.96	181	0.011
1.93	155	0.012	0.54	75	0.007	1.11	122	0.009
0.83	95	0.009	0.99	94	0.010	0.88	78	0.011

1988 (cont)

Weight in gms	Area mm^2	Weight per mm^2	Weight in gms	Area mm^2	Weight per mm^2	Weight in gms	Area mm^2	Weight per mm^2
1.72	122	0.015	0.54	82	0.006	0.70	67	0.010
0.85	57	0.015	1.08	101	0.011	1.48	132	0.011
1.17	94	0.012	0.94	102	0.009	0.85	110	0.007
1.59	98	0.016	0.94	66	0.014	1.32	62	0.021
0.94	58	0.016	0.93	87	0.011	1.21	146	0.008
0.60	164	0.004	1.11	100	0.011	0.43	41	0.010
0.70	104	0.007	0.72	107	0.007	1.04	178	0.006
0.75	94	0.008	0.85	74	0.012	0.75	96	0.008
0.62	94	0.007	0.43	72	0.006	1.11	96	0.012
0.40	74	0.005	0.91	66	0.014	0.93	88	0.011
0.84	91	0.009	0.89	96	0.009			