ENVIRONMENTAL FACTORS IN THE AETIOLOGY OF LUNG CANCER AND BRONCHITIS

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THE conclusions concerning the relationship of air pollution and lung cancer mortality in a paper in the previous issue of this Journal (Ashley, 1969) are opposite to those reported in the preceding issue (Gardner, Crawford and Morris, 1969) and in other studies reported earlier by many authors. Workers in the field of epidemiology are well aware of the importance of looking at their data correctly and of the difficulties of placing aetiological interpretations on associations found between environmental factors and mortality rates. Errors that arise from not doing so are only too well demonstrated in the paper by Ashley (1969), and in an earlier paper by him (Ashley, 1967).

It is not our concern here to attempt a review of this field (the Royal College of Physicians' Report (1970) does that) but to look closely at some details of Ashley's paper. An unusual feature one notices is the use of a 'modified Standardized Mortality Ratio', calculated separately for each County Borough according to whether it formed part of a conurbation, and if not, whether its population was over 100,000 or 50,000-100,000. This is done on the grounds that since both lung cancer and bronchitis mortality are related to town size, a modification should be made before proceeding further. The implicit assumption is that something 'urban' is operating; and one wonders whether this same undefined 'urban' factor is producing a similar relationship of town size with mortality from suicide and from syphilis and an opposite one with mortality from accidental deaths (Registrar-General, 1967). A

number of environmental factors, in particular air pollution and population density, are related to town size, and part of their association with mortality will be lost if the modified S.M.R.s are used.

Three calculations are helpful. First, the mean S.M.R.s from lung cancer in males for County Boroughs in the three urban aggregates above are 121, 108 and 103 respectively (Registrar-General, 1967). Ashley's S.M.R.s have means of 99, 114 and 114, showing a gross distortion of the towns in the conurbations. Secondly, the correlation between population (Registrar-General, 1961) and the S.M.R. from lung cancer in males (Registrar-General, 1967) for towns outside the conurbations is +0.31 whereas with Ashley's S.M.R. it is +0.22. This suggests that the procedure used has by no means eliminated the influence of town size, even if to do so were correct. Thirdly, the correlations between sulphur dioxide and the two S.M.R.s are +0.26 and -0.20 respectively; we have been unable to reproduce the published value of -0.23 for the latter coefficient from the data (Ashley, 1967). This reversal from a positive to a negative coefficient is due, we suggest, to the inappropriate modification. The Figure makes clear that, because of the association of town size and SO₂, towns low in SO₂ have had their S.M.R.s 'modified' upwards in general, and *vice versa*.

There is little information in the papers of Ashley (1967, 1969) on the way in which pollution data were selected from the tables published by the Department of Scientific and Industrial Research (1963). Inspection shows that they represent values for the

FIGURE.—Mortality from lung cancer and concentration of sulphur dioxide ($\mu\text{g./m.}^3$).

month of March 1963 at category B sites, in the less densely populated residential districts of the towns. By limiting the choice to this category the contrast between towns is much reduced, and the values are

TABLE

MEAN CONCENTRATIONS OF SMOKE AND SULPHUR DIOXIDE AT 'B' AND 'A' SITES IN COUNTY BOROUGH, MARCH 1963
(All figures in $\mu\text{g./m.}^3$)

County Borough	'B' Sites		'A' Sites	
	Smoke	SO ₂	Smoke	SO ₂
Barnsley	191	124*	227	179
Barrow-in-Furness	—	—	—	—
Bath	42	44	52	44
Birkenhead	73	86	263	286
Birmingham	117*	136*	170	195
Blackburn	214	143	264	210
Blackpool	170	175*	—	—
Bolton	198*	232*	311	269
Bootle	172	233	330	376
Bournemouth	61	102	62	101

*These figures were either not included by Ashley, or differ from those quoted in his paper.

not relevant to the main population. The effect is illustrated in the Table, in which the mean concentrations at all the 'B' sites that were operational in March 1963 are shown together with the corresponding means at 'A' sites, in the more densely populated residential districts. As in Ashley's original selection, sites in smoke control areas have been excluded.

Only the first few County Boroughs, in alphabetical order, are listed here, but from these it can be seen that in the 'cleaner' towns, such as Bath and

Bournemouth, concentrations at 'B' sites alone could be regarded as typical of the towns in which they are situated; whereas in some others, such as Birkenhead, they give a gross underestimate of the pollution to which large sections of the population are subjected.

There are also dangers in using mean values over as short a period as one month, for if there are marked contrasts in weather between different parts of the country, the distribution of pollution may be distorted. It is more satisfactory to use mean values over periods of at least one year, and there must in any case be reservations about the use of contemporary pollution data in mortality studies (Waller, 1966).

Since the basic material is inappropriate, we regard the further analyses and conclusions of Ashley (1969) as invalid.

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APPENDIX TABLE
DATA USED IN FIGURE

County Boroughs	S.M.R. Lung Cancer (males)		Sulphur Dioxide (Ashley, March 1963)
	Registrar-General 1959-63	Ashley 1958-63	
Barnsley	85	71	118
Bath	84	98	44
Birkenhead	124	106	86
Blackburn	107	94	143
Blackpool	88	100	174
Bolton	101	84	196
Bootle	139	116	233
Bournemouth	95	101	102
Bradford	109	90	203
Bristol	100	110	78
Burnley	100	104	181
Bury	84	70	213
Chester	113	124	100
Coventry	95	100	116
Croydon	129	102	124
Derby	100	114	151
Eastbourne	95	112	44
Exeter	87	100	54
Gateshead	146	119	51
Halifax	109	90	94
Huddersfield	89	75	191
Ipswich	91	99	95
Kingston upon Hull	137	145	123
Leeds	124	104	188
Leicester	99	107	90
Lincoln	109	125	124
Liverpool	150	122	235
Manchester	156	124	177
Middlesbrough	138	146	97
Newcastle upon Tyne	145	119	119
Norwich	108	118	80
Nottingham	126	133	50
Oldham	91	78	209
Oxford	101	108	148
Plymouth	95	104	33
Portsmouth	116	120	50
Reading	96	100	42
St. Helens	110	83	161
Salford	157	128	277
Sheffield	123	135	146
Smethwick	127	107	174
Southampton	116	126	73
South Shields	112	95	120
Stockport	109	92	176
Sunderland	117	130	126
Wakefield	93	77	181
Walsall	119	98	198
Warrington	130	131	226
West Bromwich	128	72	172
York	105	116	121
Cardiff	113	117	61
Newport	114	121	65
Swansea	106	94	42