‘Unswept stone, besmeer’d by sluttish time’: Air Pollution and Building Stone Decay in Oxford, 1790 – 1960.

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SUMMARY

On 1st January 1790 the Oxford canal finally opened with the arrival in Oxford of 200 tons of cheap coal from the Midlands. This event was one important stimulus to the economic transformation of Oxford from a quiet university and market town to a large commercial and industrial centre. The advent of affordable coal in plentiful supply encouraged economic progress, but at the same time brought a largely silent pollution legacy which is still evident today. In this essay, I wish to argue that the issue of building stone decay induced by air pollution has been a major theme in the recognition of, and reaction to, ‘the air pollution nuisance’ in Oxford. Changing perceptions of the aesthetic appeal of decayed buildings; opposition to industrial and economic progress; increasing scientific understanding of the decay process; and a concern with conservation and preservation of the historic university centre have all been important strands within the history of air pollution here.

INTRODUCTION

Oxford is a historical centre of world-renown; Sherwood and Pevsner (1974, p.71) acclaim it as having ‘...a density of monuments of architecture … which has not the like in Europe’. The city is much more than just an architectural museum, however. As E.W. Gilbert pointed out in 1947 it has four main functions, viz: trading and market town; seat of a university; tourist attraction; and home of large industries (Gilbert, 1947, p.13). Between 1790 and 1960 the economic growth of the city was accompanied by a changing balance of these four functions. Unlike many industrial towns in Britain, Oxford did not have large factory development in the 19th century and thus air pollution was not (compared with, say, Leeds and Manchester) a major focus of public concern in itself. The damaging effects of air pollution on buildings, coupled with a

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vociferous and important band of supporters for preservation of Oxford's 'townscape', meant that even low levels of industrialisation and pollution became a major source of debate. Interestingly, many sources claim that much air pollution in Oxford during the period under consideration came from colleges and university buildings themselves. A large university population lived within the town centre, burning coal in large quantities (Beckinsale and Combey, 1958). In Oxford, much of the local Headington freestone used extensively in buildings from the 14th to the 18th centuries is excessively sensitive to decay in polluted air. Many authorities, at different times in the city's history, assumed that once this stone was replaced by a more durable one the decay problem would go away. Sadly, this has not been the case.

This essay is based on a range of evidence collected during a pilot study of air pollution and stone decay history. There is much more evidence to be uncovered, especially about the amount of coal burned within the city. Most of the archival material used in this study is not straightforward to interpret by any means. For most of the period of record no data was purposefully collected on air pollution and stone decay, thus we must make inferences from a wide range of less focused information.

PRE-1790s OXFORD

Before the period of direct interest to this essay there is clear evidence that building stones were decaying, and environmental pollution was rife. In the 17th century there was a huge amount of building as university numbers burgeoned. Much of this building was executed in Gothic style (e.g. Wadham College, 1610-1613, University College, 1634 – 1677) which consciously or unconsciously harked back to Medieval styles of building. As Sherwood and Pevsner put it this Gothic revival '...stands for antiquarian leanings...' (Sherwood and Pevsner, 1974, p.35). Thus, we can suggest that even during the 17th century there was a clear preference for the old, the antique and the historical. Decayed stonework would, perhaps, have been an integral and picturesque part of this search for the past.

In 1676, Plot observed that the Wheatley freestone used for pinnacles on the chapel of New College, built in 1386, was 'melted away' (Arkell, 1947). By 1724, Hawksmoor was able to describe the old buildings at Magdalen College as 'soe decriped that Repairing any part (except the Hall and Chapel) signifiys but little' (Colvin, 1954). In both cases there is no evidence of the causes of the decay. Although there was little industry in Oxford at this time, and water power was still extensively used, there is evidence that 'sea coal' was brought from London up the River Thames and used in the city. Thus, Hargreaves-Mawdsley (1973) claimed that in the late 17th century Oxford recorded in the engravings of David Loggan '...comfortable plumes of sea-coal belly out from the chimney

stacks'. Building accounts from Wadham College in 1611 show that in October and September of that year about 18 quarters of 'sea coles' were delivered at a cost of 6s 8d per quarter (Jackson, 1889-92, Wadham College Archives). In line with most British towns of the period dung and filth were by far the most important environmental pollution problems, and had been so for several centuries. In 1301, for example, the University complained that 'the air was so corrupted with dung' (Crossley, 1979, p.350).

OXFORD IN c.1790

The arrival of the Oxford canal was only one of several important changes during the late 18th century. In 1771 the Paving Commissioners instigated wide-ranging reforms to the road network through the Mileways Act which included road widening and bridge repairs. Throughout the 18th century there was a paradoxical situation with both the university and city undergoing decline (in terms of public health, academic standards and student numbers), but with a frenzy of building activity (Crossley, 1979; Fasnacht, 1954). In the university '...for most of the 18th century there were recurring scandals involving drunkenness, fornication, sodomy and what Wood called general 'sauciness'...' (Hibbert and Hibbert, 1988, p.472). Meanwhile, Gibbs's great monument the Radcliffe Camera was constructed between 1737 and 1749; Hawksmoor worked on a large building programme at All Soul's College and Dean Aldrich supervised new buildings at Christ Church.

In 1772 the population of Oxford was approximately 9500 with 1811 inhabited houses. By 1781, the Gentleman's Magazine was able to report that there were 2316 inhabited houses paying window tax. At this time there were only 7 other towns outside London also with over 2000 houses, i.e. York, Sheffield, Norwich, Manchester, Liverpool and Bristol. Figure 1 shows the extent of the built-up area of Oxford at the end of the 18th century. There was little industrial development as yet; the gas works did not open until 1818; Lucy's ironworks got going properly in 1812; and Wolvercote paper mill installed its steam engine in 1811. Until the canal arrived, coal was expensive (2s 2d per cwt compared with canal coal at 1s 4d per cwt) and the supply irregular (Crossley, 1979). In 1790 there were only 10 coal merchants in Oxford, rising to 33 in 1823. During the 1790s coal merchants had many canal boats to ensure a good supply, with Ward and Holland, for example, having 17 boats (Prior, 1982).

In terms of environmental quality Oxford seemed on the surface to be quite healthy. In the early 18th century Daniel Defoe visited the city and noted '...I came to Oxford … so eminent for the goodness of its air, and healthy situation' (Defoe, 1724-6). Indeed, the air had long been perceived as being good in comparison with London, with John Evelyn in the late 17th century managing to move the Arundel Marbles to Oxford because he had observed '... how

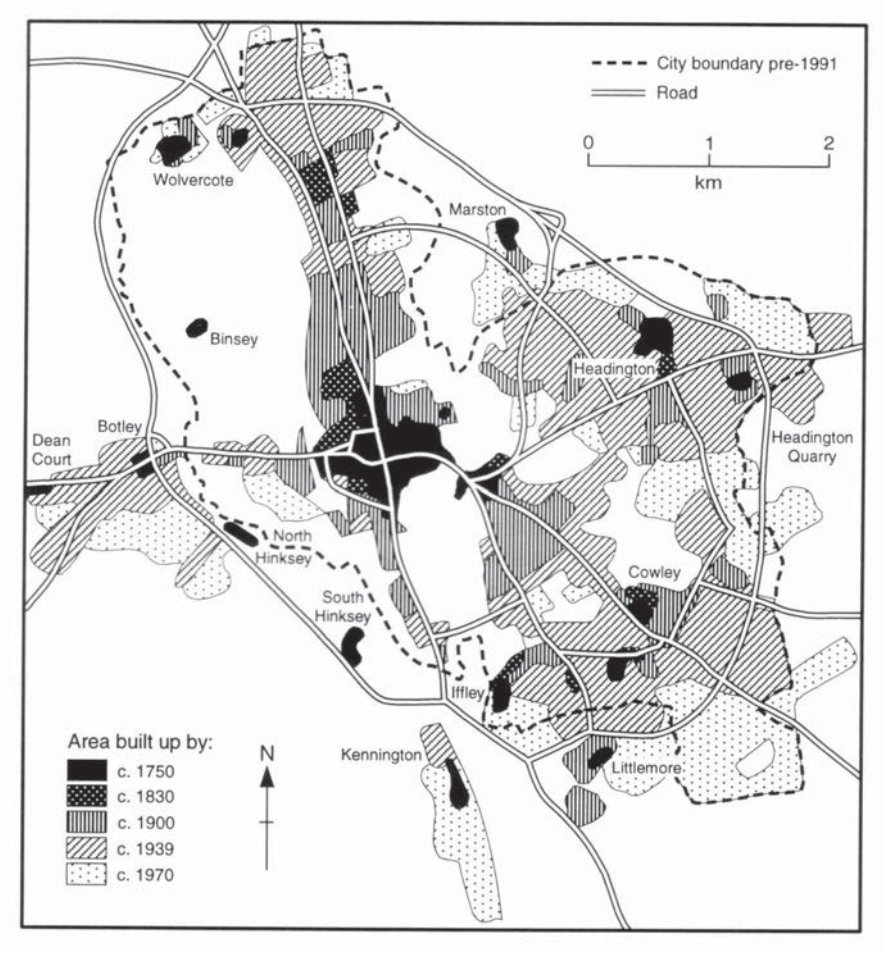

FIGURE 1. The changing urban area of Oxford, 1750-1970
(adapted from Crossley, 1979, p.207)

exceedingly the corrosive aire of London impar'd them' (Quiller-Couch, 1892). However, Oxford was by no means as clean and healthy as these quotes might have us believe. As Dale (1946) notes 'Behind the facade there was dirt, disorder and disease'. In particular, the water courses were highly polluted, especially Trill Mill Stream which was little more than an open sewer. This had been a long-term problem with many complaints during the 14th and 15th centuries about the foul state of this stream (Hurst, 1899). Like most English towns, Oxford had its chief scavengers who were first appointed in 1541, and were superseded in the 18th century by Supervisors of Nuisances (Crossley, 1979). Their duty was to report on pollution within the city; I have found no evidence that air pollution was ever a notable problem in their eyes.

Fragmentary coal consumption records give some indication of the amounts used within the city. Thus, New College used between 60 and 100 tons of coal per year over the period 1790 – 1806, spending for example £44 1s 9d in 1793 on canal coal (Bursar's Long Books, New College Archives). Merton College bought similar amounts over this period. Oxford City Council agreed to buy 500 tons of coal for distributing to the poor in winter in 1799 (Hobson, 1962). Extrapolating these figures one gets a minimum annual consumption in the city centre of around 5000 tons. This is a very low amount compared with 19th century figures, when each college consumed much more, and industrial usage was a large additional factor.

Buildings were being repaired and restored around the turn of the century and decay of sorts was noted. William Wordsworth, for example, wrote of Oxford in his poem 'The River Duddon' in 1820:

> 'Much have ye suffered from
> Time's gnawing tooth;
> Yet, O ye spires of Oxford! Domes
> and Towers!'

In the *Gentleman's Magazine* for 1792 it was reported that 'several of the Colleges at Oxford are undergoing repairs, some to a very considerable extent'. In Merton College Register we find that on March 27th 1795 the Bursar was empowered to use £292 8s to pay workmen's bills for repairs to college buildings. At Brasenose College external repairs were carried out because of decay between 1779 and 1819 (Allfrey, 1909). In 1817 the east end of the chapel was reported to be very perished, having decayed to a depth of 3 or 4 inches from its former surface. In 1815 the North side of Merton College chapel was reported to have been injured by the want of proper spouts to carry off the rain (Merton College Archives, Collegii Mertonensis Registrum, 1731-1822). In 1822 it is reported that:

> 'It appearing also, on examination, that the Pinnacles of the Tower of the Chapel are in a ruinous and dilapidated state, it is agreed, that they be immediately repaired according to the estimate produced to the College.' (Merton College Archives, Mertonensis Registrum Collegii, 1822-1876).

A report to Corpus Christi College by T. Harold Hughes in 1948 states '... it is known that the inner walls of the front quad were restored with Barrington Stone in 1804' (Corpus Christi College Archives, report on the Stonework, 1948).

Decay was by no means uniform, however. Mr Hudson, a builder, reporting to Balliol College in 1826 on the gate towers says 'although the parapets and cornices and mouldings are in a very decayed state, the walls are as good and substantial as when first built.' (Colvin, 1954, p.94). Many of these repairs proved not to be long term solutions. Thus, Corpus Christi College had to partly reface the Barrington Stone refacings of 1804 (which had replaced the original

stonework dating from c. 1517) in 1935. At Christ Church the balustrade and parapet of Peckwater Quadrangle, renewed in Bath Stone in 1829, had to be completely replaced in 1924-30 by Clipsham Stone.

By the end of the 18th century, Arkell claims that the untrustworthiness of the local Headington freestone had been realised (Arkell, 1947, p.52). He quotes the building specifications for Oriel College library (built 1788) where Headington freestone is recommended only for the side which didn't show. Two factors may have contributed to the increased problems faced by Headington freestone. Later quarried stone probably came from beds of inferior quality and, as Arkell suggests, the level of sulphur dioxide in the air may have risen sufficiently to prevent the stone 'seasoning' properly to produce a more resilient surface layer before the decay process began (Arkell, 1947, p. 52).

By about 1825 the first great period of refacing of college buildings began (Figure 2). There was also a general peak of university and domestic building within the city between 1821 and 1831 (Crossley, 1979). Much use was made of Bath Stone, and the disastrous practice of using iron cramps was followed in many cases. The Turl Street front of Exeter was refaced in 1824, the façade of All Souls in 1826-7 and Pembroke quad in 1829-30. Merton College Register for February 1st 1838 records that 'Mr Plowman (was) directed to refront the Tower and Gateway towards the street with Bath Stone'. These restorations, presumably motivated at least partly by the decayed state of much Headington freestone, were not universally approved of. Later in the century, William Morris declared that the affected buildings had been '...ruined by fakement various...' (quoted in Sherwood and Pevsner, 1974, p. 52).

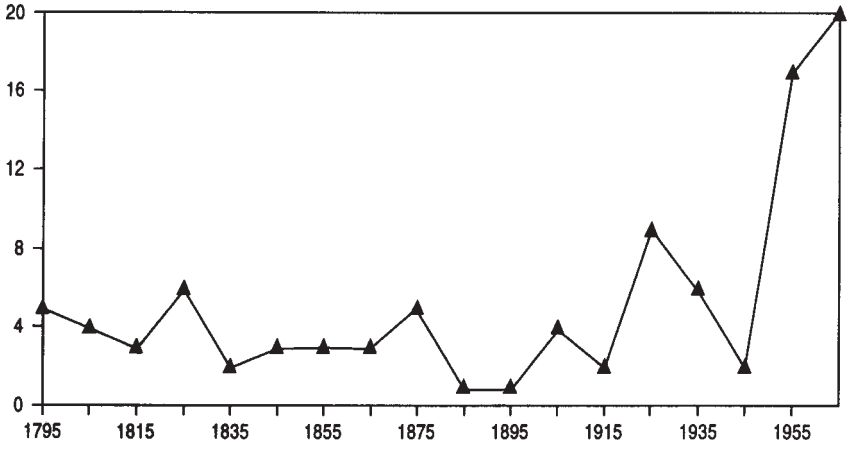

FIGURE 2. Number of repairs and restorations to 20 university buildings per decade, 1790-1965. Compiled using data from a range of sources.

OXFORD AROUND THE MIDDLE OF THE 19TH CENTURY

As is evident from Figure 1, Oxford had grown considerably in extent and industrial development by the middle of the 19th century. The Oxford canal faced stiff competition from the railways; the Great Western Railway arrived in 1844 and the London and North Western Railway opened in 1851. The population in 1851 was nearly 28,000 (with 5,100 inhabited houses), and it doubled between 1824 and 1871 as shown in Figure 3. Industry was concentrated particularly in the parishes of St Ebbe's and St Thomas, where as well as the burgeoning gas works (which extended onto the South bank of the river in 1882) there were three breweries. The only employer with more than 35 workers was a clothing factory in Queen Street, which started in the 1840s and employed around 630 people in 1851, many of them outworkers (Crossley, 1979). The university underwent reforms throughout the 19th century and rapid expansion in the 1860s. About 225 students per year entered the university in 1800, rising to around 695 per year in 1875.

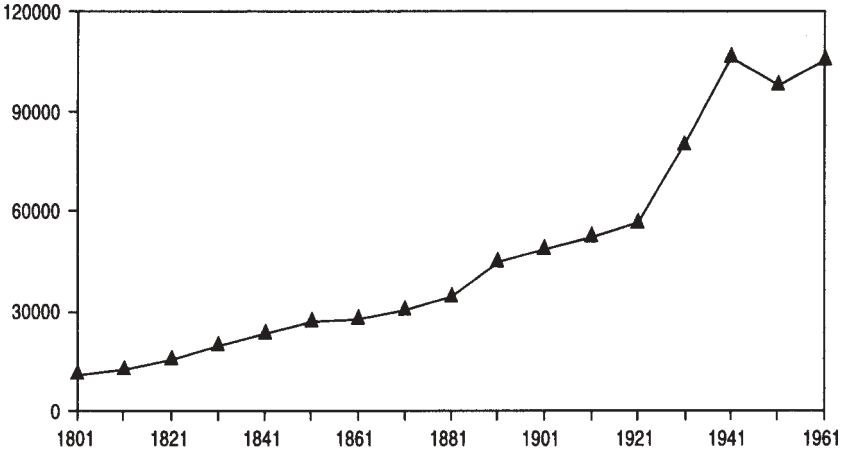

FIGURE 3. Population of Oxford, 1801-1961

Growth was accompanied by a deterioration of environmental conditions. Water supply pollution remained the major focus of concern, becoming a health issue with cholera outbreaks in 1832, 1849 and 1854. Other problems were the overcrowded nature of many of the city's churchyards, and the periodical flooding to which low-lying districts (e.g. St Thomas parish) were subjected. Boase (1887) lists heavy floods in 1846, 1852 and 1875. Trill Mill Stream was still a major nuisance, and in an unusual attempt at environmental protection the scholars of Christ Church built, in 1854, a wall between themselves and it (Dale,

1946). Richard Burton in 1840, whilst a student at the university, complained about the 'detestable' climate of Oxford and found '... the smell of the coal smoke a perpetual abomination...' (McLynn, 1990).

During the 19th century coal use and the recognition of large point sources of smoke as an important pollution problem both grew. A few coal consumption figures serve as examples. Wolvercote paper mill is reported to have used some 5000 tons of coal per year (Carter, 1957) and Lucy's Iron works and the gas works must have been similarly large consumers. College consumption figures average 200 to 250 tons per year. Exeter College coal records, which are broken down into individual users, show an average consumption of 3 cwt per person per week in winter during the 1850s (Exeter College Archives, Bursar's Quarterly Accounts). There were 37 coal merchants in 1844, rising to 46 in 1890. A very rough estimate of coal consumption in the city might be 10,000 tons for domestic consumption; 4,000 tons college use; 20,000 tons for industry, giving some 34,000 tons over all. Thus, the colleges at the ancient heart of the city were clearly responsible for some, but certainly not the major part, of the smoke pollution.

Air pollution does not appear to have been recognised as a major nuisance. The M.O.H. report for 1877 notes an increase of deaths from bronchitis and pneumonia, but makes no comment as to the causes of this. A far greater cause for concern over the late 19th century was the visual appearance and general nuisance of large industrial polluters, and the cramped and insalubrious housing provided for their workers. In 1897, Percy Dearmer complained that the vista greeting people arriving at Oxford station was '... a collection of gas-holders, coal-heaps, railway sidings … and obscene jerry buildings.' (quoted in Fasnacht, 1954). A contemporary view of the working class district of St Ebbes was a 'swamp converted into a cesspool'. (Crossley, 1979). In 1865 plans were drawn up by GWR to build a railway carriage works in Oxford, which met violent opposition on many grounds from the university and others. Potential air pollution nuisance seems to have been one concern. A letter to the local paper in 1865 from 'A citizen', responding to a letter from Professor Goldwin Smith, summarises the opposition thus: 'Some of our University authorities manifest great alarm at smoky chimneys and working men being brought within half a mile of this city. "Smoke" and "working men" … are two horrors not to come near "colleges and students"' (quoted in Graham, 1992, p.100). 'A citizen' went on to suggest: 'What if the atmosphere of Oxford were a little darkened by a few chimneys, when the wind blew from NW, if the social, commercial and perhaps the moral atmosphere were cleaned by the new element' (quoted in Graham, 1992, p.100). Opposition to smoke was just one facet of opposition to social and economic change within the university town. Finally, the plant was located in Swindon.

From the 1840s building in Oxford was almost overwhelmed by the Gothic revival with, once more, new college buildings being made to look like old ones. The Balliol range facing onto Broad Street built by Waterhouse in 1867-8 is a

classic example. Repairs and restorations were carried on amongst this rebuilding. The tower and spire of St Mary's Church were restored around 1853 in Milton Stone under the direction of Buckler. These were probably the first repairs since the tower was built in the 14th century, but they only lasted until 1893 when the tower had to be restored once more, this time by T.G. Jackson (Arkell, 1947, pp.66-7). The Emperors' Heads outside the Sheldonian Theatre were replaced by copies made in Milton Stone (or poor quality Headington freestone) in 1868. The originals carved in Headington freestone had lasted since 1669, but these copies had themselves to be replaced in 1970 with new ones carved in Clipsham Stone (Hibbert and Hibbert, 1988).

Contemporary observers were struck forcibly by the state of much of the stone. Nathaniel Hawthorne, in 1856, explains:

> 'How ancient is the aspect of these college quads! So gnawed by time as they are, so crumbly, so blackened. The quality of the stone has a great deal to do with the apparent antiquity … it … soon begins to crumble and decay superficially.'

Thus, bad stone rather than bad air was being blamed for building stone decay within the city. By the end of the nineteenth century another great period of refacing and restoration had begun, inspired by the work of T.G. Jackson and his use of the highly resistant Clipsham Stone.

OXFORD AROUND 1960

By the middle of the 20th century, Oxford's areal extent had increased dramatically (figure 1) and vast changes in industry had also occurred. The Oxford power station, in East Street by the River Thames, opened in 1892 and was a considerable source of nuisance until it closed in 1969. The last steam trains arrived in Oxford around 1965, thus removing a major source of air pollution in the form of shunting engines. By 1961 the population of Oxford was c. 106,000 – more than three times the population in the mid nineteenth century (figure 3). Twentieth century Oxford had also become an industrial city, with the Cowley based car industry employing 30 to 40% of the working population in 1947 (Gilbert, 1947). Echoing a general change in travel in Britain, car and bus traffic in the city centre also rose dramatically in the post- World War II years. The population increase and industrial development led to a large increase in building activity, especially in suburban areas. After the frenzy of refacing at the turn of the century, there was a decline in activity during the two world wars, but as in other cities the 1960s were boom years. In Oxford, for example, St Catherine's College was built between 1960 and 1964.

Over the first half of the twentieth century air pollution began to receive more serious attention. The Medical Officer of Health's annual reports during the 1930s note the number of occurrences (plus the length of time they lasted) of dense black smoke emissions from large domestic sources. The nuisance was

also felt to be partially visual. In 1948 Newman says, in a tirade against the gas works,

> '... the gas works and rail stations vie with each other for the honour of eradicating in every visitor's mind any impression of Oxford as a city of beauty and learning.'

This damning view must be compared with the more positive statements of the builder of the gas works who claimed:

> 'In designing the works special attention was devoted to making the buildings harmonize with the stonework of the various colleges.' (Eaton, 1928/9)

After World War II there were many nuisances, especially grit and smoke from the Power Station. In 1948 this problem was declared to be mainly because of the use of unsuitable and inferior fuel. During a 6 month period, 32 different types of fuel were delivered to the Power Station (M.O.H. Annual Report, 1948). An aged gas works with old fashioned retorts was also seen to be a problem, and the nearby area of St Ebbe's had the most marked smoke nuisance in the 1950s. In comparison with other towns the M.O.H. Annual Report for 1950 claims:

> 'While there doesn't seem to be any great problem in this respect existing in the city, there are 66 boiler house plants within the city...'

The modern Cowley car works posed no smoke problem; and generally industrial pollution was low in Oxford compared with many other British towns. Smoke and sulphur dioxide monitoring began in the city in November 1953, initially at eight sites, and the first Smoke Control Area of c.173 acres was established on 1st November 1958. Moves were afoot to establish Smoke Control areas before the Clean Air Act of 1956 under the Oxford Corporation Act of 1953.

It is interesting that, despite the major sources of air pollution and smoke nuisance being to the west of the city around St Ebbe's, the first major Smoke Control area (and its extension in 1962) was in the university heartland. This was partly for practical reasons, given the difficulties of industrial smoke abatement, and the future plans for the redevelopment of St Ebbe's, but must also have had some strategic value given the historical importance of the university centre. Indeed, the M.O.H. Annual Report for 1953 in its section on air pollution notes 'There is, undoubtedly, a considerable deterioration of stonework among the irreplaceable and historic buildings of the university and old city areas'. Beckinsale and Combey (1958, p. 185) make a more explicit link, saying:

> 'At first sight it may appear that the prime advantage of smokeless zones would be the prolongation of the life of stone masonry and paintwork in Oxford...'

They suggest that health would also be indirectly improved as brighter façades and less smoke would produce an air of brightness, with less fog and dirt.

It is clear that air pollution was not the sole cause of the sorry state of much Oxford stone by the middle of the 20th century. The susceptible nature of

PLATE 1. Badly decayed Headington freestone from Christ Church libary, photographed by J.W. Thomas for the Oxford Historic Buildings Fund

Headington freestone has previously been mentioned, but problems were exacerbated by a fashion for covering walls in creepers, repairing with Roman Cement, and a lack of maintenance during the two world wars. Much stonework was extremely badly damaged, as is evidenced by the photos in Oakeshott (1975). College archives also reveal widespread decay. Knowles and Son, local builders, reported in January 1958 to the bursar of Hertford College that on the Principal's Lodging, out of 96 balusters only 6 were sound, and the ashlar panels and plinth supporting them were also rapidly decaying.

Over the 1950s the university played an important role in the development of air pollution controls, paying for four out of the eight sulphur dioxide monitors and establishing, for some years, a Volumetric Daily Recorder at the School of Geography. The Inorganic Chemistry Department carried out chemical analyses for the air pollution survey, and the university's Radcliffe Meteorological Station provided meteorological data. The measured trends of smoke and sulphur dioxide over the 1950s and 1960s are shown in Figure 4. These trends may be accounted for by changing fuel use. Coal consumption within the city centre plummeted, from over 500 tons per annum in the winter of 1953/4 to less than 400 tons per year in 1956. Detailed records for Exeter College, one of the buildings in the central area, show the trend most forcefully (Figure 5).

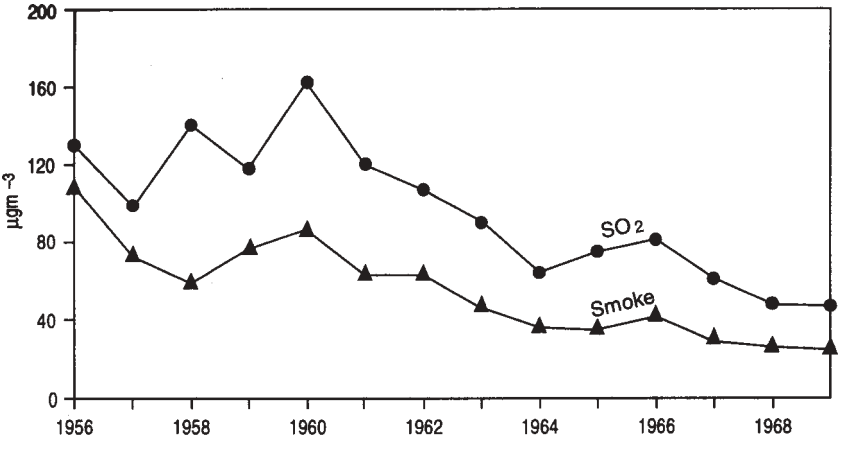

FIGURE 4. Mean annual smoke and sulphur dioxide concentration (in μgm^{-3}) in central Oxford, 1956-1969

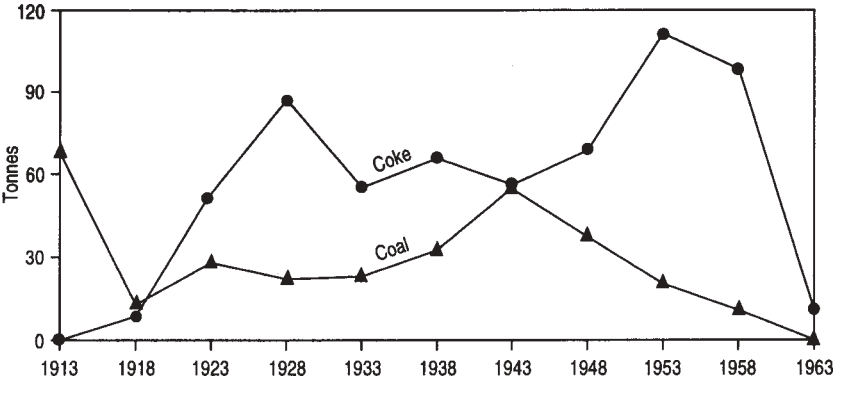

FIGURE 5. Coal and coke used in public rooms, Exeter College, 1913-1963. Data from Exeter College Archives.

Scientific and public attention was also being drawn to the state of Oxford stone in relation to its inherent quality and air pollution. Robert Beckinsale, a geographer in the university, combined with the Chief Public Health Inspector in 1958 to write a paper for the National Society for Clean Air on the smoke problem in Oxford, its solution and its relation to stone decay. Another scientist, Dr E.J. Bowen, in the university Physical Chemistry Department, was involved in experimental work on stone decay, and took seismographical readings at

University College to illustrate the vibrational effects of heavy lorries. The geologist, W.J. Arkell contributed much scholarly insight to the problem of the nature of stone decay experienced by different stones (e.g. Arkell, 1947). In June 1957 the first appeal for money to repair pre-1800 university stone buildings was launched by the newly formed Oxford Historic Buildings Fund (O.H.B.F.). The appeal document focuses on the peculiar problems posed by Headington freestone as the major reasons for the advanced state of stone decay, but acknowledges that 'By far the commonest type of decay in Oxford is 'blistering' by chemical action. Sulphur dioxide from the air reacts with the stone to form a 'skin' of gypsum'. (O.H.B.F. Appeal, 1957, p.7). The document also stresses the importance of applying 'all the scientific knowledge of the art of building which we now have the good fortune to possess' (p.8). The O.H.B.F. Appeal raised £2,400,000 and paid for a huge number of restorations between 1957 and the late 1960s. The 11th Annual Report in 1969 notes:

> 'A cleaned quadrangle is always more spacious than a dirty quadrangle, and the sense of space and light which has come to Oxford as a result of what has been done, has to be seen to be believed.'

CONCLUSIONS

In tracing what evidence there is on the history of air pollution and building stone decay in Oxford I have been struck forcibly by a number of themes. There has long been an overall desire to 'conserve' and protect the city centre, but often this has involved major refacing and 'restorations'. Thus, we see fashion reflected, rather more than the true state of decay, in the repair trends of many buildings. For most of the 19th century stone decay was blamed on 'bad stone', whereas 'bad air' was not perceived to be a major problem. Air pollution, especially in the context of major industrial polluters also opposed on aesthetic grounds, did not really become a well-articulated focus of public concern until the 1950s at which time it was explicitly linked with stone decay problems. Whether or not building stone decay on the historic monuments of Oxford was actually caused by 'self-fouling' (Beckinsale and Combey, 1958) from college chimneys, or by industrial emissions from the west of the city has not been satisfactorily proven, but both viewpoints provided a convenient weapon in the air pollution debate. This enabled concern over air pollution to be combined with an already vociferous movement for the preservation of the city centre. It is my contention that the decay of historical monuments and buildings provided a useful focus, backed up by a welter of scientific information from university scientists, for the smoke control movement in a city with relatively low air pollution levels, at a time when 'modernist' ideas of cleaning and renewal held sway. This represents a forceful conjunction of scientific and aesthetic ideas which had very practical results.

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