The International Journal of Museum Management and Curatorship (1989), *8*, 369–387

Working Exhibits and the Destruction of Evidence in the Science Museum

PETER ROBERT MANN

The purpose of this article is to try to explain why it is that so many curators of technical artefacts, particularly transport artefacts, subscribe to the ethic of the museum profession that their duty is to preserve evidence, yet devote much of their professional lives to the destruction of that evidence. Why is it that a thoughtful and dedicated curator such as John Hallam, in his paper in the Museum Association's *Manual of Curatorship*, should accept that a museum is a 'collection of artefacts assembled for preservation as evidence of man's material culture and environment' and then devote 8000 words to exploring various ways in which artefacts may be restored, modified, worn out through operation and otherwise compromised, so that little uncorrupted evidence remains to be placed before the public?[1] And all without a trace of irony. The paper is in fact excellent, and one with which few technical curators would take exception.

Are such curators dishonest, thoughtless and uncaring? Are they schizophrenic? Or is it that the dominant ethic of the profession is in fact inappropriate to technical artefacts and that they are intuitively acting out a more appropriate, though unexpressed, ethic which has yet to be defined?

The question of whether museum objects should be demonstrated is one which is a constant source of debate both inside and outside the museum profession. There are those who take a conservative view: since the purpose of a museum is the preservation of material evidence it must be wrong to compromise that evidence by wearing out artefacts through operation. At the other end of the spectrum are a few curators of car collections who insist that the best way to preserve a car is to maintain it in good working order and run it regularly. In the middle are the generality of technical museums all of which demonstrate artefacts to a greater or lesser extent. Such divergent views cannot be reconciled. An analysis of the arguments shows that the reason the debate is invariably fruitless is because the protagonists fail to recognize that they start from different assumptions and work towards different objectives. An historical survey of the policy and practice of sectioning and operating artefacts in the Science Museum, London, serves to clarify these issues. It shows how the sectioning and operating of artefacts can be justified, but only by rejecting the dominant ethic of the museum profession.

The Conservative View

The underlying ethic of the museum profession is that the primary objective of a museum is the preservation of material evidence, which may then be exploited in a variety of ways for the public benefit. Since such preservation of evidence is the primary objective, it follows that any exploitation of the artefact should not compromise that evidence.

0260-4779/89/04 0369–19 $03.00

Clearly, sectioning an artefact, or wearing it out through operation, must compromise the evidence and hence cannot be allowed. It is a concise, logical argument. However, it rests on the belief that the primary objective is indeed the preservation of material evidence and on the assumption that the only evidence in the artefact is of a material nature. If either primary objective or assumption were changed then it would be necessary to modify the conservative ethic which results.

The Working View

It may seem implausible at first that some curators should believe that operating cars preserves them, so let us see how this comes about. It is a fact that museums have often allowed their cars to deteriorate on exhibition or in store through simple lack of care and attention. Private individuals who run their own old cars point out that theirs are in better condition than those in museums and conclude that running cars helps to preserve them. This conclusion is false. What in fact is going on is that the decision to run a car necessitates the application of sufficient resources to keep the car in good enough condition for it to be run. If equivalent resources were put into conserving a car in static condition it would in fact preserve the originality and evidential value of the car far longer than would be the case for the running car with all the attendant maintenance, repair and substitution of parts. Running a car concentrates the mind on keeping the car running but not on conserving the car. What the protagonist of running cars is really saying is that if your objective is to run a car then the best way to keep the car in running order is to maintain it in running order. The running of the car has become of more importance than the preservation of its originality and its value as material evidence. It would seem, therefore, that the primary objective has changed, though in a way which is as yet unclear. Equally, it would seem that there has been some change in the underlying assumption of the object as material evidence. By the end of this article I hope to make plain these changes in assumption and objective.

Few curators hold such a strong working view, but those who operate objects all share it to some degree. And since they also tend to believe in the importance of the preservation of evidence it is not surprising that there is confusion in their minds, that they are unable to explain their position even to themselves, and that those holding the conservative view fail to understand them. This leads technical curators into the most improbable justifications for their behaviour.

The view that the best way to preserve a car is to maintain it in good working order and to run it regularly is incorrect. Let us be quite clear that working any machine causes wear and tear which requires maintenance, repair and substitution of new parts to keep it running. It may happen imperceptibly, it may happen rapidly and catastrophically. Either way, the originality and evidential value of the artefact are compromised, and no amount of justification and rationalization can alter that.

Justifications

Technical curators, particularly transport curators, become defensive when taxed with the problem of the destruction of evidence. They know instinctively that what they are doing is in some way wrong, but equally they feel that there is something instructive, inspirational or, at the very least, just plain fun in people being able to see old machinery working. They adopt a variety of defensive strategies to paper over the cracks and say: the wear, degradation and other risks are actually very small; we always replace with

original parts or with parts made to the original pattern and the right type of materials; we keep records of everything we do and keep all the original parts when they are removed; operating objects in museums is only a natural extension of their original working life and hence causes no ethical problems; operating objects is the best way of preserving them. These answers are all unsatisfactory as they make no attempt to address the basic problem of the destruction of evidence. In reality what they are is a series of rationalizations to help technical curators cope with the guilt of the destruction of evidence. Since they fail to address the problem itself, they fail to satisfy the logic of the conservative view and leave even those holding the working view feeling uneasy.

Those who take the conservative view sometimes suggest that the answer for newly acquired objects is to acquire two specimens, one to lay down as an archival specimen and one to operate; for old objects the answer is to make a reproduction to operate. Such suggestions are usually rejected by technical curators on the grounds of the cost and space of duplicating objects, and a feeling that a reproduction is no substitute for the 'real thing'; but also because they have an instinctive feeling which they cannot or dare not express, that operating objects is in some way more important than preserving them.

I have lumped sectioning and working together as if they were equal in the destruction of evidence. In fact their effects are slightly different. Sectioning is usually a unique event. There is therefore time to work out in advance what part of the artefact is to be removed so as to control the amount of destruction involved. In the case of working a machine, a series of ad hoc decisions must be made throughout the period of operation as to whether to carry on modifying the machine in order to keep it running. The process is cumulative and inexorable. Whilst nominally under the curator's control it is all too easy to end up with a completely reproduction machine and a large box of worn out 'original' parts.

Science Museum Policy on Working Exhibits

Let us now look at the policy and practice of the Science Museum in addressing these problems to see what light it can throw on the assumptions and objectives of technical museums.

The Departmental Committee on the Science Museum (better known as the Bell Committee after its Chairman Sir Hugh Bell) reported in 1911 and 1912. The recommendations of this committee, actively pursued by successive directors, were the mainspring of policy in the Science Museum between the wars, and the general outline of those policies is still with us today. The Science Museum had working exhibits before the Bell Report, but the approval of the Report enshrined the technique as a necessary part of the interpretive process:

> In the Machinery Division of the Museum many of the objects have been arranged so that the visitor may examine internal details of construction and study moving parts in successive positions . . . Such methods of exhibition are most efficacious, and when well devised they greatly increase the educational value of the objects . . . They ought to be applied so far as possible throughout the collections.[2]

This was immediately echoed in the 1913 Annual Report[3] (perhaps not surprisingly as Sir Hugh Bell became the first Chairman of the Advisory Council), and succeeding Annual Reports give ample evidence that the museum was eager to extend the policy of sectioning and working objects.[4] Nor were the science collections immune to this desire to make things work. In 1934:

> The second feature of the modern plan which has a direct bearing on Division IV [Astronomy, Mathematics, Chemistry, Optics, etc.] is an attempt to make the exhibits dynamic rather than static, to employ all the resources of power and art to make exhibits attractive, self-active or operable at will.[5]

When the advisory Council was reconstituted in 1951 it began a major review of policy in the Science Museum. As part of this process a paragraph-by-paragraph analysis was carried out of the Bell Report 40 years after its publication. Commenting on the paragraph about working exhibits quoted at the beginning of this section it reported that:

> This principle has been generally applied as far as possible and nothing is placed in the collections without consideration of the possibility of increasing the instructiveness by making it work.[6]

This review of policy appeared as an appendix to the Advisory Council Report for 1952 entitled *Report on the Policy of the Science Museum* and recommended an extension of the practice of working demonstrations:

> (iv) *Active and static displays.* The essential characteristic of the laboratory, workshop or factory is *change* . . . Museums on the other hand are traditionally static . . . but it ought to be considered whether more opportunities should not be afforded for visitors to see the real thing being done. The active display is very much more attractive to visitors of what ever type than the static . . . .[7]

The Report went on to survey the methods by which this could be achieved. Subsequent Annual Reports continued to record new exhibits which were sectioned or working. Presumably it was axiomatic that the technique was followed and no specific justification was thought necessary even when the museum started entering cars in the Brighton Run in 1954 and steaming locomotives in 1975.

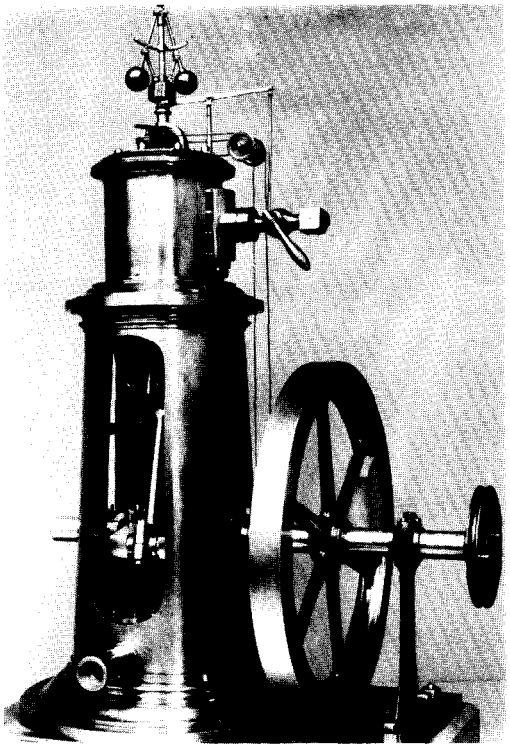
What the Annual Reports show is that the Science Museum has had a consistent and repeatedly expressed policy of wanting to section and operate objects. The purpose of this policy was to make the objects in the museum more understandable to the visitors.

Science Museum Practice in Working Exhibits

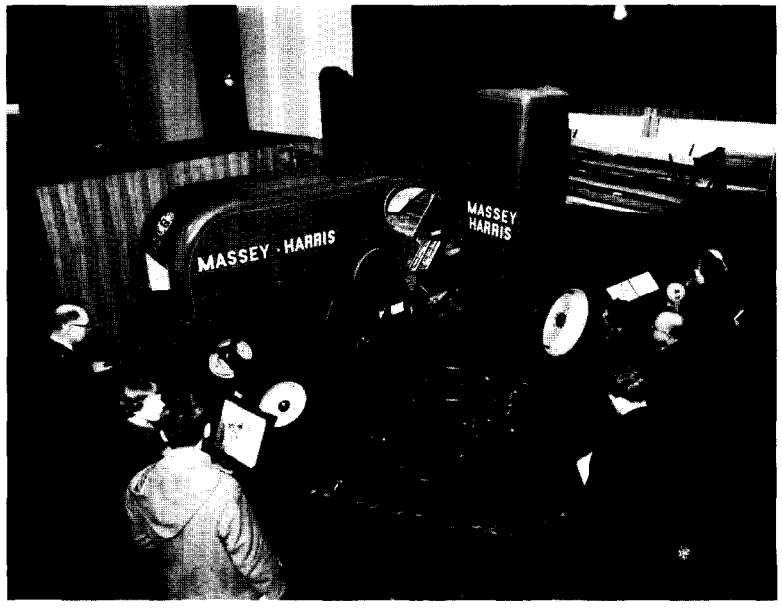
It is not known when the Science Museum first sectioned an artefact or operated a working exhibit, but certainly the practice was started before the Bell Report enshrined it as an act of policy. Dickinson regarded the appointment of W. I. Last in 1890 to the post of Keeper of the Machinery and Inventions Division as:

> . . . the dawn of the third period in museum technique that I have mentioned, that of making a museum a living institution by such arrangements that the whole public can be made to understand what they see and derive educational advantage from a visit, arrangements contemptuously stigmatised by superior persons as 'making the wheels go round'.[8]

In conducting the following survey of working exhibits in the Science Museum I have tried to use as examples artefacts which are clearly 'real full-sized' objects rather than models or reproductions. I do not intend to engage in a discussion of whether a contemporary model is a 'real' object which must be preserved at all cost, or whether it can be regarded merely as an ephemeral piece of display material. It is irrelevant to this discussion except in determining the number of objects being operated. If a model is not



Maudslay vertical engine, 1862



Sectioned and operating combine harvester in the Agriculture Gallery in 1956.

a 'real' object it does not matter; if it is a 'real' object it can be treated as part of the discussion of 'real' objects.

The 1914 Annual Report stated that in the Machinery and Inventions Division there were 184 working objects, in the Naval Division 91, whereas in the Scientific Apparatus

Division there were only 49.[9] An indication of the nature of the 250 or more working objects in the engineering collections can be obtained from the catalogues of these collections where the entries identify most, but not all, of the working exhibits. Thus the 3109 catalogue numbers contained 1086 'real full-sized' objects, of which 33 were working and 65 were sectioned, and 182 working models.[10] In other words, 10 percent of the 'real, full-sized objects' were working or sectioned, and nearly 7 percent of all objects were working. Unfortunately, the science catalogues do not systematically record which objects were working[11] so that it is not possible to identify from these catalogues the 49 working objects noted in the 1914 Annual Report.

Most of the working objects were engines and pumps, for example an 1862 Maudslay vertical engine (still working in the East Hall) and an 1860 Lenoir gas engine (no longer working), but they also included an 1863 Glover dry gas meter (still on exhibition but not working), and an 1864 Holtzapfel ornamental turning lathe. The sectioned objects included a 1906 Dursley–Pedersen cycle gear, an 1858 Giffard locomotive injector, a *c.*1894 Miller's apparatus for purifying gold, and an 1897 Singer lock-stitch sewing-machine.

As the years passed, the sectioning and working of objects broadened out into new areas of the collections. Radio demonstrations were proving very popular in 1927;[12] cine projectors, stroboscopes, zootropes were working in 1929;[13] an 1810 handloom for weaving silk was being demonstrated in 1931;[14] in 1932 five ophthalmic instruments were arranged so as to be seen in operation[15] and a polarizing microscope and strain-viewer in 1935;[16] the same year an early postal franking machine in the mathematics collection went into operation;[17] twenty working exhibits were to go into the new Illumination Gallery in 1938;[18] a sectioned and working combine-harvester was the centrepiece of the new Agriculture Gallery in 1951;[19] the same year saw the operation of a Geiger counter[20] and a Dines anemometer.[21]

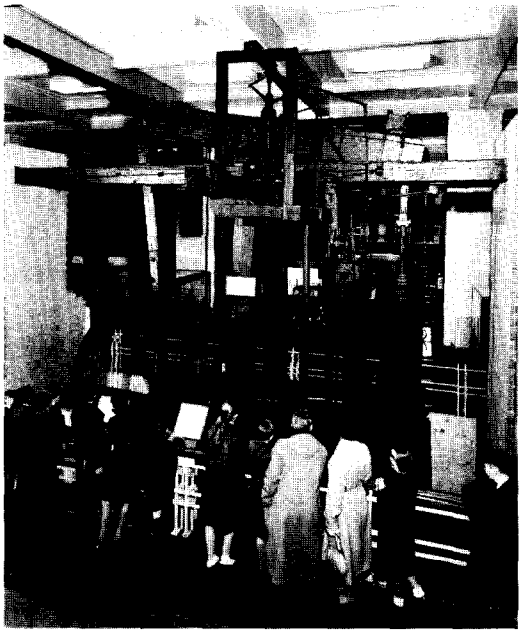
Many of these objects would have been operating under light loads and perhaps would be more accurately described as moving rather than working. However, vehicles are invariably highly stressed when working and it was not long before they too were being operated. In 1936 the 1888 Benz car was put into working order and demonstrated in the museum grounds and at the start of the Brighton Run (it did not take part in the run itself).[22] In 1939 nine horse-drawn carriages went to the Jubilee Show of the Royal Agricultural Society in Windsor Great Park[23] of which four paraded.[24] The 1902 Ivel tractor led the procession of tractors around the Grand Ring at the Royal Show at Cambridge in 1951.[25] The 1903 Wolseley became in 1954 the first car entered in the Brighton Run by the Science Museum.[26]

For the 65 years in which Reports were issued, in the period 1912 to 1983, there were an average of 4.42 mentions per year of sectioned or working exhibits (excluding those objects which were definitely not 'real full-sized' objects).

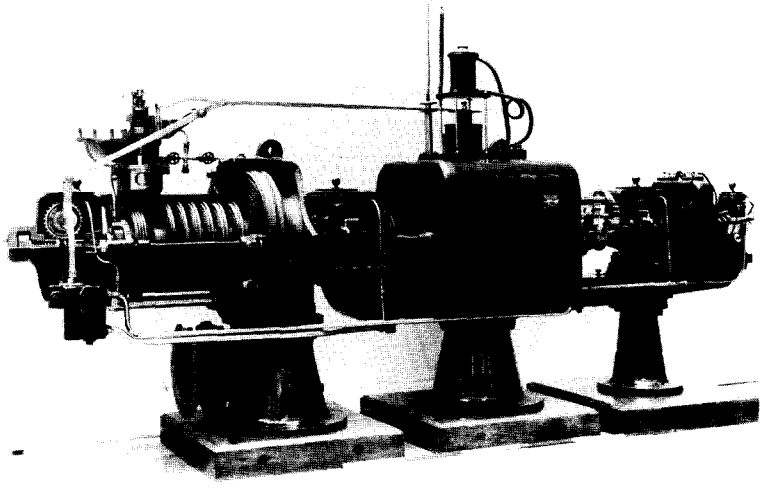
It had been my original hope to estimate the number of objects which are currently sectioned or operating in the Science Museum but it became clear that this was unrealistic. Such a survey must await the future completion of the computerized catalogue. However, it would be true to say that every gallery contains sectioned or working exhibits, and the Public Services Division are only too aware that each new exhibition brings with it new demands from curators for yet more sectioned and operating objects. There is certainly sufficient evidence to say that the museum's stated policy of sectioning and operating objects has been put into effect. Only the shortage of resources has prevented its even wider use.[27]

The Price to be Paid

If it is necessary to section and operate artefacts to explain how things work then the Science Museum has shown that it is prepared to pay the price of the destruction of evidence which inevitably results. But are there any bounds to the price it is prepared to pay? Is the museum prepared to sacrifice prime objects, or only those of lesser significance? Is it prepared to completely destroy an artefact, or allow only a limited degradation? Is there an unacceptable level of risk (for example the crashing of an aircraft



Demonstration of the 1797 Boulton and Watt rotative engine in the East Hall in 1963.



Parsons 1891 radial flow, steam turbine, sectioned at the museum's request in 1924 (see Note 31).

may be a rare event but the consequences are catastrophic, whereas crashing a car may be more likely but the consequences less serious)? Is it prepared to section and operate old objects, or only those newly manufactured or newly acquired? These questions are explored by looking further at the practice of the museum.

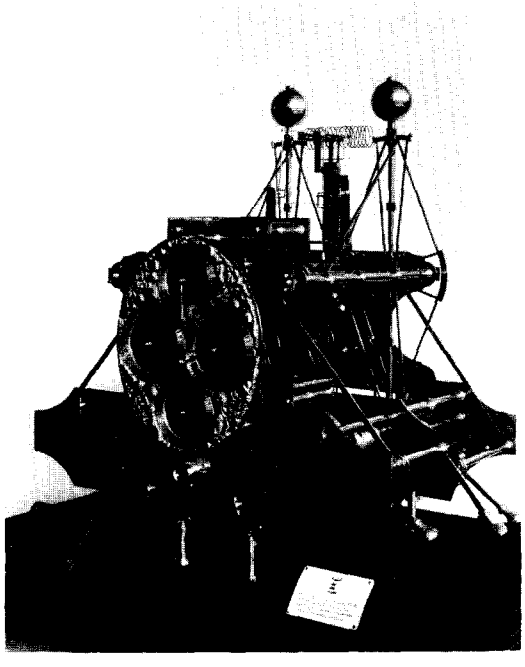
Prime Objects

If the Science Museum were concerned about the destruction of evidence it might be expected to exclude those it regarded as prime objects. However, it is not obvious that this has been the case. The prime objects which have been sectioned or operated include the 1797 Boulton and Watt engine, the Parsons turbines, all four Harrison chronometers and the 1888 Benz car.

In 1924, erection of the engines in the new East Hall began, 'one at least of which will shortly be arranged so that it can be seen in motion'.[28] By 1927 the 1797 Boulton and Watt engine had been motorized,[29] and in 1936 the museum was proud to record that it had been operated during the Watt bicentenary exhibition and that its operating sound had been radioed across the Atlantic to the Franklin Institute in Philadelphia, who reported that it could be heard quite clearly.[30] The periodic demonstration of this engine has remained a feature of the East Hall ever since.

The Parsons steam turbines involved sectioning rather than operation. In 1927 the museum acquired the radial flow steam turbine originally fitted in 1894 to Turbinia. Although replaced by an axial flow turbine in 1896, it was nevertheless the first steam turbine to power a ship, and is shown sectioned in the Marine Engineering Gallery.[31]

From 1924 the Science Museum made repeated efforts to acquire on loan from the Lords Commissioners of the Admiralty the four chronometers designed and constructed by John Harrison between the years 1728 and 1759, which he made to win the £20,000 prize offered by the government for a timekeeper of sufficient accuracy to determine



Harrison's first chronometer, completed in 1735, was restored to working order in 1934 or 1935 and is now in the National Maritime Museum.

The 1888 Benz crossing Westminster Bridge shortly after the start of the 1957 Brighton Run. Big Ben shows a time of 07.05 showing that the Benz was allowed to start an hour before all the other cars. It was driven by C. F. Caunter, Assistant Keeper in charge of the Road Transport Collection.

longitude at sea. The chronometers had not been working for over 100 years when Lt Cdr R. T. Gould began in 1920 to clean and overhaul them. The Science Museum acquired them all on loan—No. 2 in 1925, No. 3 in 1932, Nos 1 and 4 in 1935—and all four were exhibited in operation until they were sent to the recently opened National Maritime Museum at Greenwich in June 1936.[32] Three of the four were again in the Science Museum in 1952 for the special exhibition *The British Clockmakers' Heritage*, and two were kept in operation throughout the exhibition.[33]

The 1888 Benz car is the oldest car in this country and the only survivor of the first production batch of cars. It was acquired in 1913 in a rusty and dilapidated condition, although E. A. Forward seems to have carried out a trial run at that time. In 1936 the car was driven to Hyde Park for the start of the Brighton Run, although it did not take part in the run itself. Forward also gave a few demonstration runs in Exhibition Road but was clearly of the opinion that it should not attempt extended runs.[34] However, in 1957 the car was restored and entered in the Brighton Run. In the event, the car ran out of petrol and crashed into an MG saloon at some traffic lights at Purley, breaking the front fork of the Benz. With the brakes fully applied the car was still travelling at 10 mph on a wet, downhill road.[35] The car was repaired and had an additional band brake fitted to the transmission for the 1958 run. This time the car completed the run, but even so was involved in a slight accident when manoeuvring at 2 mph between two lines of traffic at Crawley. For safety reasons the car had to be manhandled down the steeper slopes.[36]

Acceptable Levels of Risk and Destruction

The purpose of the preceding section was simply to establish that the Science Museum does section and operate prime objects, rather than to record any loss of evidence which

The end of the 1957 Brighton Run for the 1888 Benz. Figure prepared from a series of five photographs published in *Autosport*.

may result from so doing. But what levels of degradation do occur and how likely is it to occur?

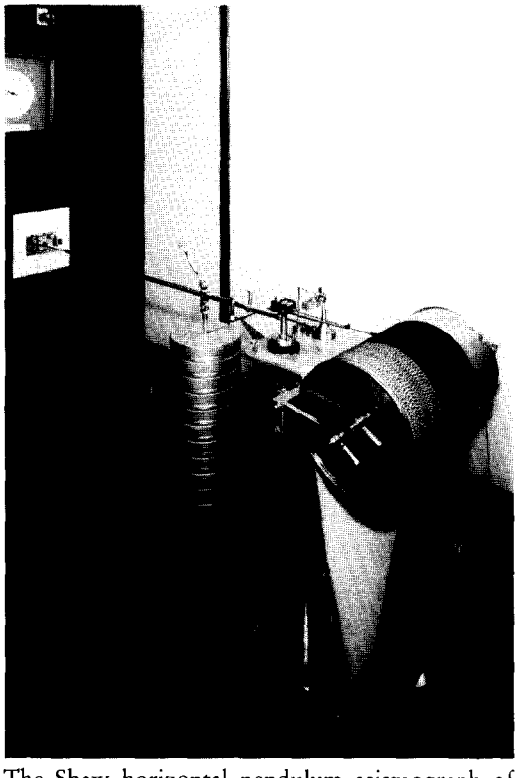
Significant cumulative degradation is quite common, but catastrophic destruction comparatively rare. Cumulative degradation occurs as a result of wear or as a result of modification, and both usually take place over a long period of time. The wear itself may amount to significant degradation even if all the component parts are still original to the artefact. And, in an attempt to reduce further wear, the artefact may be modified and parts replaced. Cumulative degradation through modification may occur even without wear in order to improve the reliability of repeatability of a demonstration by an artefact whose operation is only marginally satisfactory.

A good example of such modification is that of the horizontal pendulum seismograph built by J. J. Shaw and installed in Gallery 45 in 1935. With the exception of some of the clocks, this may well be the object with the longest record of operation in the museum. In order for the seismograph record to include a timing signal it had to be supplied with timing signals from another working exhibit in the Time Measurement Gallery, the Shortt free pendulum clock which was acquired in the same year and which controlled the public clocks in the East Block.[37] Although comprehensive records are not available, it would seem that the seismograph was modified on at least five occasions in order to improve its accuracy, reliability and sensitivity.[38] The then curator Dr McConnell, in

recommending a new pen and ink recording system in 1983 wrote, 'the original Shaw seismograph has already been so considerably modified over the years that little of the original remains. Its value lies rather in its demonstration function.'[39] After being out of action for several years the seismograph has been modified again and is now back in operation. The importance which the museum attaches to this working exhibit is indicated by the frequent references in the Annual Reports to the public and media interest in its recording of major earthquakes.[40]

Degradation through straightforward wear (though accelerated by poor design) is shown by the motorized, sectioned Coventry-Climax portable fire-pump which has been operating continuously in the Firefighting Gallery since 1966. By 1982, in the absence of any lubrication, the cam lobes had been severely scored and the faces of the cam-followers gouged out to a depth of 3 mm. This was no doubt aggravated by the chromium plating (applied by the manufacturer in preparing the engine for exhibition) breaking up and acting as a grinding paste. In order to keep the engine and pump running, a new camshaft and new followers were substituted and the engine modified so that it could be continuously lubricated.[41]

The catastrophic destruction of an artefact through operation is comparatively rare. However, the Science Museum has been associated with one case, the Bristol Bulldog aircraft, which is something of a cause celebre in the transport museum world. In 1939 The Bristol Aeroplane Co. Ltd presented the Science Museum with a 1931 Bristol



The Shaw horizontal pendulum seismograph of 1935. The photograph was taken in 1976 and seven years later it was said that little of the original remained.

The 1885 Isaac Roberts twin equatorial telescope was in store for 20 years before being overhauled for use at Herstmonceux. It was used there for four years before installation in the Science Museum's observatory.

Bulldog aircraft, then one of the standard single-seat fighters of the RAF. After being displayed for a short time, it went into store for the duration of the war but remained there after the war was over. In 1956 Bristol wrote saying that they would like to include the aircraft, which appeared to be the only one surviving, in an historical display they were planning for Bristol's 50th anniversary in 1960. In return for its loan they offered to put the aeroplane into a fully airworthy condition, and the museum agreed. Progress on restoring the aircraft was rather slow but on 21 April 1961 the museum gave permission for it to be flown. The following month the museum decided to submit it to a Board of Survey for returning to the donor because 'The Bulldog is not required . . . for exhibition in the foreseeable future, and is not of such historical or technical significance that it should remain in the Museum store . . .' and in June Bristol were duly advised that the aircraft was again their property.[42] After passing its test flight satisfactorily Bristol presented the aircraft to the Shuttleworth Trust. On Sunday 13 September 1964 it crashed at the Farnborough air show when its engine failed to pick up after a loop, and struck some fencing, the aircraft turning over. The pilot was later reported to be comfortable in hospital but the Bulldog suffered irreparable damage.[43] The aircraft has never been rebuilt and the pieces are reputed to be housed by Shuttleworth and the RAF Museum. The fact that it was not still a Science Museum object at the time of the crash is simply a matter of timing.

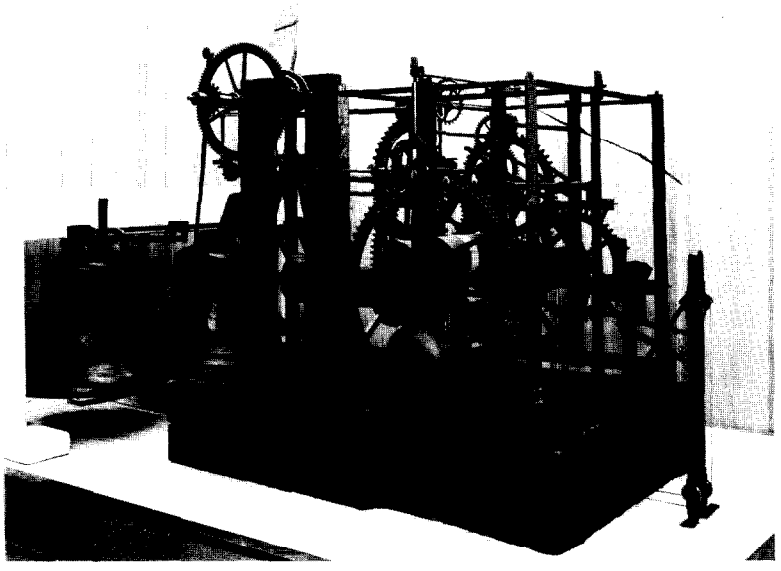
Old Objects

It is often the case that people take a different view of the sectioning or operation of a newly made object as opposed to an 'old, historical' object. If I were to section a new Rolls-Royce car for display it would be regarded as a first-class way of obtaining an interesting and informative technical exhibit. But if I were to section our 1904 Rolls-Royce which has been in the museum since 1935, there would be howls of rage at this wanton destruction. It might be expected, therefore, that the museum would not section or operate an object which was already regarded as old. It may well be the case that the museum is reluctant to section objects which have been in its possession for some time. Unfortunately, it is difficult to test this as it is actually quite difficult to find out when many of our objects were sectioned. Certainly the museum has no compunction about sectioning and operating objects which are old at the time of acquisition. Nor does it have any compunction about starting to operate old objects which have already been in its possession for some time without previously being operated.

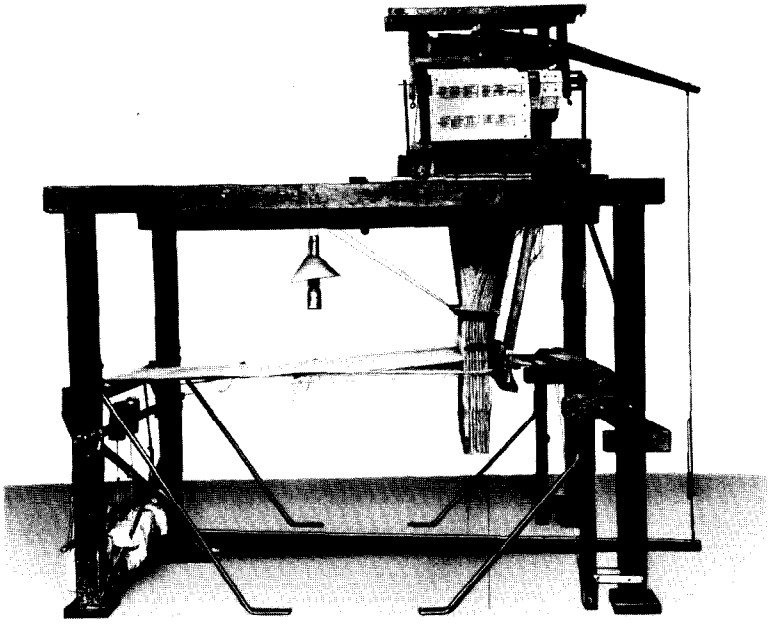
As an example of an old object being put back into service on arrival at the museum, nothing could be better than the Wells Cathedral clock. It is certainly the object with the longest period of operation, both in the outside world before coming to the museum and also since arriving there. It is:

> . . . the second oldest surviving clock in England and was probably already in use by 1392. It continued in use until 1835, when it was replaced by a modern one, and the old movement was removed to the crypt of the Cathedral. In 1871 it was lent to the Patent Office Museum . . . [transferred to the Science Museum with the Patent Office Museum in 1884] . . . and the clock has since been on public exhibition in working order.[44]

The present curator Dr Vaughan says that about 1984 one of the pinions was replaced and another is now so worn that the clock keeps stopping. A decision will shortly need to be taken as to whether to carry on replacing worn pinions or to finally retire the clock.



Photographed here in 1969, the Wells Cathedral clock is the oldest working exhibit in the museum and may soon have to be retired.



Handloom with Jacquard mechanism for silk weaving, made by Guillotte of Spitalfields, about 1810.

Other old objects in the science collections have also been put back into operation. The museum has a number of fine dividing engines, at least three of which have been operated since being acquired. Two came from A. J. Bennett, one believed to have been made by John Troughton in 1778 by copying Ramsden's engine of 1777 and put on exhibition in Gallery 42 in working order (though probably operated only by special request) in 1935, and another Ramsden-type engine which contributed to the war effort when it was lent to its donor in 1942 who used it to produce upwards of 2000 sextants for the

Admiralty.[45] The third to be operated was a *c.*1895 Cooke circular dividing engine acquired from its makers, put into operation in 1954, and still under push-button operation in the Mathematics and Computing Gallery.[46]

Another of the museum's scientific instruments to go back into service was the 1885 Isaac Roberts twin equatorial telescope. This had been purchased in 1936 and then stored in a number of packing-cases without being exhibited. When it was realized that the new observatory domes at Herstmonceux would be ready before the telescopes, the Royal Greenwich Observatory asked to borrow our telescope. In recommending the loan H. R. Calvert wrote, 'It will have the advantage that the telescope will be overhauled and put into working order so that it will be ready for use in our own observatory if we can get nothing better'. The telescope was collected on 24 September 1956, installed by August 1957, arrived back at the museum on 4 July 1961, and was assembled in our observatory by 30 November 1961.[47] It was used in the museum for the first time in May 1963.[48]

Some of the oldest objects to be operated were textile machines. None seems to have been used before the First World War, and immediately after the war the collection was in store, although a catalogue was produced in 1921.[49] In 1928 the collection came out of store for exhibition in Gallery 24 of the new East Block,[50] and the first to be demonstrated may have been an 1810 handloom for weaving silk in 1931.[51] The gallery was reopened to the public after the Second World War in early 1947[52] and, by 1957, 27 of the machines could be demonstrated.[53] Among the oldest to be demonstrated were an 18th-century manual stocking-frame and a 1796 hand rib-knitting machine, first demonstrated in 1958 and 1961 respectively.[54] This paper could have been written almost entirely around the many proud references to the working of textile machinery contained in the Annual Reports.[55]

The Science Museum Today

The Science Museum has probably been operating objects longer than any other museum in the world. What this survey shows is that, broadly speaking, the sectioning and working of artefacts has always been part of the Science Museum, that this was a deliberate act of policy of which the museum was proud and sought to extend, that although most prevalent in the engineering collections it involved all parts of the museum. Every gallery in the Science Museum now has sectioned or working exhibits of one kind or another. This has been done with the specific intention of making the objects more understandable to the public. In other words, it is an interpretive technique to improve the exploitation of the artefacts for the public benefit. Whilst the museum could suddenly decide it is no longer going to section or operate artefacts, in reality it is almost inconceivable that the museum could now turn its back on this method of display.

As the Science Museum has so much experience of running objects it might be reasonable to suppose that it would have come to terms with the problems which this undoubtedly causes. But this turns out not to be the case. The museum runs an apparently random assortment of new, old and prime objects. It allows cumulative damage to occur until any sense of originality or evidential value is negated. That this is comparatively rare is only because of the shortage of the resources to do it more often, and because for many objects it takes many decades of operation to achieve significant degradation. That there have been so few cases of catastrophic destruction may simply be due to the lack of resources to demonstrate the type of object potentially susceptible to such catastrophes.

There are two reasons for the apparently random way in which objects are used and for the absence of any guidelines governing their use. Firstly, the Science Museum's curators have very individual responsibilities and act largely independently of each other. Whilst they do talk to each other, overall policies are very difficult to obtain. When the question comes to be asked, if it ever does, as to whether a particular object should be kept running or pensioned off, it is always faced by an individual curator who may never have faced the problem before, and who may be trying to account for the first time for the actions of several generations of curators. Secondly, nobody has ever identified, or faced up to, the central paradox of the technical museum: the need to preserve evidence and the need to demonstrate objects. The result is a basic uncertainty as to what is the correct, or even what is the most reasonable, course of action to follow. So let us look again at this central paradox.

Towards a New Ethic for Technical Museums

As far as I am aware, the Science Museum has never stated as policy that it subscribes to the dominant ethic of the museum profession that the primary objective of the museum is the preservation of material evidence. However, in talking to Science Museum curators whose experience goes back 35 years it is clear that individual curators do subscribe to that ethic. I have no reason to doubt that pre-war curators also subscribed to that view. It is after all self-evident that we are in the preservation business; we acquire and keep artefacts which are undeniably material evidence of the cultures that produce them.

Why then has the Science Museum devoted so much of its resources to the destruction of evidence through the sectioning and working of artefacts? The answer is that, whilst paying lip-service to the dominant museum ethic, the Science Museum is in fact acting out a more appropriate, though unexpressed, ethic for technical museums. That more appropriate ethic is that the primary objective of a technical museum is the exploitation of the artefact for the public benefit rather than the simple preservation of material evidence. This change in the primary objective of the technical museum is in turn based on a fundamental change in the underlying assumption of artefacts as material evidence to one of objects as also including functional evidence. What the museum is doing is to accept the destruction of one form of evidence so that another 'more important' form of evidence can be revealed to the public by the sectioning and operation of artefacts. As Kenneth Hudson has said, the Science Museum is at its best when acting as the 'National Museum of How Things Work'.[56] If it is necessary to section and operate artefacts to explain how things work and to interest and excite people, then the museum has shown that it is prepared to pay the price of the destruction of material evidence which inevitably results.

To that extent the technical museum in general, and the Science museum in particular, is different from the other broad categories of museums of archaeology, natural history, fine and applied arts. Because the Science Museum has seen its primary objective as explaining how things work rather than maintaining an encyclopedic archive of artefacts, it has adopted a different strategy for the treatment of objects. In other types of museum, even when objects have a functional nature, such as a teapot or a violin, they will generally have been collected for their aesthetic qualities or their historical associations. It is not that such museums have adopted a certain ethical position on the operation of objects, it is that it just did not occur to them to operate objects for they had no need to do so. For the technical museum it is not a matter of principle as to whether or not to operate objects; some objects will inevitably be operated. The 'principle' has become the

more pragmatic (though no less difficult) decision as to which objects to operate, and the balance to be struck between the medium-term needs of exposition and the long-term needs of preservation.

I asked at the beginning of this paper whether technical curators were dishonest, thoughtless and uncaring, or whether they were schizophrenic. The answer is now clear. Because they have been labouring under an inappropriate ethic derived from other types of museum, they have been living in a schizophrenic state in which their actions contradict their beliefs. They are not dishonest, thoughtless and uncaring, but merely confused.

What is needed is that technical curators should come out of the closet and admit that they are in the business of destroying evidence. They should recognize that this is a necessary by-product of fulfilling their primary objective of exploiting their objects for the public benefit. They should cease their agonizing over the ethics of sectioning and operating objects, for no ethics are involved. Instead curators should concentrate on working out the circumstances in which it is appropriate to section or operate objects in order to meet the objectives of their museum, and the balance which they think appropriate between the medium-term needs of exposition and the long-term needs of preservation. Only then will they be able to function as 'whole' curators and carry out both exposition and preservation without suffering the confusing effects of the tension between the two.

The practical problem of balancing the conflict between exposition and preservation in the field where it is at its most severe, namely motor vehicles, will be dealt with in another paper.

Acknowledgements

I would like to express my gratitude to my colleagues Sandra Bicknell and Robert Bud for their careful reading of this paper and their suggestions for its improvement.

References and Notes

A number of abbreviations to the titles of references are used in the following notes. These are:

ScM = official files of papers held by the Registrar of the Science Museum which include correspondence concerning the acquisition of objects.

Tech File = file of papers held by the curator containing technical and other information about a particular object.

ACR = Advisory Council Report 1913–1939, 1951–1983.

SMR = Science Museum Report ?–1912, 1946–1950, 1957–1980.

Reports were published each year covering the work of the Science Museum entitled *Report for the Year xxxx on the Science Museum*. Immediately after the establishment of the Advisory Council in 1913 their series of annual reports began but retaining the same form of title. The Advisory Council was reorganized with new terms of reference in 1930 and the title of the report became *Report of the Advisory Council of the Science Museum for the Year xxxx*. Although a report was produced in typescript for 1939, because of wartime printing restrictions it was not printed and published, and for 1940–1945 no annual reports were produced. Pre-war reports were published by HMSO in the year after the year they covered, and were in the form of a report to the President of the Board of Education. The Advisory Council did not reconvene immediately after the war, so for the years 1946–1950 the museum produced an unpublished report entitled *Report on the Science Museum for the Year xxxx*. In 1951 the Advisory Council was reconstituted. The Council now reported to the Minister for Education and its reports, entitled *Science Museum, Report of the Advisory Council for the Year xxxx*, were

unpublished although they were issued to the senior staff of the museum. The 1951 report included a summary of the period 1940–1951. Thereafter the reports were in two parts but continuously paginated, the report of the Advisory Council to the Minister usually consisting of two pages, with the bulk of the report being subtitled 'The Year's Work in the Museum'. From 1952 to 1956 the latter was available to junior staff in a separately paginated version. From 1957 they were separately paginated and entitled *Science Museum, Report of the Advisory Council for the Year xxxx* (usually consisting of 2–4 pages) and *Report of the Science Museum for the Year xxxx* (usually consisting of about 30 pages). They were bound together and supplied to senior staff, junior staff receiving only the Report of the Science Museum. From 1963 they were bound separately. The Report of the Science Museum was not produced after 1980. The Report of the Advisory Council was not produced after 1983, as the Advisory Council was disbanded following the devolution of the Science Museum from the Department of Education and Science under an independent Board of Trustees.

1. J. Hallam, 'Conservation and storage: technology', in J. M. A. Thompson, ed., *Manual of Curatorship* (Butterworths, London, 1984), pp. 323–332. Quote from p. 323.
2. *Report of the Departmental Committee on the Science Museum and the Geological Museum* (HMSO, London, Part I 1911, Part II 1912). Quote from Part I, p. 9.
3. ACR (1913), p. 12.
4. See for example ACR (1933), p. 34. 'Wherever possible, [aero-] engines are sectioned in order to show their internal construction and six examples are shown in motion by means of electric motors; it is hoped to add to this number as opportunity arises. The educational value of a sectioned engine shown in operation is considerable . . . When desirable, instruments are sectioned, and some airspeed indicators, pressure gauges and anemometers have now been arranged to operate under compressed air supply, so that their mechanism may be more easily understood.'
5. ACR (1934), p. 27.
6. The Papers of Sir David Follett, Science Museum Archives Z183/2.
7. ACR (1952), Appendix 1, p. 38; see also pp. 30, 37.
8. H. W. Dickinson, 'Museums and their relation to the history of engineering and technology', *Transactions of the Newcomen Society, XIV*, 1933/34, pp. 1–12. Quote from p. 9. Last became Director in 1904 and, following his early death in 1911, it was stated that he had been responsible as Keeper for introducing the system of showing objects in motion by means of compressed air: *Times*, 9 August 1911, p. 11; *Engineer*, 11 August 1911, p. 152; *Engineering*, 11 August 1911, p. 190. Certainly the compressed air supply to the Southern Galleries had been installed by 1894: 'Many of the machines are shown in motion daily from 11am till closing time, the motive power being supplied by a compressed air service. Where practicable, these working models are fitted with self-closing air-valves, by means of which visitors may start them at will, notices to this effect being placed with the models so fitted.' *Catalogue of machinery, models, etc., in the Machinery and Inventions Division of the South Kensington Museum—Part I*, Dept of Science and Art of the Committee of the Council on Education (HMSO, London, 1894), p. 2.
9. ACR (1914), pp. 12, 13.
10. In the Naval and Marine Engineering catalogue of 1911 there were 1142 catalogue numbers. The majority were in fact models (of which 75 were working), prints, drawings and photographs, and only 70 were 'real full-sized' objects, of which three were working and two were sectioned; *Catalogue of the Naval and Marine Engineering Collection in the Science Museums*, Board of Education (HMSO, London, 2nd ed. 1911). In the Mechanical Engineering catalogue Part I of 1914 there were 1046 catalogue numbers, 563 were 'real full-sized' objects, of which 29 were working and 45 were sectioned, and there were 95 working models; *Catalogue of the Mechanical Engineering Collection in the Science Museum—Part I*, Board of Education (HMSO, London, 5th ed. 1914). In the Part II catalogue of 1908 there were 901 catalogue numbers, 453 were 'real full-sized' objects, of which only one was working and 18 were sectioned, and 12 working models; *Catalogue of the Mechanical Engineering Collection in the Science Division of the Victoria and Albert Museum—Part II*, Board of Education (HMSO, London, 2nd ed. 1908).
11. It is also more difficult to decide whether a particular object is a 'real full-sized' object as so much was demonstration apparatus which was described imprecisely. However, it would appear that out of 2305 catalogue numbers, 1446 were 'real full-sized' objects, of which none was identified as working or sectioned, and there were six working models. However, it is known that, for example, the Wells Cathedral clock was working at that time. *Catalogue of the Science Collections for Teaching and Research in the South Kensington Museum—Part I Mathematics and Mechanics*, Dept of Science and Art of the Committee of the Council on Education (HMSO, London, 1892);

Catalogue of the Science Collections for Teaching and Research in the South Kensington Museum—Part V Physiography, Dept of Science and Art of the Committee of the Council on Education (HMSO, London, 1895); *Catalogue of the Collections for Teaching and Research in the Victoria and Albert Museum—Part II Physics* (Board of Education, HMSO, London, 2nd ed. 1905); *Catalogue of the Science Collections for Teaching and Research in the Victoria and Albert Museum, South Kensington—Part IV Metallurgy* (Board of Education, HMSO, London, 1906); *Catalogue of the Collections for Teaching and Research in the Science Museum, South Kensington—Part III Chemistry* (Board of Education, HMSO, London, 1910).

12. ACR (1927/28), p. 18.
13. ACR (1929), pp. 18, 19).
14. ACR (1931), p.22.
15. ACR (1932), pp. 29, 30.
16. ACR (1935), pp. 20, 21.
17. ACR (1935), p.31.
18. ACR (1937), p.19.
19. SMR (1951), p.15.
20. SMR (1951), p. 7.
21. SMR (1951), p. 17.
22. ACR (1936), p. 16.
23. ACR (1939), p.4.
24. National Horse Association of Great Britain, 'Exhibition and Driving Parade of Ancient and Historical Vehicles Windsor July 4th to 8th 1939' (London, 1939). Lists ten as lent by the Science Museum, of which four paraded: Britzska, Irish jaunting car, Cabriolet, Punch carriage.
25. SMR (1951), p. 15.
26. ACR (1954), p. 16.
27. ACR (1936), p. 12: 'The maintenance of the operable exhibits in the Museum slowly increases and is now considerable, but is amply repaid by the interest and instructive value of such exhibits to the public'. ACR (1952), Appendix 1, p. 30: 'Wide extension of the practice of demonstration is clearly desirable, but is at present debarred by lack of personnel, permanent or temporary'. ACR (1952), Appendix 1, p. 38: 'The present shortage of man-power is the chief difficulty in the way of such developments'.
28. ACR (1924), p. 4.
29. ACR (1927/28), p. 18.
30. ACR (1936), p. 6.
31. The papers do not record whether it was sectioned at the museum's instigation. However, this was certainly the case with the 1891 radial flow steam turbine and generator from the Cambridge Electric Supply Company Parsons offered to the museum in 1924. The museum accepted the offer saying: 'the Board would be pleased, if you would, as you suggest, when overhauling it, section part of the casing so as to show the interior as this would add very greatly to its value as an exhibited object' (ScM 1315, C. A. Parsons & Co. Ltd). On the other hand, the first Parsons steam turbine and dynamo set of 1884 on exhibition in the East Hall has not been sectioned. This is almost certainly not because of any qualms about the destruction of evidence but because it is an axial flow turbine with a split casing. It is possible to expose the internal arrangement by lifting the top half of the casing. However, the radial flow turbines do not have a split casing so that the only way to reveal the turbine wheels is to section the casing. I have no doubt that the axial flow turbine would also have been sectioned if it had not had a split casing.
32. ACR (1925), p. 17; ACR (1932), p. 32; ACR (1935), p. 37; ScM 775, Royal Greenwich Observatory. Gould had succeeded in restoring No. 2 and No. 4 to working order in 1924, No. 3 was in working order in 1931, and by 1934 or 1935 No. 1 was also in working order.
33. ACR (1952), p. 4.
34. '. . . the car found the ascent at the top of Exhibition Road . . . too much for it, with two passengers, and had to be assisted by pushing on this slope . . . it is not sufficiently easily controlled to run on the public roads under modern traffic conditions . . . I would say, therefore, that it is not desirable to run the car on public roads again' (Tech File, 1913–493).
35. ScM 6130A, Pt I, The Veteran Car Club Rallies. This accident was recorded in a series of five photographs published in *Autosport*, 8 November 1957, p. 606.
36. ScM 6130a A, Pt II, The Veteran Car Club Rallies. Caunter published an account of the run in *Autocar*, 28 November 1958, p. 860: 'there is a marked indication of uncontrollability . . . The crude horse-carriage block brakes fitted are quite inadequate, and have to be used with the greatest

circumspection . . . the Benz will now go once more on permanent exhibition at the Science Museum, and will not be run again.'

37. ACR (1934), pp. 40, 42; ACR (1935), pp. 37, 46; Tech File 1935—348.
38. SMR (1960), p. 19; SMR (1967), p. 12; SMR (1969), p. 12; Tech File 1938–348.
39. Tech File 1938–348.
40. ACR (1954), p. 25; ACR (1956), p. 30; SMR (1959), p. 20; SMR (1960), p. 29; SMR (1961), p. 17; SMR (1963), p. 20; SMR (1967), p. 12; SMR (1968), p. 13; SMR (1970), p. 13.
41. ScM 489, Godiva Fire Pumps Ltd.
42. ScM 302, The Bristol Aeroplane Co Ltd. Bristol had also made it clear that if the aircraft were returned to them they would give it to the Shuttleworth Trust with an endowment of £350 per year to maintain and occasionally fly the aircraft. This was duly done, but because of the small airfield and hangars the aircraft was not based at their airfield site at Biggleswade (T. E. Guttery, *The Shuttleworth Collection*, 1st ed. May 1963, pp. 3, 22).
43. *Flight International*, 17 September 1964, p. 505. The present curator of the Aeronautics Collection J. A. Bagley, who worked at Farnborough at the time and witnessed the crash, regards the demise of the Bulldog as quite a loss, representing as it did a peculiarly British type of aircraft construction not otherwise represented in our collection.
44. F. A. B. Ward, *Handbook of the [Science Museum] Collection Illustrating Time Measurement—Part II Descriptive Catalogue* (Ministry of Education, HMSO, London, 3rd ed. 1955), p. 18.
45. ScM 230, A. J. Bennett.
46. ScM 474, Cooke, Troughton & Simms Ltd.
47. ScM 4429, J. G. Bower; ACR, 1956, p. 29.
48. SMR (1963), p. 20.
49. ACR (1921/22), p. 7.
50. ACR (1927/28), p. 9.
51. ACR (1931), p. 22.
52. SMR (1947), p. 17.
53. ACR (1957), p. 23.
54. ACR (1958), p. 19; ACR (1961), p. 15.
55. ACR (1931), p. 22; ACR (1934), p. 17; ACR (1935), p. 23; ACR (1938), p. 28; ACR (1939), p. 19; ACR (1951), p. 16; ACR (1953), p. 21; ACR (1956), p. 27; ACR (1957), p. 23; ACR (1958), p. 19; ACR (1959), p. 17; ACR (1960), p. 16; ACR (1961), p. 15; SMR (1947), p. 17; SMR (1967), p. 10; SMR (1968), p. 11; SMR (1970), p. 10; SMR (1975), p. 9; SMR (1976/77), pp. 17, 18.
56. Comments at seminar about redisplay of the Aeronautics Gallery, Science Museum, 18 February 1987 [ScM 2005/590/2 Aeronautics (General) Project—Administration].