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Cover: Beechwoods of Longdon Hill between Wendover and Princes Risborough.
Photograph: J. Allan Cash

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The Chilterns heritage

THE CHILTERNS, the chalk uplands on London's northwestern boundary, have become one of the most jealously protected areas in Britain. This is due, in the main, to the thousands of ex-urbanites drawn to live in the countryside in the postwar exodus from the capital.

Many hundreds from London and the south east now visit the area on public holidays and at weekends. More will be attracted as the western end of the capital's M25 ring road is completed by 1986 to provide easier access through the commuter belt of south Buckinghamshire.

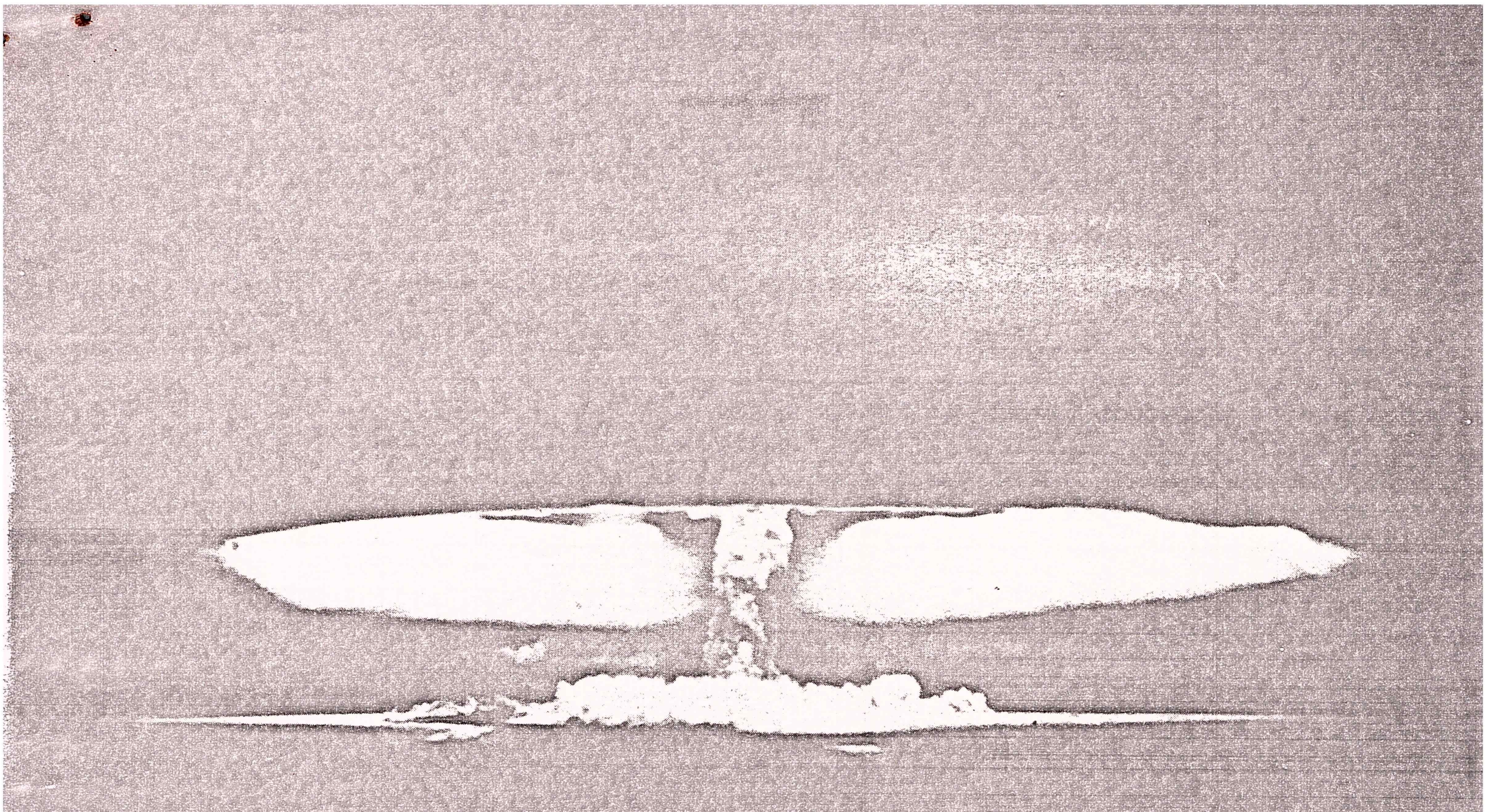
Today, planning constraints govern the future development pattern of the major parts of Buckinghamshire, Berkshire, and Oxfordshire. Some public-spirited conservationists have ensured a clearly marked system of footpaths in the Chilterns countryside. Others have restored a once derelict windmill. Members of yet another group are behind the establishment of a permanent open-air museum of historic local buildings. Naturalists have established several wildlife reserves.

But the crowning glory of most of the Chilterns scarp – its beech woodland – has yet to benefit from attention it so urgently deserves, according to a contributor to our special three-part feature in this month's issue of this magazine.

If the glory of the tree-covered landscape stretching from the Goring Gap in the Thames valley to the Vale of St Albans is to be retained for the enjoyment of future generations of Britons living in the shadow of a nuclear holocaust, urgent measures are clearly needed. As the Chilterns is not a national park – but instead a heavily utilized public playground – woodland acquisition policies cannot assist.

The real answer would appear to be public ownership, possibly adopting community ownership on the continental model, and idea which fills the chairman of Buckinghamshire County Council with horror. Although he concedes that he personally would be happier with an alternative proposal that would hand over broadleaved woods to the Treasury in return for capital taxes. In other words no cash, no conservation.

That, perhaps is the way forward in the continuing battle to preserve the Chilterns.



The Bomb: where will the survivors be?

by Stan Openshaw and Philip Steadman

With nuclear arms limitation talks in progress in Geneva and a continuing war of words between the White House and the Kremlin over the terms for any agreement, few people can be left unaware of the growing nuclear threat. But what will be the reality for the population of Great Britain in the event of a nuclear attack. Stan Openshaw and Philip Steadman have developed a computer model to assess the accuracy of official and unofficial casualty predictions

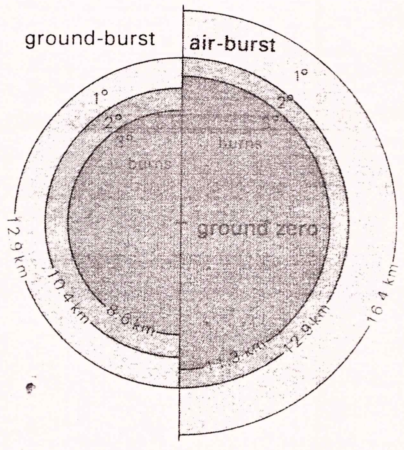
WHAT ARE your chances of surviving a nuclear war and what proportion of the British population might be expected to survive? Successive governments have been exceptionally reluctant to say what we can expect. Even the local authorities who are responsible for emergency measures have not been told what to plan for.

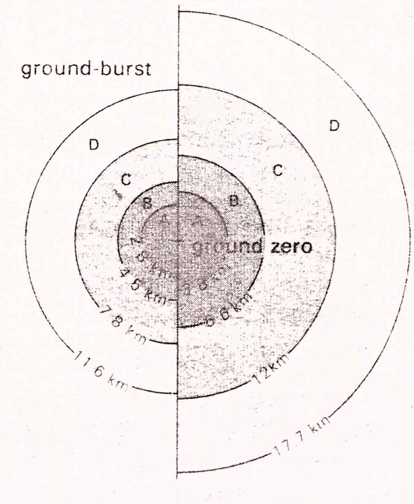
Specific casualty predictions are made by a member of the Home Office in a recently published book, *The Nuclear Arms Race: Control or Catastrophe* edited by Barnaby and Thomas. The Home Office author looks at an attack on Britain with 180 megatons of nuclear weapons. The megaton is a measure of explosive power or 'yield'. It is equivalent to one million tons of conventional high explosive. Many modern nuclear weapons have yields of one megaton or more. For comparison the atom bombs dropped on Hiroshima and Nagasaki in 1945 had yields of 12,500 and 22,000 tons respectively.

If the bombs are aimed primarily at military targets, the Home Office calculates that about 90 per cent of the population would survive. The survival rate would be 70 per cent if mixed military and population targets were attacked, and 65 per cent for mainly population targets. However, no details of the targets are given and we believe that these are unrealistically high estimates of survival rates.

Last year we gave evidence to an inquiry being conducted by the British Medical Association entitled *The Medical Effects of Nuclear War*. The BMA's report was published in April this year. It comes to the conclusion, as we have, that the Home Office estimates are seriously wrong, because of a series of mistakes and unreasonable assumptions in their calculations. The Minister responsible for civil defence, Mr Patrick Mayhew, has acknowledged the faults in his own Department's work.

This article sets out to provide independent estimates of the casualties that could result from a large scale nuclear attack on Britain, over which there is still great debate. It is an area where geographers have made virtually no contribution to public debate even though the methods and data used in the casualty estimation process are of a geographical nature.

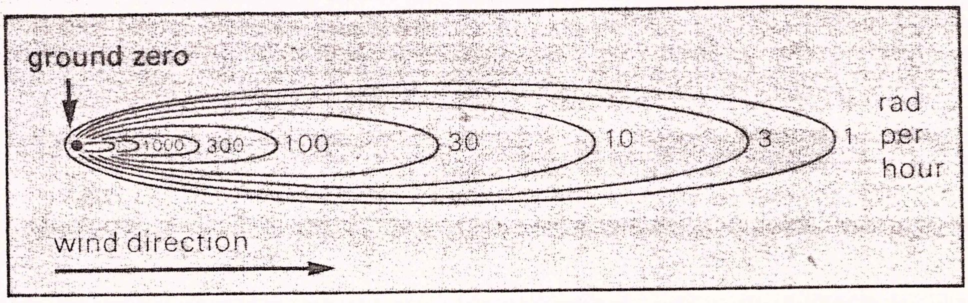




(Top) a huge mushroom cloud forms above an atoll in the South Pacific Ocean after the detonation of a French hydrogen bomb in the atmosphere.

(Top diagram) the effects of heat from a one megaton nuclear blast; third degree burns would almost certainly be fatal and second degree burns could be fatal if victims also suffer from radiation sickness.

(Bottom) blast damage from a one megaton bomb; in area A nearly all people would be killed; in area B 50 per cent would be killed and 40 per cent injured; area C 45 per cent injured; area D 25 per cent injured



Idealized ellipses show the rate (in rads per hour) at which people would receive radiation doses from fallout. The rate at each point changes as wind moves the radioactive cloud and radioactivity decays

The techniques used to make casualty estimates are fairly crude. The best source of information is *The Effects of Nuclear Weapons* by Glasstone and Dolan (Castle House, Tunbridge Wells, 1977). When a nuclear weapon is exploded it causes deaths and injuries from three major effects: heat, blast, and local radioactive fallout. There are other physical effects and a number of further unpleasant consequences of the devastation, but we shall ignore them and concentrate on the short-term primary effects.

The mathematical computer model developed by us used 1971 population data which are available for all 150,000 or so inhabited one kilometre grid-squares (the same squares as shown on a 1:50,000 Ordnance Survey map). The population data come from the Census which means that the distribution represents a night-time situation. This is quite reasonable as it is in accordance with the Home Office's 'stay-put' policy as described in their advisory leaflet *Protect and Survive* which would be distributed to us all prior to an attack. We are supposed to stay at home and construct a make-shift radiation shelter from doors and sand bags, and stock it with enough water and food for a 14 day sheltering period.

The effects of heat from the nuclear explosion depend on the height of detonation, the explosive yield of the weapon, atmospheric visibility (we assume a clear day), and the number of people exposed to the fireball. We assume a low figure of five per cent exposed. The figure could be much higher if refugees or people leaving homes wrecked by earlier weapons were caught out in the open. In order to calculate possible numbers of burns casualties we need to know the location of ground zero for each bomb (the point on the ground under the centre of the explosion). For this we have to use a hypothetical set of targets based either on those assumed in Home Office exercises or else on educated guesses.

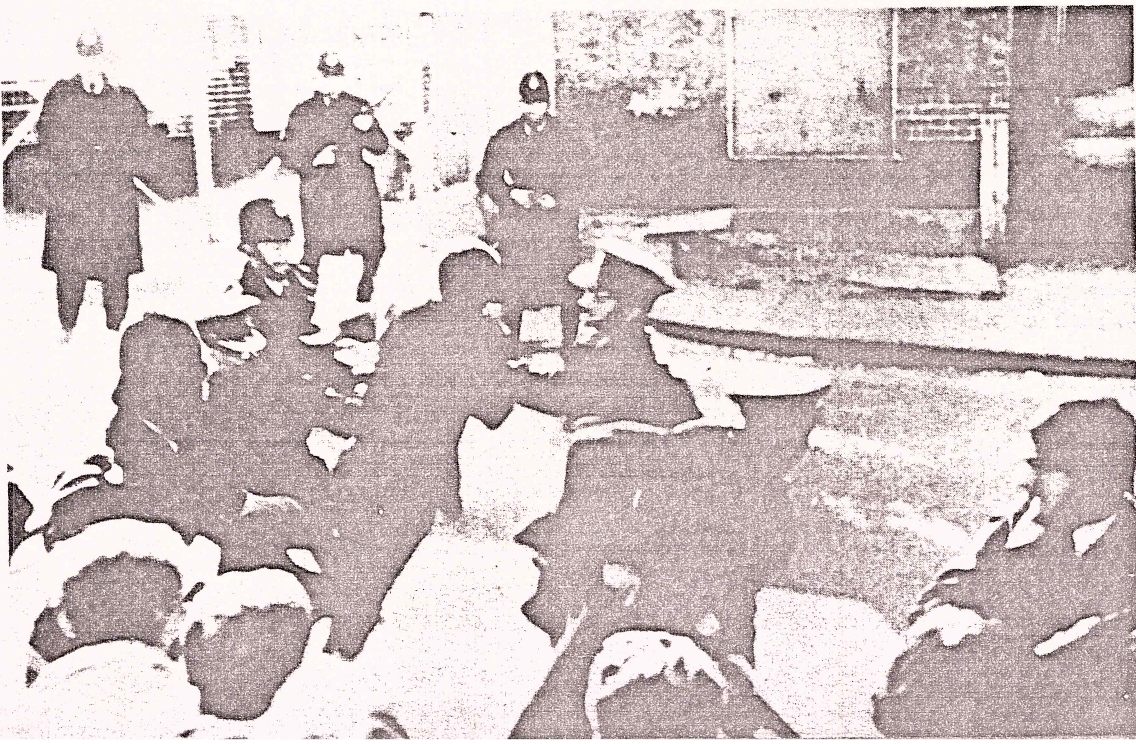
Once we have a list of targets then we can start estimating burns casualties. Heat effects are represented as a series of concentric rings. Each ring measures a different level of heat output and in each zone there is a different risk of death or injury. Casualty rates in each ring are those suggested by the US Office of Technology Assessment in their 1980 report *The Effects of Nuclear War* (Croom Helm, London). When the height of detonation is such that the fireball touches the ground, the bomb is said to be 'ground-burst'; above this it is an 'air-burst'. The rings (for both heat and blast effects) are smaller for ground-bursts than for air-bursts of the same yield. Burns casualties are estimated by adding up the numbers of people in the one km squares located within each ring, and taking the proportion assumed to be exposed. The numbers of deaths and serious injuries are then calculated for each one km square located within the various rings. This process is repeated for each target and each weapon. People who are injured twice by different weapons are assumed to die.

Blast effects are represented in a similar way although the mechanisms of injury are different and the geographical extent of the effects is much larger. The fireball caused by the nuclear explosion rapidly heats the air next to it, and the air expands outwards at high speed. The result is a sudden rise in atmospheric pressure which spreads out from ground zero. People would be vapourized, trapped in collapsing or exploding buildings, thrown through the air, and hit by flying debris. An air-burst weapon would leave no structures standing in the area around ground zero; while a ground-burst would produce a deep crater.

Blast damage is often represented in a series of four concentric rings which correspond to different ranges of blast pressure. Approximate casualty rates are available for each ring. These come from the US Department of Defense and have been described as 'relatively conservative'. In the computer model the survivors from burns effects are now subjected to blast effects, and new population counts are obtained for those who survive both burns and blast, either injured or uninjured.

It is more difficult to estimate casualties from radioactive fallout. This fallout is produced in large quantities only by ground-burst bombs. The massive quantities of earth and debris which the bomb gouges out of the crater are sucked into the fireball, and mixed with the radioactive products of the explosion. The particles then gradually 'fall out' of the radioactive mushroom cloud as it drifts down wind. Thus the areas affected depend first of all on the speed and direction of the wind. The nature of the surface is also important. A bomb exploded over water might be expected to produce intensely radioactive rain storms.

Some part of the fallout is 'local'; it is deposited in the immediate area of the explosion, although even this contamination



The breakdown of law and order could occur after a nuclear attack; a scene from *The War Game* which was made for the BBC in the 1960s but never publicly released

Complete devastation occurred near ground zero (the point of explosion) in Nagasaki in 1945. The bomb used had a yield equal to 22,000 tons of high explosive, while modern weapons often have a yield in excess of one megaton – equal to one million tons of high explosive

could extend hundreds of kilometres down wind. The very finest particles will be carried up into the stratosphere and deposited much later all round the world as 'global' fallout. We are concerned here only with local fallout.

The effects of fallout are far less predictable than blast or heat effects because of the influence that local meteorological conditions can have. Rain may cause intensely radioactive 'hot spots' in areas where only modest radiation levels might otherwise have been expected. Generally, the radiation dose received at any location depends on the time it takes for the fallout cloud to reach it. As the cloud passes overhead and the fallout accumulates the level of radiation builds up to a peak and then declines again. People sheltering indoors might be expected to receive a radiation dose at a rate that decreases rapidly with time. After 14 days they will have received about 95 per cent of the total dose expected over the next year.

For estimating casualties, the radiation dose rates may be approximated by a series of ellipses with their foci slightly upwind of ground zero and the long axes orientated downwind. These 'idealized' dose rates have to be modified to take into account the distance of a particular location from ground zero, the yield of the explosion, the sheltering effect of the building where people are sheltering and the length of the sheltering period. The degree of protection which any building provides against radiation is measured as a 'protection factor', which is the ratio of the radiation dose which would be received in the open, to the dose received inside the shelter. The Home Office uses a range of protection factors with a mean of about 20; that is to say, the doses received by people inside buildings are on average 1/20th of the outside dose. This is regarded as very high by many experts who would suggest a value of between 1/3rd and 1/5th as more realistic. Additionally, the protection afforded by a house depends on the extent to which it is damaged by blast. We use a value of 1/8th for areas with no blast damage, 1/5th for the outermost ring, one half for the next ring, and one for the two innermost rings.

The computer has to calculate cumulative fallout doses for all one km squares with possible contributions from all ground-burst weapons. The doses received over 14 days are then used to determine casualties according to a set of assumptions which give percentages seriously ill from radiation sickness, or killed, at different levels of dose. A value often referred to is that level of dose which, if large numbers of people were exposed, would result in 50 per cent of them dying. This is known as the 'median lethal dose' or LD-50. Our LD-50 value is 450 rads which is a figure widely used in radiological studies. This subject however is very controversial. The Home Office prefer to use a value, for a dose received over two weeks, which is more than double ours, in part because they make some allowance for the body's supposed ability to recover spontaneously from a certain amount of radiation damage. Our view is that the rates in this study are probably a more reasonable approximation given that many of the survivors will not be in good health because of various injuries and lack of food.

The final ingredient is a list of targets with weapons of given yields and height of burst assigned to each. Perhaps understandably there is no 'official' published list. Indeed the Home Office even refuse to advise local authorities about the numbers of potential targets in their administrative areas. We have taken our examples here from recent Home Office civil defence exercises, and from an alternative attack scenario devised by the Campaign for Nuclear Disarmament (CND).

Targets for the 1980 Home Defence exercise, code-named Square Leg, and the postponed 1982 exercise, code-named Hard Rock, have been published in *War Plan UK* by Duncan Campbell. The 1980 exercise involved a 205 megaton attack while the 1982 attack had a miniscule total yield of 48.4 megatons. A far more realistic attack pattern was devised in 1982 with the code-name Hard Luck. This has the dubious distinction of being the most detailed and most carefully thought out hypothetical attack ever imagined for Britain. A total of 166 missiles with 362 warheads and a total yield of 222 megatons are involved. The assignment of warheads to targets and the yields of the weapons are based on what is known about available Soviet weaponry. The effects of 'MIRV' missiles, whereby one missile can carry several independently targetted warheads, are taken into account. Hard Luck can nevertheless be regarded as a 'limited' attack, since the Russians actually possess weapons for use against Britain with which to mount attacks several times larger than this. Moreover, cities are not deliberately attacked as such in Hard Luck, only industries and targets of military and strategic significance.

The 14-day survival rates for Britain's population vary from 37 per cent for Square Leg, to 79 per cent for Hard Rock, to 20 per cent for Hard Luck. The latter we think is the most realistic of the three estimates. Casualty data were made available for each 10 km square in the country. For the present purposes it is better to report these casualty estimates for counties in England and Wales and regions for Scotland. This involves the use of geographical data-processing techniques to aggregate the one km totals from our model to boundaries representing these local authority areas.

It is emphasized, however, that these are only short-term survival rates. The rates after one year may be considerably lower (perhaps one third to two-thirds of these figures), because of many other longer-term effects not taken into account.

It is emphasized that nuclear war casualty prediction is a very uncertain and difficult task. We have tried to produce what we consider to be an honest assessment of the levels of casualties that Britain might be expected to face from a large-scale but still 'limited' Soviet attack. The machinery of government may well survive a nuclear war but there would be few civilians left to applaud. The current 'stay put' policy may condemn a large proportion of the urban population of Britain to an early death.

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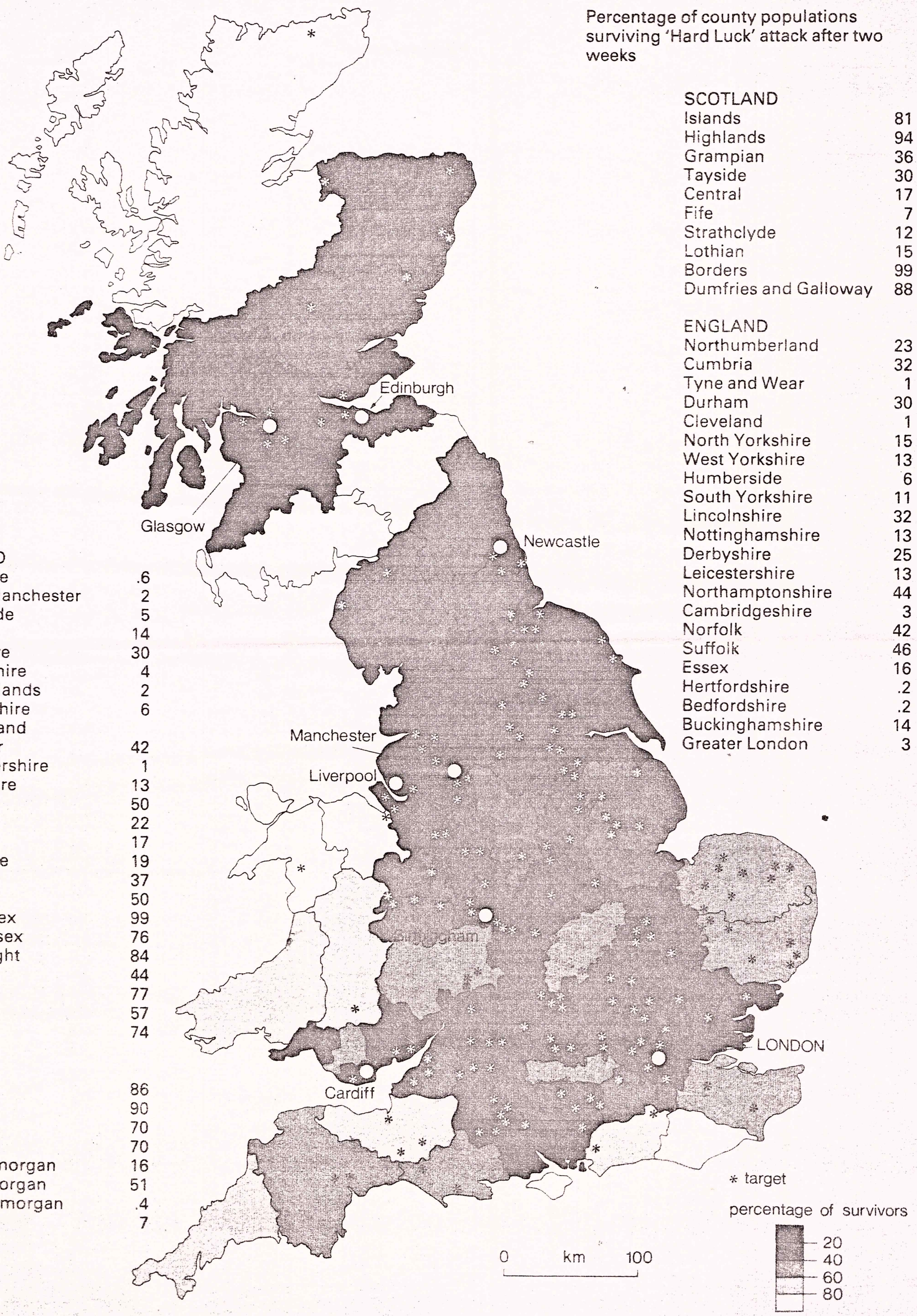
Population surviving 'Hard Luck' nuclear attack in Great Britain



Percentage of county populations surviving 'Hard Luck' attack after two weeks

SCOTLAND	
Islands	81
Highlands	94
Grampian	36
Tayside	30
Central	17
Fife	7
Strathclyde	12
Lothian	15
Borders	99
Dumfries and Galloway	88

ENGLAND	
Northumberland	23
Cumbria	32
Tyne and Wear	1
Durham	30
Cleveland	1
North Yorkshire	15
West Yorkshire	13
Humberside	6
South Yorkshire	11
Lincolnshire	32
Nottinghamshire	13
Derbyshire	25
Leicestershire	13
Northamptonshire	44
Cambridgeshire	3
Norfolk	42
Suffolk	46
Essex	16
Hertfordshire	.2
Bedfordshire	.2
Buckinghamshire	14
Greater London	3

ENGLAND	
Lancashire	.6
Greater Manchester	2
Merseyside	5
Cheshire	14
Shropshire	30
Staffordshire	4
West Midlands	2
Warwickshire	6
Hereford and Worcester	42
Gloucestershire	1
Oxfordshire	13
Berkshire	50
Avon	22
Wiltshire	17
Hampshire	19
Surrey	37
Kent	50
East Sussex	99
West Sussex	76
Isle of Wight	84
Dorset	44
Somerset	77
Devon	57
Cornwall	74

WALES	
Gwynedd	86
Clwyd	90
Powys	70
Dyfed	70
West Glamorgan	16
Mid Glamorgan	51
South Glamorgan	.4
Gwent	7