not assume that the conditions existing in his local coronary care unit are as good as those in highly specialized cardiology units described in the journals. Each general practitioner should decide on a policy and carry it out with full conviction.

Because of staffing difficulties the coronary ambulance is unlikely to become widely available and the general practitioner must learn to give primary care of high quality. In addition, there is disquiet about the delay sometimes experienced in finding a doctor in an emergency and, though outside the scope of this article, it is a problem to be examined by every practice.

In future possibly the whole medical community of an area will look at the total situation and formulate a community policy for treating myocardial infarction, but this is only in the early stages of development.⁴

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Medical History

Some Social and Forensic Aspects of Exhumation and Reinterment of Industrial Revolution Remains

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Summary

The aetiological aspects of exhumed remains from two burial sites were examined using 1839 and 1879 as years of comparison. We tried to discover whether the sample of recovered remains was representative of those buried. The state of the remains varied according to the type of soil and coffin material in which they were buried. At the earlier date most deaths were caused by infectious lesions rather than degenerative ones and 76% of those who died were below employable age—whereas in 1879 the commonest causes of death were tuberculosis ("phthisis") and bronchitis, and 42% died before they could be employed. The registration of deaths were recorded more accurately at the later date, and it was easier to build up a picture of the age, sex, and occupation of the people who died.

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Introduction

Reports on exhumed remains from burial sites have usually been either on those found on ancient sites or they have been on recent deaths, and it was a unique opportunity when a road-widening scheme in Ashton-under-Lyne enabled us to examine a number of 19th century remains. As several thousand remains were to be removed from one burial site to another we expected that the findings resulting from anthropometric and dental examinations would lend themselves to a statistical analysis.

The people in this area (now the town centre of Ashton-under-Lyne) had a period of social and economic change, when the rudiments of community health measures were modifying an environment of squalor, inadequate accommodation, rudimentary sanitation, long working hours, and malnutrition. The 1834 Poor Law Amendment Act, the repeal of the Corn Laws in 1846, and numerous factory and public health acts affected every household directly or indirectly. Though malnutrition was common, the diet increased in refinement—particularly in the intake of carbohydrates—but there was little evidence of extensive dental treatment. The overall investigation of the remains was primarily orientated towards the aetiological aspects of the latter and not directed towards forensic details.

The road widening eroded the margins of two burial sites near the town centre, separated from each other by about 400 yards (370 metres). St. Michael's parish churchyard (fig. 1) was the

FIG. 1—St. Michael's parish churchyard.

FIG. 2—The Cemetery.

only consecrated burial ground for the town from before the 14th century to about 1820. The southern half of this, adjacent to the railway cutting of the branch of the Manchester, Sheffield, and Liverpool railway, was removed. The other cemetery (fig. 2) was opened in land acquired from Lord Stamford's estate in the 1850s, and the northern margin of this site was excavated. The soil in the churchyard was light, sandy, dry, aerobic, and acid—while that in the cemetery was heavy, mainly clay, waterlogged, and less acid.

The exhumation, examination, and transference of remains were carried out under a faculty, issued by the Bishop of Manchester, and supervised by the Medical Officer of Health for that area. In this case the exhumation was carried out rapidly by a specialist contractor, under conditions of strict security. The headstones were removed, the earth taken away by a mechanical digger, and remains removed by hand and put in labelled polyethylene bags, with identifying plates when these were present. The coffins were then broken up and liberally limed.

The Method and Distribution of Burial

Most bodies were in hardwood coffins, occasionally lined with lead or velvet, or both. Some were of the fish-tailed variety, peculiar to the north of England, and used up to the 1930s. Very occasionally a body was embalmed before burial, possibly as a status symbol or family tradition. This was done by injecting

formalin into seven key points in the body. Earlier coffins tended to have beaten copper name plates, screwed or rivetted to the outside of the coffin. The body was usually dressed in a linen garment, and wrapped in a woollen, or in later years, a cotton shroud. The coffin was lined with material, and packed underneath with wood shavings or chips as padding for the body. The addition of sawdust allowed this combination to act as an absorbent.

Most remains of the more prosperous families were interred in the churchyard and the coffin was usually placed in a brick or stone vault. Other remains were buried directly in the earth, and covered with a layer of quicklime. The deepest burials were 10-15 feet below the surface. Subsequent burials were made nearer the surface, as sometimes up to 15 interments were made in the same grave.

The variables relating to the distribution of burials within the two sites were primarily the cause of death, year of burial, age at death, sex, and social class. The forensic problem was to determine if the sample of recovered remains was representative of those buried. The parish register and the Ashton town register gives the numbers of deaths. The former records the Church of England burials in the two sites throughout the 19th century but does not give the cause of death. The Ashton town register was not instituted until 1838, and covers a different, smaller area than the parish register, but it does record the alleged cause of death and occupation of the deceased. In this study 1839 and 1879 were chosen for comparison, the former as representative of a period soon after the town register was opened and because it was a peak epidemic year, and 1879, representing a later period when the benefits of social legislation were improving conditions of living. Supplementary data were also obtained from inscriptions on headstones and identification plates.

Identification Procedures

We took care to ensure that remains could be accurately identified by all available data, from the parish register, headstone inscriptions, and identifying plates, including the locating co-ordinates for each grave and compensating for earth shift where the gradient was steep particularly near the railway cutting. We checked the age from the state of development of the dentition and from skull sutures; the sex from examination of the pelvis, and from the ridges on the skull bones, due to muscular attachments, and further sociological data from the presence of embalmed remains, and the type of coffin.

Examination of Remains

The recovered skeletal remains were carefully cleaned over a sieve using a disinfectant (1% Sudol), a soft brush, and running water. In many of the remains the intracranial neural tissue was still present and required careful removal. Care was taken to recover and replace loose teeth which were shed during cleaning.

A general examination of the skull was followed by on site specialist examinations investigating the incidence of dental caries, periodontal disease and orthodontic and prosthetic problems. Specific items such as dental fillings, dentures, cysts, and impacted teeth were noted. Any evidence of craniofacial malformations, evidence of trauma, arthritic change, or other bony disease was recorded.

Cephalometric examination of the younger skulls was carried out on site to provide a permanent record in the antero-posterior, sagittal, and basilar planes. Casts were made of the dentition using alginate materials. After all examinations the remains were immediately re-interred.

Results

A survey of the main causes of death as recorded in the town registry office indicated that most of these in the peak year of

1839 (fig. 3) were caused by infectious lesions rather than degenerative ones (table I). In 1839 there appeared to be less discrimination on the part of the registrar who accepted each entry, and less precise medical diagnosis concerning the cause of death than later that century. By 1879, apart from tuberculosis, the top seven diseases had been replaced by others. The commonest stated causes of death were now "phthisis" (15%), "bronchitis" (14%), "old age" (11%), "pneumonia" (6%), "Morbus lordis" (4%), "marasmus" (3.3%), and "chronic disease of the brain" (3.3%). "Teething" had reduced to 1%.

The record of burials by age showed the high infant mortality of the time. Over one-third of those born failed to reach

FIG. 3—Burials at St. Michael's churchyard and cemetery 1813-1900 in 32,201 deaths.

TABLE I—Recorded Causes of 833 Deaths at Ashton-under-Lyne Registry in 1839

Measles	129	Heart disease	9
Complications of measles	27	Fever of the brain	4
Consumption	119	Erysipelas	4
Convulsions	99	Apoplexy	4
Scarlet fever (scarlatina)	45	Inflammation of chest	3
Teething	41*	Gastritis	3
Whooping cough	37	Water in the chest	3
Inflammation of the lungs	31	Drowning	3
Dropsy	29	Burns	3
Smallpox	29	Trauma and accident	3
Debility	24	Aneurysm and burst blood vessel	3
Old age	23†	Pleurisy	3
Water in the head	20	Inflammation of stomach	2
Asthma	19‡	Bronchitis	2
Croup	13	Flux	2
Enteritis	9	Visitation of God	2
Inflammation of bowels	8	Epilepsy	2
Typhus	7	Inflammation of brain	2
Fever	7	Diseased liver	2
Pneumonia	6	Palsy	2
Paralysis	6	Mortification of leg	2
Childbirth	6	Cancer	2

*Also fits from teething 1, teething and whooping cough 1.

†Also decay 2, palsy and old age 1.

‡Also asthma and consumption 1.

Causes of Single Deaths

Suicide	Quinsy
Rupture	Putrid sore throat
Cramp in stomach	Diseased bladder
Cephalitis	Diseased womb
Constipation	Spina bifida
Gastroenteritis	Rheumatism
A complaint in the side	Synochus
Haemorrhage	Turn of life
Peritonitis	Intemperance
Inflammation of foot and mortification	Ulceration of stomach
Inflammation	Inflammation of thyroid
English cholera	Inflammation of bladder
Disease of the hip	Inflammation of throat
Miscarriage	Inflammation and mortification
Abscess in lungs	Inflammation in the knee
Slow fever	Congestive fever
Worm fever	Abscess in hip
	Spasms of stomach

their second birthday, and one-half had died before their 18th birthday. Of those who survived the first two decades, the mean age of death was 54.5. Rather more males died soon after birth, but from the second decade, the majority were females. These, however, were mean figures for the century. In 1839 74% of those who died were below employable age. By 1879, the proportion fell to the still high figure of 42%, and, throughout, a high birthrate was being offset by a high death rate. Interestingly, illiteracy in 1839 was such that 49.2% of the informants were unable to sign their name in the registry office, whereas in 1879 the proportion was 27.2%.

An investigation into the occupation at death (table II) gives a rough assessment of the socioeconomic background of the period, but it must be remembered that a high mortality in a given occupation may be due to many being engaged in it, to a particular health risk, or to deaths within a redundant, but previously popular occupation, in which members were now dying of old age. Similarly, a low mean age at death may signify a considerable health risk in that trade, or reflect the mean age for that occupation—for example, piecers, who would normally move on to more skilled trades.

TABLE II—Frequency of Deaths by Occupation in 19th Century

1839*			1879†		
	No. (%) of Deaths	Mean Age in Years		No. (%) of Deaths	Mean Age in Years
Housewife ..	61 (28)	40.1	Housewife ..	115 (20)	47.2
Widow ..	27 (12)	65.5	Widow ..	107 (19)	67.6
Hand weaver ..	15 (7)	68.9	Labourer ..	30 (5)	52.6
Power-loom weaver ..	12 (5)	22.5	Power-loom weaver ..	24 (4)	45.9
Piecer ..	11 (5)	16.5	Self actor ..		
Labourer ..	9 (4)	45.3	minder ..	14 (3)	48.6
Cotton spinner ..	7 (3)	36.3	Cotton-frame ..		
Cotton weaver ..	6 (3)	44.3	tenter ..	14 (3)	33.4
Tenter ..	5 (2)	26.3	Carter ..	12 (2)	50.8
Coalminer ..	3 (1.5)	63.0	Shoemaker ..	11 (2)	66.3
Mechanic ..	3 (1.5)	53.7	Cotton carder ..	10 (2)	41.4
Others ..	60 (28)		Hatter ..	10 (2)	58.6
			Piecer ..	9 (2)	17.6
			Tailor ..	8 (1.5)	55.4
			Coalminer ..	7 (1.5)	65.1
			Housekeeper ..	7 (1.5)	53.7
			Grocer ..	6 (1)	64.0
			Joiner ..	6 (1)	61.8
			Cotton-mill labourer ..	6 (1)	53.7
			Book keeper ..	6 (1)	41.8
			Cotton winder ..	5 (1)	43.8
			Greengrocer ..	5 (1)	53.4
			Others ..	166 (25.5)	
Total	219 (100)		Total	577 (100)	

*Total occupations = 62.

†Total occupations = 138.

In 1839 deaths were recorded in 62 occupations, the youngest being 12 years old. The number of occupations had risen to 138 by 1879, owing to increased diversity, with the youngest death occurring at 11 years. In 1839, about one-third of the deaths were in textile (mainly cotton) industries, but they had reduced to about one-quarter in 1879. In 1839, the number of deaths of hand weavers exceeded that of power-loom weavers, the latter working in conditions resulting from Cartwright's invention in 1787, which brought production from the home into the factory. Deaths of the predominantly male hand weavers followed a normal life span (mean 69 years), while power-loom weavers (predominantly female) died in their early twenties (mean 22.5 years). Doubtless this was due to a combination of long hours and arduous conditions imposed on a young group of workers. The figures indicate that by 1879 these same workers had more than doubled their life span (mean 46 years) mainly due to the improved environment and to the employment of older workers.

Outside the cotton mill most workers in 1839 died in occupations relating to such supporting roles as building, transport, and shopkeeping. By 1879, though specialization had increased within the cotton industry, deaths were occurring in a wider range of occupations, including service industries, the armed Forces, railways, and telegraphy.

The proportion of women who died as housewives, or widows, or employed in paid occupations was similar in 1839 and 1879. But women in paid employment died young (mean age 26.6 years) in 1839, their life expectancy also being less than for male workers. By 1879 their expectancy had increased (mean 43.4 years). The ratio of housewife to widow altered within the same period: in 1839 only one in every four women survived to die a widow, but by 1879 two out of every five outlived their husbands. In 1879 the spread of age at death for widows was statistically significantly less than in 1839 presumably owing to the longer life spans of their husbands. On the other hand, the variation of age at death for working women was statistically highly significantly greater in 1879, indicating that many were still dying in the early age groups.

State of the Remains

In the churchyard those remains in lead-lined coffins in the vaults were usually in good condition, but the remains of earth burials were in a very poor state, regardless of the nature of the coffin material (that is, wood or lead). The soil environment has led to dissolution and/or oxidation of the lead, and disintegration of the remains. Two of the lead coffins in earth burials, 1836 and 1845, were devoid of human contents. When recovered from the earth, the skeletal remains were brown and dry, the colour being due to ferrous iron replacing calcium in the bone. There was some evidence of bone decalcification, though the collagen matrix was still present. Other soft-tissue remains, including the neural cranial contents, were absent.

In the cemetery the wooden coffins were generally in very good condition—even fine details of the carvings and mouldings on the lids were intact. The brass screws on the lids were intact, but steel screws were corroded, though the pressure of the overlying soil had generally prevented the lids from opening. There was little warping of the wood and the intact coffins prevented direct contact of the remains with the soil. Water pressure from the clay soil had forced water into the coffins, as a result of the wood acting as a semipermeable membrane. The remains in the coffins were impregnated with a dark stain, which was due to ferric iron, presumably derived from the release of iron from, for example, haemoglobin after biological destruction. Where the coffins were no longer watertight, remains had frequently disappeared.

There were two epidemic pits in the cemetery, unfortunately undated. The bodies had been piled into the pits without coffins, and the bones were friable, suggesting that they had been chemically treated, though their powdered state suggested that if lime had been used, its effects were only transient.

In both sites, but mainly in the graveyard, many of the bones were flaking, before disintegration. In young children, the bones tended to separate spontaneously. Teeth and mandibles were the most durable remains in the skull. Hardness tests showed the tooth enamel to be 3-5% softer than in the living, while the dentine was 25-35% harder. The cephalometric x-ray films of the skulls were noteworthy for their clarity of detail. This was because of the absence of soft tissue remains, which tend to disperse x-rays in the living, to the iron salts impregnating the bone and increasing the radiopacity, and to the dosage of the x-rays not being restricted, as they would be in the living—it had been possible to use plain wrapped films, instead of intensifying screens.

Among the remains recovered was a sawn-off cranium resulting from a necropsy; several healed, depressed fractures of the skull; a cleft palate; and a number of dental anomalies including malocclusions.

Distribution of Recovered Remains

We then assessed the recovered remains to see if they followed a similar distribution to that of the bodies recorded as having been buried, in relation to age and sex at death and length of time in which the remains had been present in the ground. A total of 761 remains were examined; of these, 213 were reasonably established as to their individual identity from the available data.

The incidence of the age at death of those remains exhumed differed from that of those buried. We consider that this is due to the infant mortality, which was very high, in which the infant bones are smaller and thinner, and are not fully calcified, the sutures are wider, and the synchondroses still open. Therefore separation and decomposition occur earlier. Before the age of three it is unlikely that the remains can be recovered, but in later years the two distributions were not dissimilar. The greatest incidence of exhumed bodies was in the middle age group, perhaps owing to greater robustness and resistance to natural disintegration.

When compared with the incidence of burial year of those exhumed, the incidence of burials by the year of the last century again showed certain discrepancies, particularly in connexion with the nearly total disappearance of bodies buried earlier in the century; but most of these bodies would have been interred in the graveyard, within which the acid soil would tend to destroy completely the remains. Indeed, this must have been the fate of a multitude of bodies buried since the 14th century, or the graveyard would have long been filled. The remains from the latter half of the 19th century tended to be exhumed from the cemetery where the preservation of the coffins prevented the destruction of the skeleton by the soil. Another reason for the discrepancies may arise from the existence of paupers' graves, and remains of those of other religious denominations which would not be entered in the parish register. Finally, in the early part of the century, relatively more children and infants died, and as these were buried in the graveyard, they were more likely to be disintegrated. Conversely, later remains, buried in the cemetery, of a higher mean age of death tended to resist disintegration.

The sex incidence also differed at a statistically highly significant level between those buried and those examined, presumably because of the greater robustness of some skulls, particularly those of the male sex. The analysis of social class was more difficult but bodies contained in lead-lined coffins, in family brick vaults (usually associated with the higher social and economic classes) were more likely to resist disintegration than others in the same site.

The relatively large number of edentulous skulls indicated that many must have received dental extractions, and have survived masticatory problems in this period before the widespread introduction of dentures.

Conclusions

Most deaths in 19th century industrial England appeared to result from infectious lesions at a relatively early age. Infant mortality was high, especially earlier in the century.

Workers in textile mills died at an earlier age than the mean age for workers in other occupations.

Women in paid employment were susceptible to a reduced life-span. This may be due to a higher incidence of younger, unmarried workers. The proportion of widows to other women rose during the 19th century.

The dissolution of human remains buried in a mildly acid, sandy soil is such that little is likely to survive over a period of 100 to 150 years, unless in a lead-lined coffin, placed in a brick vault.

The mean age of a population, exhumed from a burial site, is likely to be greater than that of the population buried. This is because skeletal remains which are most likely to suffer earlier dissolution are those of infants and children, while dissolution

tends to be slowest in the active adult years. If infant deaths are common, this difference in mean age is likely to be accentuated.

The balance of sexes of an exhumed population is statistically more likely to predominate in male skeletal remains, because of the relatively greater robustness of the male skeleton favouring preservation.

It is recommended that any subsequent investigation of a similar nature should be conducted on remains exhumed from a non-acid medium.

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Hospital Topics

Mortality from Acute Myocardial Infarction Before and After Establishment of a Coronary Care Unit

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Summary

A retrospective study of the mortality rate of acute myocardial infarction in two groups of patients treated before and after a coronary care unit was established showed no difference between them. Though it is difficult to compare two series retrospectively so far there are no well controlled studies to demonstrate clearly the value of coronary care units.

Introduction

During the past decade many studies on the results of treating acute myocardial infarction in coronary care units have been published (table I). Establishing and operating these units is very expensive and the most appropriate structure for coronary care units is still disputable. The results from Denmark's largest hospital before and after the establishment of a coronary care unit as an integral part of a medical admission section seem to raise some doubt about the generally accepted benefit of coronary care units.

Patients, Methods, and Results

In October 1967 the three medical departments of Bispebjerg Hospital opened a joint medical admission section with 22 beds,

TABLE I—Results from Coronary Care Units compared to Results from Medical Departments without Coronary Care Units

Reference	No Coronary Care Unit		Coronary Care Unit	
	No. of Patients	Mortality %	No. of Patients	Mortality %
Christiansen <i>et al.</i> , 1971 ¹	244	41	171	18
Hofvendal, 1971 ²	139	35	132	17
Killip and Kimball, 1967 ³	100	30	250	28
Langhorne, 1967 ⁴	60	37	70	13
Lawrie <i>et al.</i> , 1967 ⁵	—	22	400	18
Norris <i>et al.</i> , 1969 ¹¹	545	20	300	17
Robinson, 1969 ⁶	200	34	200	27
Present study	603	39	1,108	41

eight of which were provided with electronic equipment for monitoring patients with acute myocardial infarction. All acute medical admissions passed through this section, the emergency cases being brought directly by ambulance without stopping at emergency rooms, etc. Most non-cardiac acute patients were moved to the ordinary medical wards 24 hours after admission. Before being moved all new patients had a nine-lead E.C.G. taken and their serum aspartate aminotransferase (SGOT) and lactate dehydrogenase (LDH) were measured, thus allowing few acute myocardial infarctions to escape unnoticed. All patients with acute myocardial infarction were monitored for six days and then, if no complications occurred, they were moved to an ordinary medical ward for about three weeks of further hospitalization. Patients with a diagnosis of acute myocardial infarction established in other wards were usually moved to the coronary care unit. Contrary to the practice in many coronary care units there was no fixed age limit for admission to the monitored beds. There were no exact rules about which patients should take precedence in case of shortage of monitored beds, but in each case the decision was made on the basis of the age, general condition, and complicating diseases of the patient.

Our study deals with the period from October 1967 to December 1970. The records of all patients with a diagnosis of acute myocardial infarction in the medical wards during this

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