The Milroy Lectures

ON THE

INFLUENCE OF INDUSTRIAL EMPLOYMENT UPON GENERAL HEALTH.

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LECTURE I.

WITHIN the thirty-six years which have passed since the death of Dr. Gavin Milroy many aspects of State medicine have been examined by those to whom the College has accorded the honour of lecturing upon his foundation. Some—for instance, Dr. Boycott in his lectures on ankylostomiasis (1911), or Dr. Collis in his account of the etiology of industrial pneumoconioses (1915)—have had the privilege of describing evils to the amelioration of which their own researches were substantial contributions. Others—such as the late Dr. Bulstrode (1903) and Dr. Hamer (1906)—have brought ripe experience and wide erudition to bear upon more general and still unsolved problems.

The theme I have chosen—the direct and indirect influence of industrial employment upon health—involves the consideration of both solved and unsolved problems. I am conscious that neither by virtue of having contributed to the solution of the former, nor by intimate knowledge of the difficulties of the latter, am I well fitted to throw light upon so important a topic. But the topic is so important, the data are so numerous and so interesting, that the least competent lecturer can hardly fail to advance some propositions worthy of attention.

ANCIENT INDUSTRY.

Factory production, as we understand the term, is so novel, it is so short a time (measured in human generations) since our country was a self-contained agricultural state, that modern industrial medicine has but few traditions. To the founder of this College a description of twentieth-century medico-industrial problems would appear as monstrous, as grotesque, as the story of economic conditions in the nineteenth century seemed to John Ball in Morris's tale. We must pass back to the Roman civilization before we find anything even faintly analogous to our own times. Then we do reach a great population dependent upon imported food supplies; an external luxury and security which moved the envy of Gibbon; a complex social organization which, by the magnitude of its taxation and the multitude of its civil servants, might have inspired the indignant rhetoric of a Harmsworth.

Professor Frank of Baltimore has recently pointed out that an attempt to read into Roman history the economic motives of our time is doomed to failure, but he has likewise shown to how great an extent industrial mass production—factory production—entered into the system of life. In Rome—as indeed in England down to a time covered by the lives of some still with us—the base of the system was agricultural; the organization of the villa became capitalistic before the end of the Republic. After the conquest of Sicily, agricultural production was diverted into channels and adopted methods which remind us of what happened in England during the first half of the sixteenth century. Cattle raising and olive cultivation tended to replace tillage for cereals, and the main source of food was no longer at home. Before the time of the Empire one form of the modern population question had become acute; the *plebs urbana* was the counterpart of our urban “proletariat.” With the change of system, the task of keeping alive a population superfluous for agriculture and no longer so urgently needed for foreign wars provided an opening for industrial organization. This organization developed, but capriciously and incompletely. The best instance of monopolistic mass production is that of brick making; the great property of Domitius Afer, which ultimately passed by inheritance to Marcus Aurelius and became an imperial trust, is a good example. To take another instance, the table ware of Aretinum was widely disseminated; factories in the valley of the Po supplied all the empire except the south-east (Frank, p. 168); ultimately branch factories in Gaul swamped the parent establishments. The scale of produc-

tion was large; a Cornelius had forty designers, Calidius Strigo at least twenty. Bronze and copper ware also seem to have been manufactured on a large scale, while other examples could be given. We are thus assured that a citizen of the Roman Empire must have been familiar with some of the conditions of industrial life; yet no ancient writer has attempted to describe that life.

I suppose that anyone who reads the Roman classics with enough scholarship to overcome the mere obstacles of a foreign idiom, but with too little to be attracted and charmed by linguistic delicacies, perceives the essential inhumanity of the humaner letters, the narrowness of the range of life. Sometimes the vituperation of a slave in comedy—for example, the speech of Olympos in *Casina*, Act I, 117 et seq.—or a thumbnail sketch of an interior, such as that of the mill in Apuleius (*Metam.*, IX, cap. 12, p. 197 of van der Vliet's edition), reveals the hardship and squalor which formed the background of recorded history, but that is all. To quote Macaulay—a philistine, no doubt, but a learned one—“there is a great gulf [between us and the Romans] which no learning will empower a man to clear. Strength of imagination may enable him to create a world unlike our own; but the chances are a thousand to one that it is not the world which has passed away” (Trevelyan, p. 369). Roman literature as an instrument of culture has had many hard things said of it—the hardest and the truest would be that it is often theatrical and nearly always snobbish.

These vices have not only diminished the historical value of the lay writers; they have tainted professional literature. We all know what Cato and the elder Pliny thought of physicians. A greater than either, Tully himself, has indeed allowed a kind of respectability to arts such as medicine of a certain value (*non mediocris utilitas*), but only provided they are practised by persons to whose station in life they are suitable (*iis quorum ordini conveniunt: de Off.*, I, cap. 42). A society which thus esteems physicians will have the physicians it deserves; one gathers from Sir Clifford Allbutt's great work how small those deserts were. Galen practised in Rome for many years and wrote a large treatise on hygiene, not the least celebrated of his books and of special interest to the College, for it was one of those translated by our first president into a Latin esteemed by Erasmus superior to the Greek original. Indeed many worse books on hygiene have been written; Galen's remarks upon physical exercise would secure approval to-day, and if by hygiene we might understand the regulation of the lives of those who may do what they please, we could not wish for a better teacher. Galen makes it perfectly clear that this is the only social class with which he is concerned. He says:

“What is literally speaking the best cannot be attained in all lives, for the greatest part of mankind live encumbered by affairs which must needs injure those engaged in them and are unable to change their condition. Some are driven by poverty to this way of life, others by servitude entailed by inheritance or imposed by force. These indeed according to common speech are the only forms of servitude, although for my part I hold that those who, urged by ambition or cupidity, encumber their lives with occupations which leave them insufficient leisure to care for health are really slaves of the worst kind of masters. To lay down rules of hygiene for such persons is idle. But if anyone by luck or design is free, to him it is proper to describe how he may be healthy, may be tried as little as possible by disease and may grow old agreeably” (*de San. Tuend.*, II, 1, Kuehn, VI, 82).

The only hygienic prescription for the “greatest part of mankind” which I have found in this treatise is a recommendation to common folk whose bodies are full of crudities to take a purge on holidays instead of making matters worse by intemperance and the consumption of bad food (see Book VI, 7, Kuehn, p. 412). This is a modest contribution to the art of industrial hygiene. When, more than fifteen hundred years later, Bernardino Ramazzini* said that it was unworthy of a practising physician to amuse himself with trifles, he may have had, if not Galen, at least some Galenists in mind. When he added: “I have thought it highly serviceable to the State to submit the diseases of artificers to a diligent examination, which until now nobody has devoted to them, and to prescribe their appropriate remedies,” he claimed nothing but his rightful priority. The hygienic lessons which might have been learned from centuries of industrial experience in the Roman world were not learned, or at least were not transmitted to posterity. When towards the end of the eighteenth century our profession was again faced by the hygienic difficulties which the aggregation of handworkers divorced from agriculture imposes upon

* See the preface to *de Morbis Artificum Diatriba*, second edition; p. 272 of the edition of his works printed in London in 1717.

social life, ancient medical literature, to which great prestige still attached, could teach it nothing. This is one of the reasons why the writings of physicians on industrial disease, down to the beginning of the nineteenth century and even beyond, are less valuable than, recalling the rich field of observation, we should have expected.

THE HEALTH OF THE WORKING CLASSES AT THE END OF THE EIGHTEENTH CENTURY.

Although there was difference of opinion as to whether the condition of the people at the end of the eighteenth century were worse than it had been at some earlier date, there was none as to the proposition that it was absolutely bad. Burke was not an "agitator," yet he spoke of the "innumerable servile, degrading, unseemly, unmanly, and often most unwholesome and pestiferous occupations, to which by the social economy so many wretches are inevitably doomed," and added this remarkable passage:

"If it were not generally pernicious to disturb the natural course of things, and to impede, in any degree, the great wheel of circulation which is turned by the strangely directed labour of these unhappy people, I should be infinitely more inclined forcibly to rescue them from their miserable industry, than violently to disturb the tranquil repose of monastic quietude. Humanity, and perhaps policy, might better justify me in the one than in the other. It is a subject upon which I have often reflected, and never reflected without feeling from it" (*Reflections on the Revolution in France*, Payne's edition, p. 190).

The medical history of the great industrial districts during this period is an incident of one of the classics of British medical scholarship, and a story which Dr. Charles Creighton has told nobody need tell again. We find very large populations herded together in circumstances peculiarly favourable to the dissemination of contagious disease, and consequently we have a gloomy succession of typhus, relapsing fever, and small-pox. I permit myself but two remarks—the first is to emphasize the truth contained in the following words of Creighton:

"The long period of comparative immunity from typhus near the beginning of the nineteenth century was first broken, both in Great Britain and in Ireland, by the very severe winter of 1814-15; but it was not until the great depression of trade following the peace of 1815 (which made a difference of forty millions sterling a year in the public expenditure) and the bad harvest of 1816 that typhus fever and relapsing fever became truly epidemic, chiefly in Ireland but also in Scotland and England. The lesson of the history is unmistakable: with all the inducements to typhus from neglect of sanitation in the midst of rapidly increasing numbers, there was surprisingly little of the disease so long as trade was brisk and the means of subsistence abundant. The reckoning came in the thirty years following the Peace" (Creighton, II, 167).

We are apt to forget that the penalty of sin against the laws of hygiene is rarely exacted at once. We cannot rightly appraise the significance of current rates of mortality or morbidity unless we know what went before; that is why medical history is worth studying.

The second remark is that as early as 1796 it had been realized by some that poverty was not the only factor of industrial ill health, that it was not entirely because factory hands were wretchedly lodged, clothed, and fed that they died in such myriads. These points are quite clearly taken in the resolutions submitted to the Manchester Board of Health by Dr. Percival on January 25th, 1796 (see *Select Documents*, p. 495). The first asserts that those working in factories are "peculiarly disposed to be affected by the contagion of fever," and that infection so received is liable to be propagated outside the factory. The second and third are as follows:

"The large factories are generally injurious to the constitution of those employed in them, even when no particular diseases prevail, from the close confinement which is enjoined, from the debilitating effects of hot and impure air, and from the want of the active exercises which nature points out as essential in childhood and youth, to invigorate the system and to fit our species for the employments and for the duties of manhood.

"The untimely labour of the night, and the protracted labour of the day, with respect to children, not only tends to diminish future expectations as to the general sum of life and industry, by impairing the strength and destroying the vital stamina of the rising generation, but it too often gives encouragement to idleness, extravagance, and profligacy in the parents, who, contrary to the order of nature, subsist by the oppression of their offspring."

These resolutions enunciated for the first time the proposition that in addition to the bringing into existence of slum populations, one could find in the immediate circumstances of mass production conditions noxious to general health. We shall see that this side of the matter did not in the ensuing

century receive the attention it deserved, that it is nearly true to say that the close study of intrinsic factory hygiene has been postponed to our generation.

THE EARLY NINETEENTH CENTURY.

In his history of English sanitary institutions Sir John Simon devoted a chapter to the "Growth of humanity in British politics," because he perceived that a quickened sense of humanity, or an uneasy social conscience, was very largely the motive of the public and private inquiries during the first forty years of the nineteenth century which produced the legislation of Queen Victoria. No less powerful motive would have sufficed to call into being the large amount of literature which appeared—especially between 1830 and 1850. The general historical value of this material is great, but from the medical side it is inevitably defective. Very few people can reason well when they are angry, even when they are righteously angry; attack provokes defence or counter-attack; in presence of social evils a generous-minded man acutely conscious of these evils is sorely tempted to use any intellectual weapon to his hand, and to forget the story of Eli's sons. Then, again, nobody can free himself from the empire of intellectual theories, the idols of the study. These shortcomings, absolutely inevitable shortcomings (we do not see them in our own researches, but the Milroy lecturer of 2022 will point them out), are obvious enough in the reports of committees and commissions of inquiry eighty or ninety years ago. Here we are interested chiefly in the intellectual side of the work, and its defects, I think, may be resumed under two headings: (a) an inadequate grasp of the statistical method; (b) a failure to escape from Galenical realism. The former defect was, I think, the more serious. It was not until after most of the reports to which I refer had been completed that we possessed accurate statistics of mortality through which we could relate deaths to risk. Wanting these data, appreciations of mortality could only be obtained indirectly, and the limited value of the indirect methods was not always perceived by those who used them. The pioneer investigators, Thackeray of Leeds and Edwin Chadwick, almost exclusively based conclusions as to the comparative healthiness of different localities or trades upon confrontations of the mean ages at death. Although the fallacy of this method seems to us very obvious, and had been already exposed at the time to which we refer by both Neison and Farr, little notice was taken of the criticisms, with the result that many of the statistical tables printed by Chadwick are of very small value. Another indirect method of assessing the importance of particular causes of deaths, that of comparing the proportion of such deaths to all deaths in several trades or localities, which was also extensively used, although less objectionable, can only be trusted if precautions are observed and subsidiary tests employed which the early Victorian writers neglected. These statistical errors were imposed upon the inquirers by the nature of their data, and the only blame attaching to them is that they were too chary of self-criticism, a charge on which a verdict of guilty will be returned against all of us on some future day of reckoning. These criticisms are directed to the attempts to estimate English regional or occupational mortality during the years of the nineteenth century before the establishment of the General Register Office; we must, I think, deem them unsuccessful attempts and confine ourselves to the years following 1838 so far as the discussion of mortality is concerned.

But the General Register Office has necessarily been restricted to the study of births, marriages, and deaths, while the various commissions and committees of the early and mid-Victorian age printed much evidence of a statistical character dealing with the morbidity, physique, housing conditions, and factory conditions of the working classes. These data are ample to establish the existence eighty years ago of a vast amount of unwholesomeness—enough to justify the severest strictures of Chadwick and Simon. They are not, however, sufficient to sustain a comparison between the circumstances of the industrially employed and the rural populations of the time, owing to errors of method. When it is not possible to examine all the members of the "universe" under consideration—this possibility is only realized in a complete census and then only for very simple characters—one is forced to adopt the method of sampling, and the validity of inferences drawn from the examination of the samples depends upon (1) a satisfactory assurance that the sampling has been random or, if not random, that the bias

can be characterized, and (2) measurement of the probable range of random fluctuations of sampling. In the best recent sociological inquiries, such as those of Professor Bowley and his colleagues, to which I shall again refer, the importance of these considerations has been realized. This was not so eighty years since. A good deal of the evidence tendered consisted of the opinions of "experts" resting upon experience the sufficiency of which cannot be determined. Many of the statistics relate to small collections of data reduced to categories the significance of which may have varied, and probably did vary, from observer to observer. To attempt to deduce from these fragments any measure which shall confirm or weaken the teaching of mortality statistics is, I fear, a hopeless undertaking. I can illustrate the difficulties from a recent instance.

The Ministry of National Service issued in 1920 an analysis of the results of physical examination by medical boards from November 1st, 1917, to October 1st, 1918. The information contained in this report is enough to prove that the absolute volume of physical inefficiency in this country is enormous; the simple fact that out of 2,425,184 examinations or re-examinations more than a quarter of a million men were found to be "totally and permanently unfit for any form of military service" is a very dreadful fact, explain it how we may. But the authors of the report did not confine themselves to the recital of these facts; they deemed it "probable, therefore, that the men examined during the year under review may be regarded in the aggregate as fairly representing the manhood of military age of the country in the early part of the twentieth century from the standpoint of health and physique." In other words, they claimed to have fulfilled the requirements of random sampling.

Down to October 31st, 1917, and after August 4th, 1914, the War Office had recruited in England and Wales 3,190,618 men for general service and 615,365 men for other grades—that is, 3,805,983 men mainly between the ages of 18 and 40 had been excluded from the Ministry of National Service's field of sampling. From a consideration of the enumerated population in 1911 and the rates of mortality, I should suppose that between 6,800,000 and 7,200,000 men came within the limits of 18 and 40 during the period of War Office recruiting—that is, the War Office had already dealt with something like half the available population. What are the grounds for inferring that the residue were a random sample? The Ministry of National Service adduced the following arguments:

1. In the early days of the war many unfit men were passed as fit owing to haste and ill-considered methods of examination.

2. A very large number of men were at first protected, and those protected industries "employed an abnormally high proportion of the physically fit."

3. Men were examined who "had been previously rejected when the need was less urgent."

4. A large proportion of lads attained the age of 18 during the war.

5. A certain number of men between the ages of 41 and 51 first became liable for service under the Military Service (No. 2) Act.

That portion of the Ministry's experience which relates to youths who attained the age of 18 after October 31st, 1917, is, so far as selection by the War Office is concerned, not biased; men between 41 and 51 in protected industries were not, I think, examined. To admit the wider claim is to accept the first three propositions. Of these (2) might be partially verified; the mortality at military ages of coal-miners and of agricultural workers is less than the average; whether this is true of other protected industries is a question I cannot answer, nor does it receive any statistical discussion in the Report. Propositions (1) and (3), which assume the existence of two biases, the one tending to raise, the other to lower the proportion of unfit men removed from the population or added to it, seem to me quite incapable of being tested. The mere fact of the existence of the former bias, which the Report states to be "notorious," and of the latter, the existence of which was within the direct knowledge of the Ministry of National Service, must, as I think, deprive the data—with the exception just noticed—of any claim to be regarded as random samples of manhood of military age; at the most there was a random sampling of youths of 18. It is no strong argument in favour of the accuracy of a sum total to be able to say that two of the items cast are wrong, and to surmise that their errors may cancel out. (See par. 54, p. 24, of the Annual Report of the Chief Medical Officer of the Board of Education; Cmd. 995 of 1920.)

Perhaps data exist to establish the propositions which I suggest are doubtful; in any event the subject can be discussed *viva voce*. When similar uncertainties attach to the data of two generations ago, we cannot pass behind the printed words and must neglect what we think needs verification.

The other defect of the earlier literature is historically interesting, but may be dealt with more briefly. Galenical etiology put the maximum of stress upon the all-embracing atmosphere, its katastases and their operation upon men's bodies leading, when an appropriate dyscrasia existed, to humoral corruptions. In time the doctrine—not originally, as I have tried to show elsewhere, unreasonable—became, like the peccant humours themselves, extremely corrupt; the belief in some putrefaction or subtle organic impurity of the

air—a notion which survives in the belief in the etiological importance of sewer gas—dominated scientific opinion until late in the nineteenth century. Simon, writing in 1858 of typhus, held that "the exhalations from a patient undergoing it are, till they have been neutralized by dilution with pure air, capable of communicating the same form of disease" (Simon, 1445), and adds a footnote explaining the susceptibility and powers of transmitting the disease of the famine-stricken by the undefaecated condition of their tissues and juices, an explanation which would have been acceptable to Galen.

Our grandfathers had, of course, grasped the importance of an etiological factor which Galen mentioned but slighted; they were fully awake to the dangers of water or food supplies liable to contamination with excremental matter. But, after making this extremely important exception, one finds little in their etiology which would have been strange to Linacre. This, I think, is the reason why, next to water and drains, ventilation—and ventilation in a rather restricted sense of the term—was the staple of Chadwick's and Simon's reports. This preoccupation caused them to miss etiological factors to which we are now beginning to attach importance, especially, perhaps, the physiologico-psychological predisposing causes of ill health. But, since ventilation, expressed in terms of a wider philosophy than the Galenical, is still recognized to be of the highest importance, what was lost was not perhaps much.

METHODS OF INVESTIGATION.

I have now brought the story down to an epoch from which into our generation a continuous statistical record exists. As a loyal member of this College, mindful of the importance the College attaches to the study of historical origins, whether of theory or practice, it was my duty to describe, however imperfectly, the fragments of early experience handed down to us. What remains must be examined with more precision, and I shall first indicate the manner in which, as I think, one ought to proceed.

In the first place, we may adopt the historical-statistical method. We know that this country, already a great industrial nation seventy years ago, has become more and more industrialized. It no longer, indeed, enjoys—if that be the fitting expression—the industrial hegemony of the world, but in each successive decennium a larger proportion of its citizens have spent their lives in industrial pursuits. Hence our records of mortality are those of a continuously changing community, the change being one of increasing urbanization. The changes in the extent and distribution of mortality are changes highly correlated with industrialization. These must therefore be examined both as a whole and in the several divisions of the country which have been more or less immediately concerned in industrial development.

But unless we can place beside this chronological record that of some other country wherein the economic development has differed very much from that of England and Wales, we shall be unable to draw any conclusions as to the influence of industry upon the changes in the public health which our mortality registers indicate. For this purpose I employ the vital statistics of Sweden, a country the statistics of which are nearly as valuable as our own, and have been published regularly for a much longer period. Seventy years ago Sweden was almost wholly an agricultural and maritime state; at a time when more than half our population was already urbanized not more than 10 per cent. of the Swedes lived in towns (Hendriks). In the last forty years industrialization has notably advanced in Sweden, and now almost half her people live by industry; even now, however, there is relatively much less factory employment in Sweden than in England and Wales.

But the historical-statistical method, even with the help of such a control series as here utilized, is impotent to provide answers to all our questions. In no other branch of statistics is the method of multiple correlation more needed or more difficult to employ. We must have resort to the method of contemporaneous comparisons and must contrast the industrial and non-industrial sections of the population observed over one and the same period, that period being our own generation. It will soon appear that even this method is treacherous, that there are numerous etiological factors which available data leave obscure. Indeed, my analysis raises more questions than it settles, and, chiefly for that reason, I exclude technical discussions to which, as a statistical epidemiologist, I attach importance.

THE VICTORIAN AGE.

In the Supplement to the thirty-fifth Annual Report of the Registrar-General, almost the last and one of the finest contributions to official literature of Dr. William Farr, there is a table, which I reproduce (Table I), of the death rates at

TABLE I.—*Annual Mortality per Cent. of Males and Females in England and Wales.*

(Supplement to 35th Annual Report of the Registrar-General, p. xxvi.)

Ages.	Males.		Females.	
	1838-54.	1838-71.	1838-54.	1838-71.
All ages ...	2.33	2.33	2.17	2.15
0 ...	7.25	7.26	6.23	6.17
5 ...	0.92	0.57	0.91	0.95
10 ...	0.52	0.49	0.54	0.50
15 ...	0.82	0.78	0.5	0.80
25 ...	1.00	0.93	1.06	1.01
35 ...	1.28	1.30	1.17	1.23
45 ...	1.85	1.85	1.59	1.56
55 ...	3.18	3.20	2.82	2.80
65 ...	6.69	6.71	6.00	5.89
75 ...	14.76	14.71	13.44	13.43
85 ...	30.14	33.55	27.52	27.95
95 ...	44.03	44.11	43.22	43.04

ages for the seventeen years 1838-54 and for the whole available period 1838-71. It will be noticed that from the age of 5 to the age of 25 the death rate of males is slightly lower in the second than in the first half of the table, but from 35 to 75 the two rates are either equal or that of the complete series is higher. The death rates of women exhibit a decline at each age above 5. In the middle period of life male mortality either did not improve or somewhat deteriorated over this series of thirty-four years. These are the rates of all England and Wales, and, since the agricultural population was declining, are increasingly weighted by the experience of the industrial districts. In Table II are set out some details of contrasting areas selected from the ninth Annual Report of the Registrar-General and from the first two decennial supplements. It will be seen that, with the exception of the registration district of Manchester, mortality at ages 10-15 was less in 1861-70 than in 1838-44. This is also true of the ages 15-20 and 20-25, but not generally true of later maturity. Take as an example the age group 45-55, and compare the South-Western Registration area, which included, and still includes, a large proportion of agriculturally employed persons, with the great industrial districts of Birmingham and Manchester. The South-Western rate on males was in 1861-70 almost the same (not quite 2 per cent. higher) as in 1838-44. So was the Birmingham rate (a decrease of less than 1 per cent.). The ratios of the two rates were 1.77 to 1 in 1838-44, 1.73 to 1 in 1861-70. The female rates were in the proportion of 1.50 to 1 in the former and of 1.62 to 1 in the latter period. Manchester emerges still worse from the comparison; the ratios are 1.95 and 2.18 for males, 2.20 and 2.35 for females. Contrast these with the rates upon adolescents. The mortality of males aged 10-15 in Birmingham was in 1861-70 only 79 per cent. of what it had been in 1838-44, of females 78 per cent. The adolescent mortality in the South-West had improved, but not so much—86 per cent. and 81 per cent.; so that the ratio of town to country fell, 1.21 to 1.11 for males, 1.07 to 1.03 for females. This is a different picture, but Manchester makes an even worse showing than in ages of maturity; her ratios to the South-Western are 1.27 and 1.70 males, 1.34 and 1.40 females. We must be careful not to attach great importance to particular instances; even our national vital statistics are to be used with caution or we are entangled in the snare of realism. We all know how increasingly untrustworthy as measures of mortality in the capital the old bills became, because London "within the bills" grew less and less typical of London as an economic or social unit. The same difficulty is met when we compare any registration district at intervals of many years. The

TABLE II.—*Rates of Mortality per 1,000 at Different Ages and in Certain Registration Districts.*

	1832-44.		1851-60.		1861-70.	
	M.	F.	M.	F.	M.	F.
AGED 10 TO 15.						
England and Wales ...	5.04	5.48	4.83	5.06	4.45	4.48
London... ..	4.82	4.66	4.52	4.15	4.24	4.07
Birmingham... ..	5.39	5.47	4.97	4.90	4.24	4.24
Manchester	5.67	6.81	5.75	5.60	6.51	5.79
South-Western Counties...	4.46	5.09	4.38	4.94	3.83	4.13
AGED 15 TO 25.						
England and Wales ...	8.05	8.33	6.69 8.83	7.38 8.53	6.16 8.45	6.62 7.96
London... ..	7.59	6.19	6.25 8.31	5.43 6.44	5.82 8.23	5.10 6.22
Birmingham... ..	7.58	7.35	6.53 7.92	6.56 7.37	5.55 7.55	5.14 7.02
Manchester	9.26	8.71	8.43 10.14	7.85 9.49	9.39 11.67	7.40 9.55
South-Western Counties...	9.26	9.09	5.59 8.83	6.77 9.93	5.38 8.30	6.6 7.68
AGED 25 TO 35.						
England and Wales ...	9.58	10.09	9.57	9.92	9.90	9.68
London... ..	10.70	9.17	10.50	8.75	10.85	8.80
Birmingham... ..	10.95	9.26	10.12	9.85	10.85	9.10
Manchester	12.93	12.48	12.93	12.29	14.69	13.07
South-Western Counties...	9.26	8.71	9.32	8.90	9.67	8.71
AGED 35 TO 45.						
England and Wales ...	12.49	12.42	12.48	12.15	13.46	12.03
London... ..	17.88	13.77	16.29	12.81	17.14	12.84
Birmingham... ..	17.46	13.78	16.24	13.72	17.70	13.08
Manchester	19.84	17.80	20.35	17.37	23.25	19.26
South-Western Counties...	10.81	10.45	11.01	10.24	11.68	9.96
AGED 45 TO 55.						
England and Wales ...	17.76	15.48	17.96	15.20	19.16	15.55
London... ..	27.26	20.01	24.68	18.06	25.68	18.52
Birmingham... ..	27.58	19.28	25.87	19.08	27.41	19.82
Manchester	30.40	28.31	31.70	27.16	34.58	28.76
South-Western Counties...	15.55	12.88	15.32	12.55	15.83	12.26
AGED 55 TO 65.						
England and Wales ...	31.41	27.82	30.85	27.01	33.00	27.77
London... ..	48.12	33.05	42.43	33.27	43.85	33.45
Birmingham... ..	44.28	37.43	45.81	35.23	46.57	38.48
Manchester	52.47	44.66	52.66	44.76	60.67	50.31
South-Western Counties...	27.41	23.87	27.38	23.02	27.24	22.36

name persists, the proportion what is measured bears to what we think we are measuring changes. I believe we may infer from these statistics no more than that in those palmy days of industrial supremacy which followed the repeal of the Corn Laws adolescent mortality in the whole population improved, while the mortality of adults did not improve but even deteriorated, and deteriorated more in the industrial districts than in the agricultural areas. But perhaps this was a world phenomenon purely accidentally correlated with the growth of modern industry. To settle this we must extend our horizon and take notice of the changes in some other country where, during this period, industrial employment was unimportant. In Table III the statistics of England and Wales are compared with those of Sweden; I shall have to mention these again later, now I invite attention to the parting of the ways between Sweden and ourselves; within this period Swedish mortality during ages of maturity at first higher than ours, crossed the English line in its descending path, and established a superiority which has ever since characterized it.

If we now recur to the social-hygienic progress of the time some correlative facts are noteworthy. Nearly all the legislation relating to industrial employment before the reign of Victoria was intended to shield children and young persons

TABLE III.—Rates of Mortality in England and Wales and in Sweden.

Ages :	MALES.						FEMALES.					
	15-20.		20-25.		25-35.		15-20.		20-25.		25-35.	
	England and Wales.	Sweden.	England and Wales.	Sweden.	England and Wales.	Sweden.	England and Wales.	Sweden.	England and Wales.	Sweden.	England and Wales.	Sweden.
1846-50 ...	7.3	4.9	10.0	7.0	10.5	8.9	8.1	4.7	9.6	5.7	11.2	7.1
1851-55 ...	7.0	5.4	9.2	7.5	10.0	9.7	7.8	4.9	8.9	5.7	10.3	7.8
1856-60 ...	6.4	5.9	8.4	8.1	9.2	8.8	7.1	5.5	8.2	6.0	9.6	7.5
1861-65 ...	6.4	4.5	8.7	6.6	9.7	7.2	6.9	4.1	8.2	4.9	9.8	6.3
1856-70 ...	6.0	5.2	8.3	7.4	10.1	8.4	6.4	4.3	7.8	5.3	9.6	7.0
1871-75 ...	5.7	4.5	8.1	7.7	10.0	8.5	5.9	4.3	7.4	5.7	9.2	7.2
1876-80 ...	4.9	4.6	6.7	6.6	8.7	7.2	5.0	4.6	6.2	5.4	8.0	6.7
1881-85 ...	4.5	4.5	6.0	6.7	8.2	7.0	4.7	4.6	5.9	5.3	7.9	6.4
1886-90 ...	4.1	4.5	5.5	6.5	7.4	6.6	4.1	4.5	5.2	5.3	6.9	6.3
1891-95 ...	4.0	4.6	5.2	6.8	7.1	6.7	4.0	4.7	4.8	5.7	6.6	6.4
1896-1900 ...	3.6	4.7	4.9	6.7	6.5	6.7	3.3	4.8	4.1	5.7	5.6	6.3
1901-05 ...	3.2	4.8	4.4	6.7	5.9	6.4	3.0	5.0	3.7	5.6	5.0	6.3
1906-10 ...	3.0	4.3	4.0	6.3	5.3	6.0	2.8	4.5	3.3	5.5	4.5	5.9
Ages :	35-45.		45-55.		55-65.		35-45.		45-55.		55-65.	
	England and Wales.	Sweden.	England and Wales.	Sweden.	England and Wales.	Sweden.	England and Wales.	Sweden.	England and Wales.	Sweden.	England and Wales.	Sweden.
1846-50 ...	13.6	14.2	19.2	22.6	33.2	36.9	13.7	10.6	17.0	15.2	29.7	28.4
1851-55 ...	12.9	11.6	18.6	23.0	31.5	38.1	12.6	11.4	15.8	15.8	27.8	30.0
1856-60 ...	12.2	11.9	17.5	19.2	30.4	33.7	11.9	10.3	14.8	14.5	26.5	28.2
1861-65 ...	13.2	10.1	18.9	16.5	32.8	31.1	12.1	8.7	15.5	12.2	27.9	24.5
1866-70 ...	13.8	11.8	19.6	18.6	33.5	34.2	12.1	9.8	15.8	13.6	27.9	26.4
1871-75 ...	14.3	10.8	20.3	16.2	34.8	28.4	12.0	9.2	15.9	11.9	28.7	22.4
1876-80 ...	13.4	9.3	19.8	14.0	34.9	24.8	11.2	8.1	15.4	10.7	28.6	20.0
1881-85 ...	12.8	8.9	19.3	13.6	34.2	24.4	11.0	7.9	15.2	10.4	28.1	15.4
1886-90 ...	12.0	8.2	19.4	12.6	35.2	22.8	10.3	7.7	15.0	9.9	28.8	18.5
1891-95 ...	12.0	8.2	19.6	12.3	35.9	22.6	10.2	7.7	15.2	9.9	29.5	18.2
1896-1900 ...	11.1	8.1	18.3	12.0	34.1	21.7	9.1	7.4	14.3	9.6	27.4	17.0
1901-05 ...	9.7	7.6	17.0	11.7	32.4	20.8	8.0	7.2	13.1	9.3	25.4	16.8
1906-10 ...	8.6	7.1	15.5	10.9	31.2	20.1	7.1	6.8	12.0	8.9	24.3	16.0

from ill treatment, by the horrors of which "even the methodical and dry language of official documents is startled into life" (Gibbins), and it was not until 1833 that these victims received the protection of State-appointed inspectors. It was not until 1847 that the Ten Hours Act, which still only applied to *female* adults, did indirectly shorten the hours of labour of men. But this Act, as the provisions of and discussion upon an Act of 1850 indicate, was often evaded, and it is substantially correct to say that the Factory Act of 1867 was the first to deal with the matter on a really wide scale.

This Act brought within its scope all the metal trades, foundries, engineering shops, the manufacture of paper and of glass, the tobacco industry, and printing. It also provided that any place in which fifty or more persons were industrially employed should be deemed a factory. A few years before this Greenhow's studies of industry and disease had been published in the medical reports of the Privy Council, and, as Professor Collis and I have suggested elsewhere (Collis and Greenwood, p. 33), the provisions of the Act respecting the removal of injurious dust may well have been motivated by Greenhow's researches.

In this year, too, the first Workshops Act was passed, regulating the conduct of industrial establishments employing less than fifty persons. Young persons and women might only be employed for twelve hours, less half an hour for meals, and no protected person might be employed after 2 p.m. on Saturdays. The duty of enforcing this Act was not, however, laid upon the State inspectors until 1871.

We see, then, that industrial health legislation almost to the end of the period we have been considering only concerned protected persons—women and children—that the Act which indirectly affected the working conditions of adult men only became fully operative within a year or two of its close.

With these facts we may correlate the stagnation—if not worse—of adult mortality. After this period, after indirectly effective legislation dealing with adult labour, the rate of mortality at ages of maturity did decline. Put into other words, the story is this: The generation from 1837 to 1870 was, hygienically speaking, characterized by (1) a very considerable improvement of public sanitation, in particular of urban water supplies; (2) a reduction of hours of labour and an improvement of the conditions of industrial work amongst "young persons" and women. There was also improvement, but, to judge by still existing conditions, not a very great improvement, of the domestic housing of the working classes. Both (1) and (2) would be expected to produce their greatest effects upon mortality at ages between, say, 2 and 20 (in childhood and adolescence). The conditions of domestic sanitation which multiply infant deaths were not improved; the factory laws only helped the young persons and women, and a large proportion of the industrially employed women were and are young women. Hence the stagnation of mortality in the earliest years of life and after adolescence, together with the improvement in later childhood and at adolescence, may be consequences of what was done and what was left undone. One of our greatest sanitary triumphs has been over water-borne diseases such as typhoid. At the period under notice typhoid was not statistically distinguished from typhus; in 1851-60 the combined group was responsible for 14.1 per cent. and 12.8 per cent. of all deaths at ages 10-15 and 15-20 (males), but for less than 5 per cent. of deaths at ages over 35. But this recital does not authorize us to replace correlation by causation.

No student of medical history doubts the truth of Bishop Butler's words: "What a wonderful incongruity it is for a man to see the doubtfulness in which things are involved, and yet to be impatient out of action, or vehement in it." Read Dr Creighton's interpretation of the epidemiology of

plague in the light of Pariset's theory; none of the rich, the exhaustive series of facts but is perfectly congruent with the theory; the pieces fit together like the elements of a jigsaw puzzle. Yet we all recognize now that Pariset's theory is false. The condition that a hypothesis shall describe all the available facts is necessary to its validity but is not sufficient to guarantee it more than a provisional value. We have to bear this in mind when we seek to interpret the vast complex of industrial phenomena. We are to remember that an industrial community attracts to itself immigrants both from the non-industrial districts of the country within which it is situated and from other countries, and subjects these migrants to a new form of environmental selection.

In Dr. Perry's study of one of the great seats of the American cotton manufacturing industry it is shown that the incidence of mortality upon workers of different races varies enormously. The general death rate per 1,000, at ages 15-45, over the period studied (1908-12) was 6.97 amongst Americans, 8.31 amongst English, and 17.26 amongst Irish (p. 238). This is perhaps an example of the consequences of introducing an "unsalted" population to factory life of which I shall speak later. But as the supply of home-born labourers increases and migration relatively decreases it might be that the incidence of excess mortality would be shifted to the later ages. It might be that the phenomenon to which I have drawn attention is rather due to a change in the character of the population than in the nature of their environment. To study this matter we should need data which do not exist; the possibility can be stated, its probability cannot be measured. Still there is one set of facts which, though by no means decisive, is yet of importance.

I have already commented upon the unfavourable comparison between our mortality in later ages and that of Sweden, and the favourable contrast between our adolescent mortality and that in the Scandinavian countries. More will be said of this; now I would remark that, in the opinion of many Swedish medical men and statisticians, the extremely unfavourable position between the ages of 15 and 25 is attributable to industrial employment. It is noteworthy that Swedish industrial legislation for the protection of young persons in the matter of length of hours, night employment, etc., is still less stringent than our own and only became really effective within the last twenty years; that is to say, that the rising importance of Swedish industries which has been associated with a stagnation of mortality at adolescent ages did not, as did the Victorian growth of factory industry, produce either so early or so complete a legislative interference in the interests of national hygiene as we have experienced. Again I repeat the caution that other explanations are possible. Still it is a fact that the country in which growing industries were accompanied by hygienic control of juvenile labour experienced a declining juvenile mortality; the country which introduced such control late in time has had a stationary juvenile mortality.

EXCISION OF THE HEAD OF THE FEMUR IN ARTHRITIS DEFORMANS (OSTEO-ARTHRITIS) OF THE HIP-JOINT.*

BY

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THE variable terminology of chronic joint diseases has been productive of much confusion, but it is well recognized that the chronic "non-specific" joint diseases of adult life fall into two great groups—the rheumatoid and the osteo-arthritis—each presenting a clinical picture and a train of morbid joint changes of a distinctive type. Both were formerly included under the term "arthritis deformans," but should properly be regarded as separate clinical and pathological entities; if the term is retained it is more applicable to the osteo-arthritis class alone, for it is here that bony deformation of the articular ends is a conspicuous feature.

We may thus define osteo-arthritis of the hip-joint as a chronic monarticular lesion, the dominant pathological changes being of a hypertrophic nature as indicated by the development of marginal osteophytic deposits with expansion

and mushrooming of the femoral head, but with no tendency towards the production of true ankylosis. The term "morbus coxae senilis," often applied to this affection, is a misnomer. The clinical, pathological, and radiographic pictures of osteo-arthritis of the hip may be seen at varying periods of life: in the adolescent, in the young adult, in middle life, and in old age. It is, however, in the middle-aged individual that we encounter the fully matured arthritis with its consequent serious crippling and disablement.

ETIOLOGICAL CONSIDERATIONS.

A review of some forty cases under observation and treatment during the past few years seems to show that osteo-arthritis of the hip can be classified into three more or less arbitrary groups.

1. *Infective*.—In this group there is definite evidence of the continued existence over a long period of time of some active focus of infection, this in the majority of instances being sepsis in connexion with the mouth or nasal passages. In these patients the joint changes are often far advanced in early middle life.

2. *Traumatic*.—Under this heading are included those cases of osteo-arthritis of the hip which appear to follow the infliction of a single severe trauma. In a certain number of cases this has been an actual crush fracture of the neck of the femur without immediate displacement; absence of displacement accounts for the fact that the patient is able to bear weight on the limb almost at once, and in consequence the actual lesion may escape diagnosis. In this class of case there is invariably a latent period between the infliction of the injury and the onset of the subjective signs of arthritis, and it is usual for the patient to consider that complete recovery from the accident had occurred. The age incidence in this group tends to be higher than in the infective class. The end result of this type of incomplete fracture may be contrasted with the hip-joint disability seen in cases of non-union following a complete solution of continuity of the femoral neck.

3. *Secondary*.—The third class comprises those cases in which there is seen to be the development of signs of progressive arthritis in a hip-joint which at an earlier period—in childhood or adolescence—has been the seat of some deforming process, such as pseudo-coxalgia or arthritis deformans juvenilis. These hip-joints from early life have exhibited a structure departing from the anatomical normal, but there has been a period of complete quiescence from symptoms until in later life certain influences, such as infection, trauma, or chronic strain, provide the necessary etiological factors to initiate a renewal of active arthritis.

The separation of these different groups is somewhat artificial, for it is probable that in the majority of cases of osteo-arthritis of the hip-joint the actual etiology is complex and represents the interplay of a combination of factors.

CLINICAL CONSIDERATIONS.

I shall not give a long description of the ordinary clinical features, pathological changes, and radiographic signs characteristic of osteo-arthritis of the hip-joint, but will content myself by briefly emphasizing certain important clinical aspects of the typical case.

Early Stages.—In the early stages the outstanding symptom is the long persistence of severe pain localized to the region of the hip-joint, and referred along the distribution of both the sciatic and anterior crural nerves. Many of these patients are diagnosed as suffering from so-called sciatica, and receive the whole gamut of inappropriate treatment for a long time before the underlying lesion is discovered; it is therefore important that an early efficient physical examination of such a patient should be made. There are certain difficulties in the way, for at this period the early bone changes may be relatively inconspicuous or invisible even in the best radiograms; again, in obese individuals it is no easy matter to obtain good hip-joint skiagrams. It should be unnecessary to insist on the futility of interpretations derived from the examination of a radiogram of one hip-joint alone without comparison with its fellow. In the earlier stages of the disease the limitation in the mobility of the joint is comparatively slight; it usually affects the range of abduction only, but in some cases the movements of flexion and internal rotation also. The patient himself is often soon aware that a restricted mobility has developed because of his inability to bend down in comfort to take off or lace the boot on the affected side.

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