TESTS
OF A
THRIVING POPULATION
BY
DR. TWISS.

ON

CERTAIN TESTS

OF A

THRIVING POPULATION.

FOUR LECTURES

DELIVERED BEFORE

THE UNIVERSITY OF OXFORD,

IN LENT TERM, 1845.

BY

TRAVERS TWISS, D.C.L. F.R.S.

PROFESSOR OF POLITICAL ECONOMY, AND FELLOW OF UNIVERSITY COLLEGE, OXFORD.

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The following Lectures have been selected for publication from the course delivered in Lent Term, 1845, in accordance with the conditions of the foundation of the Professorship of Political Economy. Their form has been slightly remodelled, from the necessity of omitting some portions which were connected with the subsequent Lectures, and the tabular results of M. Mallet's researches at Geneva have been inserted for the first time in the fourth Lecture, as they could not well be delivered orally. The title which has been prefixed has been selected as explanatory of the questions which have been chiefly discussed; but the general scope of the course of Lectures was more comprehensive. If, therefore, the accompanying discussions should seem to be incomplete, the requisitions of the foundation must furnish my excuse for their fragmentary character.

T. T.

University College, Oxford,
April 10. 1845.

TESTS

OF

A THRIVING POPULATION.

LECTURE I.

ADAM SMITH, in the 8th chapter of the "Wealth of Nations," has laid it down that "the most decisive mark of the prosperity of a country is the increase of the number of its inhabitants." "It is plain, however," adds Mr. M'Culloch in commenting on this passage, "that this remark must be received with great modification," and M. Blanqui, in his improved edition of M. Garnier's French version of Dr. Smith's work, appends at the foot of the page the words "et l'Ireland!"

It can hardly be doubted that a decrease of the population is amongst the most conclusive symptoms of the decay of a country; and if Dr. Smith's statement had been slightly qualified, if he had laid it down that the increase of the

relative number of inhabitants, who are of full age and strength to labour, is in one respect the surest indication of the thriving and prosperous state of a community, his position might have been unassailable. Experience, however, has abundantly shown that there are circumstances under which the absolute numbers of a community may increase without any amelioration in their physical condition, and sometimes even with considerable deterioration.

"The Wealth of Nations" was published in 1776. At that time its author, in illustration of his statement above quoted, and in confirmation of what he had previously asserted in respect to North America being much more thriving than England, observes, that in Great Britain and most other European countries, the inhabitants "are not supposed to double in less than 500 years. In the British Colonies and in North America it has been found that they double in twenty or twenty-five years." How little did this eminent writer then anticipate that within the comparatively short interval which has elapsed since he wrote his great work, the population of Great Britain would have actually doubled itself, that is, within a period of less than seventy years. For, if we take the average estimate of the population of Great Britain in 1776, at 9,100,000, we shall find, from the census

of 1841, the numbers increased to 18,844,434. Again, if we cast our eyes a little further back, we shall perceive this acceleration steadily in progress, since the population of England and Wales more than doubled itself in the period between 1740 and 1821.

It would be an interesting investigation to ascertain accurately the corresponding progress of Great Britain, in its various branches of material prosperity. Such an enquiry, however, would exceed the limits to which I propose to confine myself on the present occasion. I shall therefore briefly direct your attention to a few facts. That the prosperity of Great Britain should have increased, would require not merely that its population and the means of subsistence should have doubled in a given period; for so long as population and subsistence march abreast, no change can take place in the material condition of a people, but that its capital should have increased faster than its population. A money estimate of the capital of Great Britain would not enable us to determine this problem, for such an estimate would be so much affected by the variations in the exchangeable value of money, as to furnish no safe criterion. For instance, the increased money value of the rental of land in England would not necessarily indicate the proportion in which the productiveness of

agriculture had been augmented: if in the course of the last 150 years the money rents in England should have been trebled, or in some cases quadrupled, we should not therefore be warranted in concluding that the landlord's proportion of the produce had been increased in that ratio. Again, the *declared value* or *money value* of our manufactured exports would be a totally false measure of the increase of the quantity exported, if their quantity be looked to as an index of the growth of our manufacturing capital. For our present purpose, therefore, I shall prefer to test the increase in the prosperity of the population by their increased consumption of certain given articles of food, which implies an increased power of procuring the necessaries of life, resulting undoubtedly from the increased efficiency of their labour.

Let us take, for instance, the article of grain in the first place. Mr. Charles Smith, in his Tracts on the Corn Trade, estimated the population of England and Wales in 1760 at 6,000,000, which is sufficiently near the truth for our present enquiry. The entire consumption of grain at that time he estimated to be 7,550,350 quarters, of which 3,750,000 quarters were wheat, and of the remainder 1,026,125 consisted of barley, 999,000 of rye, and 1,791,225 of oats.

The change which has taken place in the spe-

cies of grain used for bread in England since the period referred to by Mr. Smith, is notorious. Rye has almost entirely ceased to be employed. The same remark might almost be applied to barley; and oatmeal and oatcake are not consumed to anything like the same extent as in the previous century. Almost every individual now uses wheaten bread, and in some of our manufacturing towns the inferior sorts even of wheaten flour have been rejected by all, except the most indigent, classes.

The total average produce of grain in England and Wales has been estimated, within the last ten years, at 29,450,000 quarters, of which 12,450,000 quarters consist of wheat. (M'Culloch's Statistics of the British Empire, i. 529.) It would thus appear that whilst the population of England and Wales has doubled, the consumption of wheat, as well as of other grain, has nearly quadrupled; for the home producer is unable to supply the demand of the consumers, and an annual average of at least 500,000 quarters of wheat may be added to the total quantity produced at home, on account of foreign importations.

In a similar manner, in regard to butcher's meat, if we take the market of the metropolis, we shall find that the number of cattle and sheep annually sold at Smithfield has doubled within

the last century, whilst the weight of the carcase has also more than doubled in that interval. In the early part of last century (1710), according to an estimate made by Dr. Davenant, the nett weight of the cattle sold at Smithfield averaged not more than 370 lbs., whilst calves averaged about 50 lbs., and sheep 28 lbs. In 1800 the nett weight of the cattle was estimated at 800 lbs., of the calves at 140 lbs., of the sheep at 80 lbs. Owing to a clerical error in the second edition of Mr. M'Culloch's "Commercial Dictionary," where this was stated as the gross weight, a French author has been enabled to make out a more favourable case for the inhabitants of Paris than for those of our metropolis; but the error has since been corrected in the third edition of that valuable work. Again, in 1742 we find 79,601 head of cattle, 503,260 sheep, to be the numbers sold at Smithfield; in 1842 the numbers had increased to 175,347 cattle, 1,438,960 sheep. According to the calculation which Mr. M'Culloch adopted for the amount in 1830, when he sets down 154,434,850 lbs. for the supply of butcher's meat required in London, if we assume the population to have then amounted to 1,450,000, exclusively of some suburban districts, we should find the average annual consumption of each individual to be very nearly 107 lbs. In the last edition of his

Dictionary published in 1842, he sets down the consumption in 1842 at 228,542,340 lbs. for the metropolis, and consequently assigns 120$\frac{1}{6}$ lbs. to each individual. This may, however, be possibly a little above the mark, as the convenience of transport by railroad has made Smithfield the central market of a far larger circle than heretofore.

The returns obtained by the Statistical Society of Manchester, as to the cattle sold in the markets of that town, furnish an annual consumption of not less than 105 lbs. of butcher's meat for each inhabitant. In Paris, on the other hand, the quantity has been estimated by M. Chabrol at from 85 to 86 lbs. per head; and in Brussels it is supposed to average 89 lbs. We thus find that the consumption of animal food in the towns of England far exceeds that of foreign cities; and as this consumption has gone on steadily increasing, we are warranted in concluding that the labour of the English people is not only more efficient as compared with that of other nations, but is daily acquiring greater efficiency, if the present be contrasted with previous results.

It will be unnecessary to pursue this examination further, as few persons will deny that the absolute increase of the population of England and Wales has been accompanied not merely with

a proportionate, but a relative augmentation of material prosperity; nor do I think that it can be disputed, that an absolute increase of national prosperity will be invariably attended with an increase of population. Where the means of subsistence are more easily procured, the natural impulse of man will lead him to marry. Celibacy cannot be a matter of indifference in a healthy state of society, as it is essentially an incomplete state of existence.

The circumstances of Ireland are not identical with those of England; nor can we apply the same simple tests of the improved condition of its population. Of the 8,000,000 of its people, 5,000,000 are, according to Mr. M'Culloch, principally dependent upon the potato for support, and 2,500,000 upon oats. We may form an approximate estimate of the present comparative consumption of the Irish and British people, as indicative of their respective productive power, in the following rough manner. The money value of the entire annual produce of the land in Ireland has been calculated at 45,000,000*l.* Of this amount about 10,000,000*l.* may be deducted for various outgoings, under which the nett rent paid to absentees is reckoned, so that about 35,000,000*l.* of agricultural produce would remain to be divided amongst a population of about eight millions. This would allow

a consumption of rather more than 4*l.* in value to each individual. In Great Britain, a population of rather more than eighteen millions consumes agricultural produce of the value of about 143,000,000*l.*, which allows nearly the value of 8*l.* to each individual. We might perhaps be justified in making some allowance in the Irish estimate, from the greater exchangeable value which money possesses in Ireland: on the other hand, if the commercial exports of agricultural produce should be found to exceed the amount of nett rental paid to absentees, the balance would have to be deducted from the home consumption.

But in estimating the comparative progress made by the two countries, there are greater difficulties from this circumstance, that whilst the quality of the food used by the English people has improved, the reverse has taken place in the case of the Irish people; so that the increased value of the gross amount of agricultural produce would not correspond to the increased quantity of produce available for consumption. If it be a correct statement, that, whilst the population of Great Britain has doubled, the quantity of agricultural produce of a *given kind* has quadrupled, the efficiency of the labour employed in raising that produce will at least have doubled; but if the produce, as in Ireland, whilst it has increased in quantity,

has deteriorated in quality, the efficiency of the labour of the agricultural population will not have increased *pari passu* with the quantity.

In 1778, Arthur Young estimated the gross rental of Ireland at 6,000,000*l.* : in the present day it is calculated to amount to 12,715,478*l.* In 1771, A. Young estimated the rental of England and Wales at 16,000,000*l.* : it was calculated in 1836 to have been a little below 30,000,000*l.*, though in 1815 it was as high as 34,330,462*l.* If now it be correct to refer the increase of the gross rentals of the two countries to analogous facts, whatever they may be, connected with the increased gross amount of agricultural produce, the value of that gross amount must be supposed to have quadrupled in Ireland, as in the case of England. But during this interval of less than 70 years, the population of Ireland has trebled itself, for the number of souls which in 1777 amounted to 2,690,556 had increased in 1841 to 8,175,124, whilst the English population has only doubled itself. The progress, therefore, of the Irish people, in respect of the increased efficiency of their labour, will only have been half as great as that which the English returns exhibit. This circumstance is at once accounted for by the substitution of an inferior article of food, such as the potato, in place of grain; and though the quantity of agricultural produce must have in-

creased to support the increased numbers of the population, its value has not increased in proportion, from its quality being inferior.

It has been remarked that in Ireland the population has increased in a more rapid ratio in those provinces in which agriculture has made the slowest improvement. Thus from the tables of the census of 1831, it appears that in the province of Leinster, where there are several very large towns, and where the agricultural system has very considerably improved by the side of an increased growth of trade and manufactures, the increase of the population in the preceding ten years was only 9 per cent.; whilst in Connaught, the agriculture of which has scarcely improved at all, and the manufactures are hardly worthy of notice, the increase has not been less than 22 per cent. To a similar purport we find, from the census of 1841, that in Leinster the annual proportion of births to the mean population was 1 in 32·3, whilst in Connaught it was 1 in 28; and whilst the increment of population in the former province has been rather less than one thirtieth, that of the latter has been rather more than one twentieth of the respective numbers in 1831. The prosperity however of Connaught has not been commensurate. Mr. M'Culloch, in his Statistical Account of the British Empire, seems to consider it beyond

doubt, that this rapid increase of the population in Connaught is wholly to be ascribed to the splitting of land, which is there carried into effect with the most deteriorating influence both on the system of cultivation, and the condition of the occupiers of soil. The smallness of the holdings prevents the cultivators from adopting a generous system of cultivation, and forces a great quantity of pasture land into tillage, independently of other causes. This system, according to Mr. Dutton's evidence, published in the Report of the Agricultural Committee of 1833, has been carried on to the most injurious extent, and the increase in the growth of oats and barley, as it has not resulted from an improved system of tillage, but rather from turning up improvidently old pasture land, has only served to stimulate population unduly.

Ireland presents many features of similarity in its agricultural system to those which may be observed in British India. The first volume of Professor H. H. Wilson's "History of British India from 1805 to 1835" contains much valuable information on the subject of landed tenure in our Indian possessions; and I should be desirous, on a future occasion, to trace out the more important features of resemblance in this respect between the two countries. Connaught is not the only province of Ireland where minute

subdivision of land is a prominent evil. In Munster, and even in Ulster, farms are frequently held in partnership, and divided amongst the family of the previous occupant. Dr. Kelly, late Roman Catholic Archbishop of Tuam, in his evidence before the Select Committee of the House of Commons in 1830, on the state of Ireland, said that he knew a farm in his neighbourhood which was originally leased on the partnership system to about twenty families, and he afterwards recollected to have seen sixty families living on the same farm. Under such a system of management, where white crops succeed each other as long as the land will produce them, agriculture must necessarily deteriorate, and, with the exhaustion of the soil, the condition of the cultivators must become depressed. The con-acre system of allotment, which is perhaps carried to the greatest extent in Connaught, is very prevalent in some parts of Munster, in the county of Tipperary for instance. "Under this system the occupiers of the larger farms sublet to the peasants or cottiers small slips of land, varying from a perch to half an acre for a single season, to be planted with potatoes, or white crops. Old grass land is frequently let out in this manner, and the surface is allowed to be pared and burnt for manure. The rent exacted is enormous, sometimes, according to the

evidence before the Agricultural Committee of 1833, amounting to 12*l.* or 13*l.* per acre. Potatoes are usually first planted on con-acre land, and a succession of ten or a dozen corn crops follow; so that there can be no improvement of the soil: on the contrary, nothing but its extraordinary natural fertility could support such destructive treatment. When at last the soil is incapable of producing any thing, it is left to recover itself by the action of the rain and atmosphere on its elements."

The custom of equally dividing the paternal inheritance amongst the several members of each family, either founded upon or giving rise to the generally received notion of the equal and inalienable right of all the children to the inheritance of their father's property, whether lands or goods, has tended to increase the subdivision of land as already alluded to. This custom extends not merely to freehold, but likewise to leasehold property; and it furnishes a remarkable illustration of the fact, how utterly ineffective legislation becomes where the laws are not in harmony with the manners of a people. For though the statute law allows the landlord to prohibit this subdivision by express clauses in the lease, yet courts of law have shown themselves hostile to such limitation, and juries have uniformly awarded nominal damages, if ever

their verdict has supported the principle of the law. This subdivision is not limited to the sons, but even the daughters are generally portioned with a patch of land; and in some districts, strange to say, in the county of Waterford for instance, according to Mr. Wakefield, "when the eldest daughter of a farmer marries, the father, instead of giving her a marriage portion, divides his farm between himself and his son-in-law. The next daughter receives half the remainder, and this subdivision is continued as long as there are daughters to be disposed of. The sons are left to shift for themselves in the best way they can." Whether this peculiar custom is at all to be attributed to the distinct origin of the people in this district, it would be foreign to inquire. The custom of portioning the inheritance amongst the daughters instead of the sons, is said by Mr. Walpole to prevail very generally amongst the islanders of the Greek Archipelago. The tendency of such a custom is evidently to encourage, if not to force, the youths to marry as soon as possible the daughters of their neighbours: and we should not be surprised to find the forcible abduction of young women so long regarded with sympathy in a country where all women are heiresses.

Without pausing to examine more closely the opinion of Mr. M'Culloch, that the rapid increase of population in Ireland is wholly ascribable to

the splitting of land ("Statistical Account of the British Empire," vol. i. p. 441.), we may be quite satisfied that the custom has taught every individual brought up in the country to look to the land for his support. It has thus secured to the peasantry a wretched sort of half-savage independence, and has, in consequence, given a powerful stimulus to population.

Scotland presents a remarkable contrast to Ireland both in the principle and the results of its agricultural system. The tenant has rarely the power to sublet or subdivide his farm, and at his death it must descend to his heir-at-law. The younger children are thus made aware that they must not trust to the land for support, but must direct their labour to some other occupation; and this circumstance has contributed to foster that enterprising spirit, and adventurous temper of mind, for which natives of Scotland are remarkable. The land is thus allowed to follow the ordinary laws which regulate the relations of capital and labour. As capital accumulates, it is applied on a larger scale to land, and agriculture enlists more and more in its service the aid of science, and the cultivator is thereby enabled to produce the primary necessaries of life under analogous advantages to those which the manufacturer enjoys.

There is one consideration which we must not

overlook in instituting comparisons between the national divisions of the British Empire in respect to the increase of their respective populations: we must remember that England is the centre to which two very considerable tides of local migration converge from Ireland and Scotland, and that a steady current of emigration from Ireland sets in toward the manufacturing districts on the west coast of Scotland. With this caution in view, we may admit the fact as certain, that the increase of population in Scotland, as compared with the increase of wealth, has been less rapid than in England, and much less rapid than in Ireland. In consequence of this the Scotch are said to have made a greater advance than the English or Irish people in their means of commanding the necessaries and conveniences of life. We should be prepared to expect such a result, as far as the effect of emigration is concerned. Emigrants to an old established country like England can hardly be expected to thrive so well as those whom they have left behind in Scotland; for those who are left behind have not merely the advantage, most probably, of pursuing an occupation to which they have been trained from infancy, but they have also the assistance of the fixed capital in the establishments which they have inherited, and which ought to enable them to employ their circulating capital or their labour

with greater effect than the emigrant to England can hope to do. In regard, however, to the Irish emigrant to England, he may be in a very different situation relatively to his companions whom he has left at home. He, indeed, may hope to thrive more rapidly; for he has sought a country where the industrial system is far better organised than in that which he has quitted, and where the subdivision of labour is carried out so completely as to afford to every kind of industry a place; whilst he has left behind him a population battling with the soil for support, single-handed, as it were, without the aid of capital, whose condition must of necessity become daily more depressed from no accumulation of capital being possible under such circumstances. It is clear, however, under any circumstances, that the Scotch system, as a fact, has been attended with results which have not been surpassed in any European country, whether we regard the progress of Scotland in material prosperity, or in the civilization which has accompanied it. If, however, we admit that extensive emigration will account in some degree for the comparatively slow increase of the agricultural population, still emigration acts only in the manner of a *positive check* to population, the influence of which will be absolutely inappreciable, unless there are preventive checks in simultaneous operation. But

the circumstance that the progress of population has been less rapid than the progress of wealth may assure us that there are adequate preventive checks in operation, growing out of either the social institutions or the moral habits of the Scotch people.

I have employed the terms *positive* and *preventive* to distinguish the two great classes of checks upon population in accordance with the nomenclature of Mr. Malthus. Perhaps, were I called upon to coin new terms, I might be inclined to adopt the expression *diminutive* in preference to *positive*, distinguishing the checks to population according as they effect an actual *decrease* in numbers, by shortening the duration of human life, or preclude an *increase* by restraining the natural inclination of man to continue his race.

In proposing, however, a change in the classification of actual checks, as laid down by Mr. Malthus, and adopted by the most eminent economical writers without objection, amongst whom Mr. Senior and Mr. M'Culloch may be enumerated, I feel considerable diffidence. It is almost invariably found to be the case, that no system of classification will be quite exhaustive, if I may use such a term to imply a classification of which the heads are entirely distinct. On the contrary, even in the moral classification of

actions under the heads of voluntary and involuntary, it was found that there was a class of actions which, when regarded from one point of view, presented the appearance of voluntary actions, whilst from another they seemed rather to be the result of some force or necessity, so that a third head of *mixed* actions was introduced. The comprehensive mind of the great founder of the most influential school of practical philosophy — the author, I might almost call him, of the system of logical classification — found himself thus constrained to admit this unscientific exception to his proposed twofold division of human actions. He found a class of actions which, if he looked at the immediate circumstances attending them, seemed voluntary, because at the moment of action the agents preferred to do them; but if he looked at the principle involved in them, they appeared to have been performed against the will of the agents. Such, I apprehend, will invariably be the difficulty in reducing practical matters to scientific laws. It is impossible to subject them strictly to the same laws of accurate reasoning to which questions of a purely intellectual character admit of being reduced. In all attempts to classify, the intellect dictates the principles of classification; but those principles, when they come to be applied to the various phenomena

of man's life, are found inadequate in their strictness to comprise all the facts. They are, as it were, *intellectual formulæ* applied to the determination of practical questions, and the result is much the same as when the formulæ of pure mathematics are applied to the solution of problems in physics, where the result is only an approximation to the truth. Subsequent observations, it is true, by the discovery of new phenomena, may subject many of these problems more strictly to the existing laws of classification, or mathematical analysis may discover more comprehensive laws. Thus, the orbits of comets were supposed to satisfy the theory of bodies moving in a parabola: subsequent observation, however, has determined their orbits to be ellipses whose major axes are infinitely greater than their minor axes. On this hypothesis they will fulfil different laws from those which would govern bodies moving in parabolas: they will return at regular intervals, as integral though eccentric members of the great system in which our sun and its attendant planets revolve. If, then, in physics, further and more correct observations are found to warrant modifications of former methods of classification, *à fortiori* we should be prepared to expect further observations in questions so contingent as those which are connected with the growth of human com-

munities, to warrant changes in some of the branches of classification.

Mr. Senior, in his "Lectures on Population," p. 10., observes, "Mr. Malthus has divided the checks to population into the preventive and the positive. The first are those which limit fecundity; the second, those which decrease longevity. The first diminish the number of births, the second increase that of deaths. And as fecundity and longevity are the only elements of the classification, it is clear that Mr. Malthus's division is exhaustive."

Similar language, however, might, as it appears to me, have been used in commenting upon Aristotle's division of human actions into voluntary and involuntary. Yet precisely as in attempting to apply this principle of classification, which was logically exhaustive, it was found that there were certain actions of an anomalous character, which, though they might be *conditionally* regarded as voluntary, yet were *absolutely* performed by the agent against his will; so in the attempt to group prudence or self-restraint, moral evil or vice, and physical evil or distress, under the twofold division of preventive and positive checks, moral evil or vice seems to elude our grasp, and, when regarded in one light, bears the appearance of a positive, in another of a preventive, check. Mr. Malthus and Mr. Senior

both class moral evil under the head of preventive checks. I am disposed to consider that it should rather come under the division of positive or diminutive checks.

I am not unaware that the greatest caution is requisite in ascertaining accurately the meaning in which these distinguished writers use the term "moral evil." Mr. Malthus certainly seems to admit that there are certain positive checks of a mixed nature, which are brought upon us by vice, and their consequences are misery, such as wars, sensual excesses, &c. These, indeed, when their result is physical evil, he would class with positive checks; but inasmuch as there are many such checks, the general tendency of which is to produce misery, though they may accidentally, in their immediate or individual effects, not produce it, as their result does not bring them under the head of physical evil or distress, and their effect, in his opinion, is rather to prevent an increase than cause a decrease in numbers, he considers they must be classed amongst the preventive checks, and yet be distinguished by a peculiar name from prudence or self-restraint.

But it appears to me, that if we look to the vicious habits of any society as exerting a check upon population sufficiently important in its effects as to require to be classed under a distinct head, their operation will be found to be rather of

a positive than a preventive character. Doubtless there have been societies in heathen times, or in heathen countries, as in Rome, for instance, under the emperors, or in China and some of the islands of the Pacific Ocean in the present day, where the habits of life of a great mass of the people are calculated to retard the rate of increase by limiting fecundity. The condition of our own West Indian possessions would, a short time ago, have furnished us with a peculiar instance of a more anomalous kind; but as it was so remarkably artificial, though on a rather large scale, it may be neglected in the consideration of general causes. But in regard to the civilised communities of modern Europe, it would seem that we are well warranted in inferring the case to be otherwise, and that the effects of vice are exhibited rather in an increased mortality, than a diminished rate of increase. The data, which the more accurate statistics of the French police have of late furnished, and which the careful researches of such writers as Parent Duchatelet, Frégier, Ducpetiaux, and others have confirmed, seem to be quite decisive as to the fact, that the positive check which vice exercises on the growth of population in diminishing longevity is infinitely greater than the preventive check; and that as vice partakes of a mixed character, we are justly entitled to class it with those

checks with which it seems most akin in its results. Mr. Malthus seems to admit that the *general tendency* of vice is to produce physical misery, and that the contrary result is an exception to the general rule. But surely, in attempting to clothe such investigations in a philosophical dress, we must direct our attention to the general, and not to the particular operation of each cause; and there appear to be two valid reasons why it is more desirable to class vice under the head of positive checks, in which respect its influence is very considerable, than under the head of preventive checks, in which I agree with Mr. Senior, that its social effects may be disregarded.

The first and obvious reason is, that as the object of such investigations is to discover the true laws which regulate the growth of population, it is of the utmost importance that the mode in which each check operates should be correctly determined; otherwise the statesman might have his attention misdirected to other than the true causes of certain social evils, and misapply his remedies. In the second place, I cannot but consider that the classification of vice under the head of preventive checks has been a pretext, if not really a cause, for much of the popular outcry against the doctrine of Mr. Malthus, though no doubt the fundamental objection

to his views was to be found in the averseness of society to recognise the obnoxious necessity of discouraging rather than stimulating population by positive legislation. But at the time when he first published his Essay on the Principle of Population, the mass of mankind could little foresee the great changes, the dawn of which was slowly approaching. Hobbes had pronounced the state of nature to be a state of war, and even Locke had asserted that captives taken in a just war became by the right of nature the slaves of their captors. But a period was approaching when statesmen were destined to correct the errors of philosophers. The French Revolution, like the tempest which purifies the atmosphere, swept away on the continent of Europe many worn-out traditions of the Roman Empire; and whilst the genius of Napoleon made war loathsome to the nations of Europe, and his overthrow taught the French nation itself how little permanency even that genius could secure for conquests by the sword, the successful career of Great Britain was teaching the world the surer mode of national advancement through the arts of peaceful industry. War has thus lost its ancient sway in Europe over the imagination of nations, and the demand for new lives, which was entailed by its former frequent recurrence, with famine in its train,

and pestilence not unfrequently following in its rear, has ceased to operate amongst the more enlightened states, whilst the great problem which statesmen are employed in solving, is, how to combine the full employment of their own people with their free enjoyment of the fruits of their neighbours' industry.

If, then, it be correct to take the view above suggested of moral evil, and to regard it as exerting a positive rather than a preventive check to population, there will be no objection to laying down broadly this proposition, that the advance of a nation in true civilisation will be commensurate with the mitigation of the positive, and the increased action of the preventive, checks: in other words, that the prosperity of a country will vary inversely with the intensity of the positive checks, directly with the efficacy of the preventive checks. It is full time that the term Malthusian doctrine should cease to be a by-word of reproach. It was of the utmost importance that the world should rightly appreciate the startling statement of Mr. Malthus, that whilst food had a tendency to increase in an arithmetical, population has a tendency to increase in a geometrical ratio. Since, however, the correspondence of Mr. Senior with that distinguished and much misrepresented writer has supplied the necessary correction for the errors

which the unconditional statement of the abstract proposition might occasion, no one need fear to speak of Mr. Malthus's work with commendation. He may indeed, with the pardonable egotism of a discoverer, have exaggerated somewhat the importance of his own conclusions, and by his abstract mode of propounding a great practical truth, have risked its immediate reception; yet it cannot be denied that the controversy to which his essay has given rise, has led to the examination and solution of many practical problems of the greatest interest, and that Mr. Senior has justly pronounced him to be entitled to the gratitude of mankind, as a benefactor, by the side of Adam Smith. "Whether, in the absence of disturbing causes," says Mr. Senior, "it be the tendency of subsistence or of population to advance with greater rapidity, is a question of slight importance, if it be acknowledged that human happiness or misery depends principally on their relative advance, and that there are causes, and causes within human control, by which that advance can be regulated." And to use the words of Mr. Chancellor Raikes, "whilst many excellent men have deemed themselves bound to impugn a system which, according to their views, impeached the benevolence of the Deity, those circumstances which a hasty view of the theory led men to think were in-

compatible with what they knew of the goodness of the Creator, have been shown by Bishop Sumner, in the second volume of the Records of the Creation, to be evidences of that very truth which they were supposed at one time to impeach."

LECTURE II.

It may be objected to the test of the prosperity of a people which has been adopted in the previous lecture,—namely, its increased consumption of certain articles of food, as implying a proportionate increase of its productive power, — that it is of too general and vague a character to furnish any satisfactory criterion of the improved condition of individual life. A case might be supposed, where the growth of population should have been considerable from the number of births far exceeding the number of deaths, and the general productive power of the country, as evinced by the increased amount of produce, have been more than commensurately augmented, yet the result be consistent with the substitution of rude in the place of skilled industry, of infant in the place of adult labour, resulting from the invention of improved machinery. The productive power of the adult population might, consistently with such a state of things, be declining, the moral and material condition of the individuals might be deteriorating, and their tenure of life be, as a consequence, shortened. The condition of a country thus circumstanced could hardly be

considered one of true prosperity, however much it might exhibit the external semblance. If, on the other hand, it should be found that, with the growth of its population, its productive power has increased, and with the increase of its productive power the average duration of human life is augmented, it can hardly be doubted that the necessary elements of prosperity are here combined, and that a state of things which fulfils these conditions must be one of satisfactory and substantial progress.

But the determination of the question, whether the cypher of vitality has been raised or diminished in the case of a given population during a considerable period of time,—such, for instance, as that of England and Wales,—is a more complicated task than might be reasonably supposed from the profusion of tables, upon which calculations of the expectation of life are daily made in the numerous Life Insurance Offices. It might be expected that a comparison of the results exhibited by the later tables with those of the earlier tables would suffice to solve this problem: but, upon a careful examination of the various tables, it will be found that the results presented by them are conclusions deduced from very different data, and arrived at by very different methods; and therefore they do not furnish any safe grounds for comparison. For

instance, "the mean age at death" alone supplies the data for calculation in the case of certain Life Tables, whilst the ages of the living, out of whose number the deaths have occurred at the several periods of life, form the important element in the construction of others. But "the mean age of the living" in a country where the births far exceed in number the deaths, differs very widely from "the mean age at death," and the former may be increasing whilst the latter has been reduced. These have been so often erroneously confounded, that it is most desirable to distinguish carefully from each other the facts which they represent. Thus the mean age at death is obtained by merely summing up the ages at which people die, and dividing the amount by the number of deaths; but the mean age of the living is the quotient obtained by dividing the sum of the number of years which a given number of persons born in the same year have altogether lived, by the number of persons. For instance, if 4,115,890 years be the sum total of the number of years which 100,000 persons born in the same year have lived, this sum being divided by 100,000 would give us 41 years and a fraction of a year as the mean duration of their lives. The mean age at death on the other hand does not require illustration.

It is a conceivable supposition that the registers of two nations should exhibit the same number

of births and deaths, yet that the efficiency of the respective populations should be very different. In the one case the mortality might mainly prevail amongst the adult population, in the other instance amongst the infant and youthful members: in the one case the best quality of lives will have been carried off, in the other they will have survived. The mean age at death will have augmented on the former of these suppositions, it will have decreased on the latter; whilst the mean age of the living will have varied inversely as the mean age at death. It would be quite possible even for the mean age at death to have increased, and yet the actual numbers of the population to have diminished: as, for instance, in the case of the city of Amsterdam, where the average number of deaths during the twelve years preceding 1832 exceeded the number of births. A population so circumstanced will every day contain a greater proportion of old lives, and therefore the mean age at death will tend to increase, yet the population itself will be diminishing in numbers if the rate of mortality is constant. During the twelve years just enumerated, the tables of mortality gave the same proportion of deaths as in 1777, namely, 1 in 27. (Quetelet, de Physique Sociale, I. p. 157.) We have, however, assumed that one of the criteria of the prosperity of a population was the

increase of its numbers: Amsterdam, therefore, will for this reason not come under the class of prosperous communities.

In England, the mean duration of life, according to the life table annexed to the Fifth Report of the Registrar General, is 41 years, (I purposely omit fractions,) and if the population remained stationary, the mean age of those who died would be 41 years, and 1 in 41 would die annually. The population, however, has increased nearly 1½ per cent. annually during the last 40 years, and we find that the mean age of the persons who died in 1841 was 29 years, whilst 1 in 46 of the population died. This is in perfect harmony with what Mr. Milne has laid down in his article on Mortality in the Encyclopædia Britannica, "that when the population has been increasing, the mean duration of life from birth, according to a table of mortality properly constructed from the necessary data, will be less than the number out of which one dies annually, but the difference will be small, except under very particular circumstances; and again, that the mean duration of life, according to a table of mortality constructed from the number of deaths only in the different intervals of age, without comparing them with the number of living persons in the same intervals, — in other words, the mean age at death, — will fall short

of the number out of which one dies annually by a much greater number than in the case just considered." This he illustrates by tables of observations; but in the case of England and Wales the differences are increased beyond the limit which he has assigned, owing to the very rapid increase of the population.

This is a very important fact, and Mr. Milne proceeds to state that where the proportion of people dying annually is known, it will not be difficult to judge whether a table of mortality for that people has been constructed properly from the necessary data: or, what is more common and more easily effected, merely by the summation of deaths at all ages.

In further illustration of the difference between the mean age at death, and the mean duration of life, as gathered from the ages of the living, it appears, in regard to Sweden, that from 1801 to 1805, during which the ages of the living out of which the deaths occurred were carefully enumerated, the mean age at death was nearly 31 years, whilst the mean age of the living (*the true basis*, according to Mr. Milne, *for calculating the mean duration of life*,) was rather more than 39, and the proportion of deaths 1 in 41. In France, the ages of the living out of which the deaths registered in the French census occurred, are not given, but it may be assumed that the calculation made

by M. Demonferrand, whose tables were published in the year 1838, in vol. xvi. of the Journal de l'Ecole Royale Polytechnique, approximates to the truth sufficiently for our present purpose. According to them the mean duration of life in France would be rather more than 39 years, whilst the census of 1831 gives us 34 years for the mean age at death, and the proportion of deaths as 1 in 42. So that the average age of the persons who died, or the mean age at death, would be 34 years in France, 31 in Sweden, 29 years in England, and a calculation of the expectation of life based upon data of this nature would evidently give a result unfavourable to England. Without attempting to decide what I am aware is a very difficult practical question, whether insurance offices are justified in regulating their transactions by life tables constructed according to this latter method, it is very clear that such life tables will not furnish the expectation of life which will answer the purpose of our present inquiry, which is to ascertain the efficiency of a given population. This must evidently be determined by the *mean age of the living.*

The reason why the mean age at death is so much lower in England than in France or Sweden, is that the population is increasing much more rapidly. The mass of the people, therefore, are younger, and the mean age at death, which,

as already observed, is obtained by dividing the sum of the ages of those who die by the number of deaths, will be lower, as there will be a greater proportion of low numbers among the ages at death. Mr. Milne has stated, what at first seems paradoxical, that in an increasing population the average age at death is less, and the annual mortality less, than in a stationary population having the same expectation of life. The cause of this is explained in the Fifth Annual Report of the Registrar General, which contains much valuable information on such questions. "The births exceeded the deaths in England in 1841, the former being registered at 512,158, the latter at 343,847. If the population were stationary, the births would be 343,847; they would maintain the existing population. But the annual excess of 168,311 children, more or less, which have been thrown for many years into the English population, has produced a preponderance of the youthful over the aged part of the population. If the law of mortality had remained constant, and the births and deaths had been equal for the last century, it would have been found that on an average about 35 in 100 of the people were under 20, and 14 in 100 above 60 years of age; but it appears from the census that 46 in 100 were under 20 years, and only 7 in 100 above 60 years of age."

The great difference here exhibited between the results of observation, and the results which theory would furnish on the hypothesis of the population being stationary, and the decrements of life, that is, the annual deaths being a constant quantity, is very great. Yet the distinguished analyst De Moivre, in the mathematical formulæ which he published in 1724, in his treatise on Annuities on Lives, assumed the annual decrements of life to be equal, and its utmost limit eighty-six years, and on this hypothesis gave a general theorem, by which the values of annuities on single lives might be determined. Dr. Price, in the first edition of his work on Reversionary Payments, published in 1770, adopted this method in the construction of his Life Tables. On the other hand, the illustrious English astronomer, Halley, who had calculated what may be termed the first experimental life table so far back as 1693, which was published in the Transactions of the Royal Society of London for that year, had constructed it upon a series of observations on the movement of the population of the city of Breslau in Silesia, when "the births did a little exceed the funerals."

The question may reasonably suggest itself, if the mean duration of life, which term I shall use to designate the expectation of life calculated from the mean age of the living, is 41 years in

England, why is the mortality so low as 1 in 46? To use the words of the Report already cited, "the reason is, that as the increase of the population has been long and progressive, an excess has been accumulated of persons between the ages of 5 and 55, among whom the mortality is lower than it is among persons of all ages. With the reduction in the relative numbers above the age of 60, this has more than compensated for the high rate of mortality among the excessive number of children under 3 years of age; and has reduced the mortality below 1 in 41 annually, which would be the case if the population were stationary. As the populations of France and Sweden have not increased more than half as fast as the English population, the diminution of the age at death has been less considerable, though sufficient to derange all calculations and all comparisons, such as that of the 'mean age at death,' deduced upon the supposition that in the populations compared the births and deaths have been equal, and the mortality uniform, for a long series of years."

The statistical facts, therefore, with which our present inquiry is concerned, are evidently the variation in the *rate of mortality*, and the variation in the *mean age of the living*. If, for instance, the proportion of deaths to the population be diminished, or if the average life of the great

mass be prolonged, we may be satisfied that the condition of the nation is improved in respect to vitality. The comparative mean age of the living at different periods would no doubt be the more important fact to ascertain, but it is only of late that the ages of the living out of which the deaths have taken place, have been enumerated in our own country, and that life tables on the more complete *data* have been calculated; whilst in France, as already stated, this most essential element for calculating the particular *expectation of life* with which the political economist or the statesman is concerned, has never yet been published.

But even in comparing the rate of mortality at different periods there are greater difficulties than might be supposed. We must either have recourse to the actual returns of mortality, and we have no criterion for judging of the degree of accuracy with which the returns of the actual population were made, out of which the mortality is supposed to have taken place; or we must go back to the calculations of scientific men, such as the Northampton Tables of Dr. Price, or the French Tables of Duvillard, which were considered by their respective authors to present all the results of the general mortality, and were made public as representing with sufficient accuracy the law of mortality.

In speaking of the calculations of Dr. Price, founded on the observations of the bills of mortality at Northampton, we must carefully distinguish them from the calculations of that justly celebrated author founded on the observations of the population and deaths in Sweden and Finland, which had been published by M. Wargentin in the Memoirs of the Academy of Sciences at Stockholm in 1776. Dr. Price himself, in his Introduction to the Observations on Reversionary Payments, 4th edit. 1783, states, "that there are two kinds of data for forming tables of the probabilities of the duration of human life at every age. One is furnished by registers of mortality showing the numbers dying at all ages; the other, by the proportions of deaths at all ages to the numbers living at those ages, discovered by surveys or enumerations. Tables formed from the former of these data are correct only when there is no considerable fluctuation among the inhabitants of a place, and the births and burials are equal. When there are more removals *from* than *to* a place, and the births exceed the burials, as is almost always the case in country parishes and villages, tables so formed give the probabilities of living too low. When the contrary happens, as is generally the case in towns, they give the probabilities of living too high. But tables formed from the latter of

these data are subject to no errors. They must be correct, whatever the fluctuations are in a place, and how great soever the inequalities may be between the births and deaths." He then continues to state that the Swedish observations communicated to him by M. Wargentin "are more curious than any that have been yet published, and leave us little to wish for on this subject, except that similar observations were made in other kingdoms under the direction of men equally able and ingenious with M. Wargentin."

The Northampton table, on the other hand, to use the words of Mr. Milne, in the article "Mortality" above alluded to, "was constructed by Dr. Price from the bills of mortality (from the year 1735 to 1780) of the single parish of All Saints, containing a little more than half the inhabitants of the town; and as *the deaths exceeded the births in number*, the author applied a correction to the table under twenty years of age, which, if it had answered the intended purpose under that age, as we are satisfied it did not, could have no effect on any of the numbers above the same age; and almost all the useful applications of such tables are to ages above twenty."

"The table so formed could only be correct provided both the numbers of the living and the annual deaths at every age above twenty years,

had continued invariable during the 146 years that intervened between 1634, and 1780; provided also, that no migration from or to the town took place, except at twenty years of age, and that the annual increase which the population received by migration at that age was just equal to the excess of the annual deaths above the annual births."

It appears, however, from the abstracts of population, that the annual births and annual settlers in Northampton had been increasing ever since about the year 1715 or 1720: also, that although the burials exceeded the baptisms till the year 1802, the supply by immigration was much greater than that excess, and consequently that the numbers of the living had been accumulating more at the early ages, and less at the advanced ones, than would have been the case had the population remained stationary.

Mr. Milne seems disposed to think that the unsettled state of the kingdom for some years before and after the death of Charles I. had prevented or greatly retarded the increase of the annual births during the time in which those persons were born, who died past 60 years of age between the years 1734 and 1781, and may account for the table after that age being near the truth, whilst the comparatively rapid increase of the people during the 60 years ending with 1780

appears to explain the great excess of mortality in that table at the early period.

In regard to the Table of Duvillard, which is employed in French life offices, and is one of the two French tables given every year in the "Annuaire," we know very little of the *data*, excepting that it was calculated upon 100,542 deaths at all ages amongst a population of 2,920,670 in different parts of France. The author first published it in 1806, in his "Analyse de l'Influence de la petite Vérole sur la Mortalité," and stated that it presented all the results of the general mortality, according to a considerable number of facts collected before the Revolution in different districts of France, and that it ought to represent with sufficient exactness the law of mortality. I have not been able to procure the work itself, but it seems that in his calculations the population was supposed to be stationary. M. Jules Bienaymé, Inspecteur Général de Finances, in a memoir, "Sur la Durée de la Vie en France depuis le Commencement du XIX Siècle," read before the French Institute in 1835, and published in the Annales d'Hygiène, vol. xviii., states that the circumstance which brought Duvillard's table into repute was, that the census of the year XI (1803), which was taken at the request of La Place, made the proportion of annual births to the actual population very nearly identical with that

given by Duvillard, namely, as 1 to $28\frac{3}{4}$. This caused the table of Deparcieux, which will be alluded to in the next Lecture, and which had hitherto been approved by men of science, to be laid aside for a time. M. Bienaymé presumes the 101,542 deaths of Duvillard to have been those given by Messance, in his "Nouvelles Recherches sur la Population de la France;" and 2,920,672 persons, the whole number of the population upon which the observations had been made, divided by this number, evidently furnished the quotient $28\frac{3}{4}$, which was Duvillard's expectation of life at birth. The births, it will thus appear, were supposed not to exceed in number the deaths; in which case, as above stated, the mean age of the living would be identical with the mean age at death. M. Matthieu had observed, in his notice, "Sur le Mouvement de la Population en France," in the "Annuaire" for the year 1826, that the alterations in the different elements of calculation make this table altogether inapplicable to the present circumstances of the population. In a note to the Fifth Report of the Registrar General it is suggested that this Table probably involves the same errors as the Northampton Table.

We must therefore not be surprised to find that the expectation of life calculated upon the more complete data which have been made use

of in constructing the English Life Tables of 1841 in the Registrar General's Report should be in appearance enormously augmented, when compared with that given in the Northampton Table, or that the approximate expectation of life in France, calculated from official documents by M. Demonferrand, in which, however, there have not been furnished, as already stated, all the necessary elements, should bear a corresponding inordinate disproportion in excess over the table of Duvillard. Thus, whilst the Northampton Table gives the expectation of life at birth at nearly $25\frac{1}{5}$ years, the English Life Table of 1841 gives nearly $41\frac{1}{5}$ years; whilst Duvillard's table gives us $28\frac{3}{4}$ years, the table of M. Demonferrand gives us rather more than $39\frac{1}{2}$ years at birth. It may be observed, that M. Demonferrand gives the expectation of life for each month during the first year of life separately, whilst Duvillard's table gives the expectation of life for the entire first year in one sum; so that we are at liberty to take the expectation of life at the end of six months, in M. Demonferrand's table, instead of the expectation in the first month, to make the comparison just. On this supposition, the latter table would give us about $42\frac{1}{6}$ years for the average expectation of life in the first year. This very great discrepancy in the results makes it evident that the term *expectation of life*, or *vie*

moyenne, in the earlier tables, represents some very different fact from that which the later tables indicate, as it would be inadmissible to suppose that there had been a gain of 16 years average vitality to the English population, or of 15 years to the French, within a period of less than a century. These tables, therefore, will not furnish us with any basis of comparison in respect to the average duration of life.

We must consequently have recourse to the comparative rate of mortality, if this can be ascertained with any degree of accuracy. If it should appear that the rate of mortality has gradually decreased during the last century, the average duration of life will have reciprocally increased during that period, though not in so great a ratio; for, as already observed, in a community where the annual births exceed the annual deaths considerably, which is the case both in England and in France, not only the actual population, but the proportion of young persons in it, must necessarily be augmented. Thus it is found from observation, that the people are younger in England than in France or Sweden, in accordance with the corresponding preponderance of births over deaths in the former country. It will therefore be impossible to attribute the diminished rate of mortality, where it is very remarkable, to any thing but a

decided improvement in the vitality of the youthful population, which of course implies an augmentation of the average duration of human life. A nation thus circumstanced will continue to accumulate a greater number of efficient lives. I may observe, by the way, how very important the question of the employment of children in factories becomes in connection with the period of life over which the efficiency of the labour of a population may be supposed to extend.

There can be little doubt that the mortality amongst children is not quite so great as was formerly the case, when the means of preserving them by good nursing and medical skill were not so well understood. But in comparing the mortality of this part of the population, two errors are to be guarded against. All the births are not registered in the annual tables, even under the present more stringent system of police in this respect: this was even more the case formerly, as there is not the same domestic necessity for registering a birth as a death: the deaths, therefore, in the first year, will have occurred out of more than the number of births returned, and the real proportionate mortality will have been less than the apparent one. This remark applies more strongly to the early registers of births and deaths; as the system of registration is now so much more complete, we must make considerable

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exaggerated the proportion of deaths at an early age.

We have, however, trustworthy data to show that the rate of mortality has decreased in this country during the last 100 years. Thus, the population abstracts of England and Wales, extending over a period from 1720 to 1820, furnish us with the average annual numbers of the baptisms and burials. Similar documents, collected at the respective censuses of 1801, 1811, and 1821, furnish the estimated population at the end of each decennial period, and the returned baptisms; from which it appears that the returned baptisms, at those periods, bore very nearly a constant proportion to the estimated population. Hence, supposing the annual average baptisms in each of the above periods to bear a given ratio to the respective population, and the returned burials to represent a similar constant proportion of the annual deaths, we should be enabled to measure with sufficient accuracy the variation in the mortality. It thus appears, that out of the same amount of population, whatever may have been that which corresponded to 1000 baptisms, there died annually,

1068	between	1720	and 1730
1043	—	1730	— 1740
924	—	1740	— 1750
858	—	1750	— 1760

840	between	1760	and	1770
857	—	1770	—	1780
787	—	1780	—	1790
747	—	1790	—	1800
697	—	1800	—	1805
659	—	1805	—	1810
612	—	1810	—	1815
623	—	1815	—	1820.

Observations on Life Assurances. By G. D. (Unpublished.)

There can be no doubt, therefore, that there has been a very great diminution in the rate of mortality in England and Wales during the last 100 years; and, as the observations which determined, that the ratio which the baptisms bore to the estimated population was 1 to 35 with a very slight fractional variation, were made at three different periods during the present century, we may rest satisfied that there can be no great error in the calculation from overlooking a possible increase in the proportion of baptisms by others than ministers of the Established Church.

Although, therefore, we must make a considerable allowance for the increased proportion of young lives, which would somewhat diminish the average age of the whole community, yet the very great difference of mortality will warrant us in concluding from the above table, that the average duration of human life in England and Wales has received a very decided augmenta-

tion, though not to the full extent of the ratio of the diminished mortality.

An analogous result has, without doubt, taken place in respect to the population of France. According to a calculation adopted by M. Necker in his work "De l'Administration des Finances," the mortality in France before the Revolution was 1 in 30 or $31\frac{1}{8}$, which Mr. Malthus considered to be an extraordinarily large proportion, and that in so fine a climate as that of France, nothing but the very great misery of the lower classes could account for it. It is possible that this estimate may be rather too high, and may have been based chiefly upon the statistics of towns, from which more accurate returns could most probably be procured at that time than from the country, and the mortality in towns, as is well known, far exceeds that amongst a rural population. The French census of 1831 gives the annual mortality of France from 1817 to 1831 as 1 in 42. The general fact, therefore, of a considerable decrease of mortality seems to be established, though we should not perhaps be justified in concluding that the difference in the two proportions just cited measures accurately the extent of it.

In confirmation of the statement, that a diminished rate of mortality, where a population is increasing in numbers, will necessarily be

attended with an augmentation in the proportion of efficient lives, the following results may be aptly cited.

From a table in the appendix to the Supplementary Sanatory Report of 1843, by Mr. Chadwick, it appears that the increase in the proportion of the adult population of the United Kingdom is very considerable in regard to England and Scotland, though comparatively slight in regard to Ireland.

1821.	England.	Ireland.	Scotland.	
Under 15 years	39·09	41·06	41·0	per cent.
Above 15 years	60·91	58·94	59·0	
1841.				
Under 15 years	36·07	40·44	36·4	per cent.
Above 15 years	63·93	59·56	63·6	

There is thus an increase of 3 per cent. in the proportion of adults in England, and 4 per cent. in Scotland, and only 1 per cent. in Ireland, within an interval of 20 years. I should be disposed to think that the emigration of adults from Ireland may account for the great difference which the Irish returns exhibit.

LECTURE III.

I HAVE already alluded to the ambiguous meaning of the term "expectation of life," or *Vie moyenne*, that it is employed to designate two very different results: the one arrived at from a calculation of "the mean age at death;" the other based upon the enumeration of the ages of the living. In illustration of the distinct character of these two results, I will quote a few facts from the Registrar General's Report, which refer to three different portions of the population of this country; namely, that of Surrey (extra-metropolitan), the metropolis itself, and the town of Liverpool. "Surrey presents a specimen of the rate at which life wastes in a country district; Liverpool is an example, at the other extreme, of the effects of concentration in towns, without any adequate provision for removing the effluvia, and for securing by art the degree of purity in the dwellings and atmosphere, which is partially maintained by nature in an open cultivated country. Surrey, however, has not been selected as the healthiest county, and there are parts of most towns in England as favourable to life as Liverpool.

"The population of the extra-metropolitan parts of Surrey happens to be but little more than the population of Liverpool: yet in 1841 the deaths in Surrey were 4256; the deaths in Liverpool, 7556; out of 14,450 boys under five years of age, 2087 died in Liverpool; of 14,045 boys in Surrey, only 699 died within the same time. By this immense mortality in Liverpool, the number of males at the age of 10—15 is reduced much below the number in Surrey at a corresponding age. The living in Surrey aged 20—30 are 18,746, but the influx of immigrants into Liverpool raised the number of males living there at that age to 23,494, who are, however, rapidly cut down by sickness or death, (unless other accidental circumstances cause them to remove elsewhere); so that at the age of 45—55, only 7504 males were enumerated in Liverpool, whilst 9281 were living in Surrey."

As far indeed as such local facts are concerned, I should conceive that the inferences which might be drawn from the mortality of the young, would be far safer than those which might be gathered from the longevity of the old. For one disturbing cause will operate inversely on the respective populations of two districts, so differently circumstanced as Surrey and Liverpool, as individuals advance in life. The desire to exchange the close atmosphere and confined limits of a town

for the fresher air and freer range of the country, since such a desire may be more readily gratified as life advances, through the increased means which a career of successful industry frequently affords, as it will tend to empty Liverpool of a portion of its population above a certain age, so it will be likely to add to the numbers of those who will be found living in Surrey at a corresponding age. This fact must not be overlooked in any inquiry connected with the comparative healthiness of two districts, as gathered from such data.

According, then, to the Surrey observations, 75 out of 100 children born attain the age of 10, 52 reach the age of 50, and 28 that of 70: in the metropolis 64 live to 10, 41 to 50, and 16 to 70: in Liverpool 48 attain the age of 10, 25 that of 50, and 8 that of 70.

The probable duration of life, the *vie probable* of the French, differs from the expectation of life arrived at by either of the methods already alluded to. This expression designates the time in which the number born is reduced one half. In the English life table of 1841 it is 45½ years. "It is probable, or, to use Halley's words, it is an even wager, that a child born in England will live 45½ years, for a given number of children born are reduced to nearly half their number at the age of 45. So that there is an equal num-

ber of chances in favour of an individual living to, or dying before, the age of $45\frac{1}{2}$." We have in the previous lecture seen that the mean duration of life is about 41 years according to the English life table. This is less than the probable life, from this circumstance, that the number of those who die in the first year of life exceeds so much the number of those who live after the 90th. As, therefore, an increased diminution of the *mean duration* as compared with the *probable duration* of life indicates a relative increase in the proportion of infants dying in the first year to adults living after 90, this fact may be due either to an absolute increase in the mortality amongst infants, or to an absolute decrease in the number of very old people.

" The probable duration of life in Surrey is 53 years, in the metropolis 40, in Liverpool 7 or 8 years. The mean duration of life does not differ so enormously; it is, however, 45 years in Surrey, 37 years in the metropolis, and only 26 years in Liverpool." According to the same authority, the Registrar General's Fifth Report, the mean age at death in Surrey is 34 years, in the metropolis 29 years, the same as the average mean age at death in England, whilst from a table in the First Report of the Health of Towns Commission, it appears that 17 is the mean age at death in Liverpool. There will therefore be

a variation in the expectation of life, according as the life tables are calculated upon the mean age at death, or upon the mean age of the living, of not less than 11 years in the case of Surrey, 8 years in that of the metropolis, and 9 years in that of Liverpool.

"The rate of increase, the duration of the increase of population, the emigration, the relative numbers of children and adults, the mean age of the living, upon all which the mean age at death depends, differ in town and country, in manufacturing and agricultural districts, to an extent which renders any application of this method to the construction of local life tables, or to the calculation of the relative durations of life, difficult and doubtful, if the proper corrections be made; absurd and misleading, if the mean age at death be taken to represent the expectation of life."

I have borrowed largely from the Registrar General's Fifth Report, as we are entitled to place more confidence in it than in the works of individual writers on the duration of life, which may have been written not unfrequently with a strong bias, and in many cases with a special object. The Sixth Report, which has been published in the present year, contains some very valuable official returns respecting the population of foreign countries.

Calculations based upon the mean age at death may likewise, in comparative estimates of the vitality of *different classes of persons*, lead to very erroneous results. For instance, it has been urged as a proof of the severe hardships to which dress-makers are exposed, that the mean age at death of this class is very low, and therefore the nature of their employment must tend to shorten life. But Mr. Grainger in his Report states that "the majority of dress-makers are between the ages of sixteen and twenty-six, and it is understood, if they die after they marry, they are not often designated by that title in the Register of Burials." This source of error in the registration, coupled with the increase of population, will be found to affect the estimate of the influence of other occupations: and though there can be no doubt that, in this as in many other cases, the lives of individuals are much shortened by the mistreatment to which they are exposed, yet false arguments may injure instead of aiding their cause.

On the other hand, very considerable exaggeration may take place in respect to other classes. In a thriving commercial country, for instance, like England, where there is a continual movement amidst the social ranks, where it probably happens that fewer individuals in proportion to the mass retain their original position in society

during life, than in any other European country, we shall find the class of "independent gentry," or "persons in easy circumstances," on the one hand, and that of "paupers" on the other, apparently extremely long-lived, if we look to the mean age at death of persons so described in the Registers of Burial. It is true that every Whittington does not become Lord Mayor of London, but shop-boys in time grow up into aldermen, and tradesmen retire into the ranks of independent gentry. These promotions, however, as a general rule, require time, and those persons only, who live long, attain the higher positions. It would be an error to invert the reasoning, and to suppose that they live long because they attain the higher positions. A relaxation of labour may doubtless contribute in certain cases to the prolongation of life; but in many instances the abandonment of their ordinary occupations, upon which the habits of a long life have been formed, would be found rather to diminish than increase the chances of longevity. The reverse of the picture shows us many individuals, who have not succeeded in their plans of life, compelled to seek an asylum at an advanced age in the workhouse of the parish, and these are rarely designated in the mortuary registers by the occupations which they have followed in manhood, but are classed

under the general head of "paupers." "The ages of those who die in the ranks of their respective trades and occupations are thus reduced to the same extent as the age of paupers who die in the workhouses is raised above the average. Thus, in 1841, the mean age of 45,508 persons who died in London was 29 years, and the mortality was 1 in 40. In the same year 4284 persons died in the London workhouses at the advanced (average) age of 49 years, which they must nearly have attained before they entered them, inasmuch as the mortality there appears to have been about 22 per cent. annually; since at the time when the census was taken, in June 1841, the pauper population in the London workhouses was 19,412, and it is supposed to be greater in winter." If we were thus to contrast 49, "the mean age at death" of the paupers in the workhouses, with other statements which make the mean age at death of the same or a superior class of persons to be 16 or 20 years, we should be liable to arrive at very erroneous conclusions.

Again, it has been declared by a distinguished French academician, that the mortality amongst the French military in time of peace is greater than amongst civilians. This difference may partly be traced to the circumstance that the conscription collects a number of youths from

the country and the villages, and exposes them to the greater temptations which large towns afford, at a very critical period of their lives.

The greater mortality, however, amongst soldiers is for the most part but an apparent result, and is but a particular form in which the general fact displays itself of the rate of mortality receiving a sudden increment about the age of military service. M. Demonferrand has observed that the general rate of mortality decreases from the first year to the fourteenth, after which it increases again gradually to the eighteenth, from which year up to the twenty-fifth it receives a much more rapid augmentation, when it again begins to diminish up to the forty-first. Thus, out of 10,000 youths who reached the age of eighteen, he found that not more than 8885 attained their thirtieth year: but if the rate of mortality had not augmented in a greater ratio than during the preceding four years, there would have been 9174 survivors. The general increased mortality of this period, therefore, alone entailed a loss of 289 out of every 10,000 lives. The mortality, therefore, amongst 10,000 soldiers, when compared with that amongst 10,000 of the inhabitants at large irrespectively of their age, would inevitably be greater from this circumstance alone.

In instituting a comparison, in the previous

Lecture, between the expectation of life, which is given in the most carefully constructed modern life tables both in England and in France, and that which is exhibited in Dr. Price's Northampton Tables on the one hand, and in Duvillard's Tables on the other, I selected Dr. Price's Tables as the oldest English life tables, and Duvillard's as the only French life tables, in which the general law of mortality at about the same period was professed to be represented. There are, however, other tables in both countries, constructed upon very different data, and in which the results are very much more favourable to vitality: I allude to the Carlisle Tables, and the Tables of M. Deparcieux. The latter writer published in 1746 an Essay "Sur les Probabilités de la Durée de la Vie humaine," accompanied by six tables of mortality. The observations upon which the first table was constructed, had been made on the nominees of two Tontines in France, created in 1689 and 1696 respectively. The use of the term Tontine, so well known to the generation of the past century, is now almost confined to history, and as its meaning may not be familiar, its origin may deserve a brief explanation. Early in the reign of Louis XIV. of France, soon after he had attained his majority, and recalled Cardinal Mazarin as Prime Minister to his councils, and appointed

Fouquet "Surintendant des Finances," an Italian of the name of Tonti suggested a method of raising a state-loan by an association of life-annuitants on these terms: — that the surplus dividends accruing on the deaths of individual annuitants should be distributed amongst the surviving subscribers, until the whole body should become extinct. Mazarin's administration was but a series of financial expedients, so that such a proposal found a ready welcome, and for some time this method of raising money for public works, or the necessities of the government, was successful. But as this system involved a speculation on the part of each individual against his neighbour's life, and the self-love of man, even in this respect, could not but lead him to undervalue his neighbour's chance of living as compared with his own, and the supposed laws of mortality, upon which the calculations were based, were occasionally far from correct, the nominees in some cases became discontented with the unreasonable longevity of their fellow subscribers. Thus, in regard to the three Irish Tontines in our own country, which were created in the years 1773, 1775, and 1778, assertions that nominees were sometimes fraudulently personated after their death, and their dividends unwarrantably drawn for a series of years, so far prevailed at the beginning of the present cen-

tury, that a select Parliamentary Committee was appointed to inquire into the fact, and the result was a report that the mortality had not been so rapid as the calculations of Dr. Price had led the subscribers to expect. Mr. Finlaison, the actuary of the National Debt, in his Report on the law of mortality of the Government Life Annuitants, states that there is abundant evidence in the subsequent observations, that the subscribers did not die off so fast as Dr. Price had predicted.

Four of the remaining tables of Deparcieux were founded on the observations of the mortality amongst monks of different orders in France, and the fifth represented the mortality amongst the nuns of several convents in Paris from 1685 to 1745. These were amongst the earliest tables of mortality constructed for the two sexes separately, and by them the greater longevity of the female sex was made evident,—a fact already noticed by M. Kerseboom, in his Essay, in the Dutch language, "On the probable Number of Persons in Holland and West Friesland," published in 1738, of which a notice by Mr. Eames may be found in the Philosophical Transactions for that year. They could, however, be of comparatively little value in determining the general law of mortality, from the peculiar habits of life of the individuals, as it

appeared that the mortality amongst these classes was below the average under 50 years of age; but after that time, above the average, and considerably so in the case of the nuns. Deparcieux, therefore, calculated his life table from the mortality amongst the Tontinists. But in both series of observations, he had no data beyond the age of those who died. "He had not even the advantage of personal access to the original record of the two Tontines, but compiled his facts from the file of flying sheets, which, in the case of all Tontines, used to be published periodically, to announce the deaths of nominees. But in no case whatever did he receive information either of the sex, or even of the age of the nominee, either at entry or at death, or at surviving, because the Tontinists were in classes, persons from 5 to 10 being in one class, from 10 to 15 in another, and so on, without any mention of the particular number enrolled or dying at each or every age." M. Finlaison considers that such imperfect data could hardly furnish a sufficient approximation to the truth, although the facts were very numerous; and in computing an observation on the two Tontines separately, he found that the rate of mortality after forty years in one was very different from that in the other.

One strong theoretical objection against the life

table of Deparcieux will readily suggest itself,—that as the observations on which it was founded were made from picked lives, they can hardly be supposed to represent the general law of mortality. Mr. Finlaison, on the other hand, at the conclusion of his Report, after a very extensive examination of not fewer than twenty-two sets of observations, gives his opinion, though he carefully limits himself to a mere opinion, "that there is very little, if any, advantage at all, in favour of selection," and that picked and chosen lives (such as are presented to insurance offices) are not superior in longevity to the rest of the same rank in society, from among whom they are so chosen. If, however, we admit that the table of Deparcieux represents a select mortality which was most probably rather below the general mortality in France in the middle of the last century, the result of a comparison of the respective expectations of life given by it, and by M. Demonferrand's life table of 1837, is in favour of an increased vitality amongst the French population, for its conclusions accord with those which are supplied in the present day by a table for those departments of France where the mortality is most rapid, in which the rate is raised above the average by the returns from Paris and the other great towns.

The English life tables, which exhibit results

most closely corresponding to those at which Deparcieux had arrived, are the Carlisle Tables, published in 1815 by Mr. Milne in his "Treatise on Annuities." They were at that time the only life tables, applicable to the mass of the people, which had been formed from the necessary data, namely, the enumerations of the living from amongst whom the deaths occurred at every age, excepting those of Sweden and Finland, already alluded to, as compiled by M. Wargentin in 1755, from which countries a subsequent series of returns was published by M. Nicander in 1801. Dr. Heysham of Carlisle had kept an accurate register of the births and of the deaths at all ages during a period of nine years, from 1779 to 1787, in the two parishes which comprehend Carlisle and its environs, and had distinguished the sexes. During the same interval, two enumerations of the population of these two parishes had been made in 1780 and 1787 respectively, in both of which the ages were distinguished, and the sums total of both sexes. The tables constructed from these data, as may readily be supposed, afford a far higher expectation of life than the Northampton Tables; and though the observations were only carried on during so short a space of time as nine years, yet this circumstance is of less importance, as during the twenty-two years commencing with 1779, as

Mr. Milne has shown, the proportion of the annual average number of deaths to the mean number of the people, was the same as in the first nine years, namely, 1 in 40. The expectation of life at birth, which the Carlisle tables exhibit, is rather more than 38 years. Whether, therefore, we contrast the mean duration of life, or the rate of mortality, as furnished by these tables, with those which the last observations in England and Wales afford, in either case we find an evident improvement; the expectation of life at birth being at present rather more than 41 years, and the rate of mortality 1 in 46.

When the mean duration of life is said to be augmented, it must not be supposed to imply that the term of human existence is in any way extended, but merely that a greater number of individuals attain a mature age — for instance, the age of 45—55.

LECTURE IV.

The most important object to which a National Life Table can be applied, is without doubt the determination of problems connected with the efficient state of the population, such as the proportion of males capable of bearing arms, the numbers whose labour is available for different branches of industry, and the proportion of infants and old people for whose support the labour of the efficient portion of the population must be taxed. The secondary use to which they have been applied, and which in reality led to the study of such contingencies, was the determination of the value of life annuities, pensions, and other financial transactions. It was for this latter purpose that Halley may be said to have invented the form of the life table in 1693, when he presented to the Royal Society of London an "Estimate of the mortality of mankind drawn from various tables of the births and funerals in the city of Breslau, with an attempt to ascertain the prices of annuities upon lives."—(Philosophical Transactions Abridged, vol. iii. p. 510.)

Halley selected the bills of mortality of the city of Breslau as furnishing the least objectionable data, for the calculation of a life table, because "the births exceeded a little the funerals, and the confluence of strangers was but small;" and although he was well aware that he wanted the number of the whole people to ensure the necessary accuracy in his calculation, yet he considered it to give a more just idea of the state and condition of mankind than any thing then extant. Amongst the manifold uses of it which he pointed out, was that it "showed the chances of mortality at all ages, and likewise how to make a certain estimate of the value of annuities for lives, which had previously been effected by an imaginary valuation." The form in which a life table on Halley's principle is constructed may be very briefly stated. If 100,000 persons be the assumed number born alive, which is termed the *base* or *radix* of the table, the relative numbers living in each consecutive year till the whole number is exhausted must be ascertained. Thus the age at which the table terminates will vary with different observations. In the English life table of 1841, the last survivor of a given 100,000 lives did not expire till the 105th year. Upon adding up the column of the relative numbers living, in the English life table for example, the sum of their lives amounts to 4,165,890

years. From this sum half the number of lives during the first year must be subtracted, as half on the average are born during the last six months of it. The remainder 4,115,890 will give us the whole number of years over which the 100,000 lives have extended. If then this sum be divided by 100,000, the quotient will give us the mean duration of life, which in this case will be 41·16 years for both sexes. For males, however, it is 40·19, for females 42·18. By repeating this process the mean duration of life at each year of age is obtained, and this may be properly termed the *expectation of life.*

Two years before the publication of Halley's table an act of parliament "was passed for borrowing a million upon annuities for lives upon decidedly advantageous terms for the annuitants, but the subscription was not filled up. In the following year the deficiency was made good by borrowing upon annuities for lives at 14 per cent., or at little more than seven years' purchase. In 1695, the persons who had purchased those annuities were allowed to exchange them for others of 96 years, upon paying into the Exchequer 63*l.* in the hundred; that is, the difference between 14 per cent. for life, and 14 per cent. for 96 years was sold for 63*l.*, or for $4\frac{1}{2}$ years' purchase. Such was the supposed instability of government, that even these terms pro-

cured few purchasers." (Smith's Wealth of Nations, B. v. ch. 3.).

Halley referring to this measure in his paper, read before the Royal Society, remarks that his calculation shows "the great advantage of putting money into the present fund lately granted to their Majesties, giving 14 per cent. per annum, or at the rate of seven years' purchase for a life, when young lives at the usual rate of interest are worth above 13 years' purchase." In the ignorance then prevailing as to the duration of life, annuities were granted at the same rate to persons of every age: and Halley pointed out the advantage of young lives over those more advanced in years, "a life of 10 years being almost worth $13\frac{1}{2}$ years' purchase, whereas one of 36 is worth but 11."

In a note appended to the Registrar General's Fifth Report, it is observed, that "in declining to convert their life annuities into long annuities of 96 years, the purchasers appear to have well understood their own interests. The instability of government would affect life annuities as much as long annuities. But the life annuity of seven years' purchase was much the best bargain for the purchaser: for the interest of money being 6 per cent., the life annuity was worth, at Halley's estimate, rather more than 13 years' purchase at the age of 10, and an annuity for 96 years was

worth only $16\frac{3}{5}$ years of purchase. The value therefore of a life annuity of 100*l.* was 1300*l*, which was obtained for 714*l.*, and the new offer to the purchaser was that, if he would advance 450*l.* more, he should obtain an annuity worth 1660*l.* By accepting the offer he would have gained 496*l.* on 1164*l.*, by rejecting it his profit was 586*l.* on 714*l.* The Chancellor of the Exchequer of that day (Sydney, Lord Godolphin) thus attempted to gain more money, whilst he recovered part of the sums which Halley's table showed had been thrown away in the previous transactions."

The least important application of life tables in a national point of view, though the most important perhaps to individuals from the daily increasing extent of the transactions, is the mercantile use of them in computing premiums for life assurances.

The immediate object, however, of the calculation here is precisely the reverse of what is to be looked to in regard to annuitants. In this case the problem to be determined is, what are "the chances of death?" in the case of annuitants it is, what are "the probabilities of living?" If the population, indeed, were stationary, these questions would refer to the same fact; for the "mean age at death," and the "mean duration of life," would on this supposition be

identical; but if the births exceed the deaths, and that very considerably, there will be a great discrepancy between the numbers which represent these two results. I have already perhaps diverged too far from the proper province of economical inquiry, by entering into details which rather come under the department of the mathematician. I shall therefore content myself with stating, that it appears that the "expectation of life," with which the life insurer is concerned, may be very different from that, in which the political economist and statesman are interested. Thus, in France, according to the Annuaire du Bureau des Longitudes, there are assurance companies which employ the tables of Deparcieux where the rate of mortality is low, in calculating the value of annuities to be paid during the lives of the assured, and the tables of Duvillard where the rate of mortality is high, in the case of sums to be paid on the deaths of the assured. On the other hand, in England, the returns of certain life offices represent the decrements of life to be less than those given in the tables of Deparcieux, and during the earlier years to be even less than those given in the Carlisle Tables, whilst the experience of other offices has not warranted them in abandoning altogether the use of the Northampton Tables.

It must not be forgotten that the experience

of a life assurance office is based upon the number of *policies*, not on the number of *lives*, on which those insurances were effected; whereas there are a great number of instances in every insurance office where several policies are taken out on one and the same life; and also that the mortality with which each office is concerned must be a *special mortality*, requiring a special experience to decide in what degree it differs from the general mortality.

For instance, it may be perfectly true that the mean duration of life in England has very sensibly increased, but it does not follow that the increase is distributed equally over all periods of life: it may, for example, be chiefly confined to the younger portion of the population. The experience, therefore, of an insurance office, where there is a greater proportion of policies on lives under 40, will furnish a different result from that where the majority are above 40; again, the University Life Office, owing to its connection with the clergy, may be expected, in all probability, to exhibit a larger list of septuagenarian insurers than the Law Life, if M. Caspar of Berlin, in his Contribution to Medical Statistics (Beitrage zur Medicinischen Statistik), be correct in his observations, that out of 100 clergy 42 attain the age of 70 and more, whilst out of 100 advocates only 29 reach that age. It should

not be forgotten, however, that a clergyman almost always dies under the class of clergy; whereas an advocate frequently abandons his profession, and is registered under the more indiscriminate head of gentry.

Whilst the rate of mortality amongst infants has almost everywhere decreased from various causes, amongst which a better method of nursing exercises a very decided effect, the mortality in maturer life has diminished chiefly from improved habits of cleanliness and temperance. The influence of many of the positive checks to population most certainly diminishes, as men become less entirely the slaves of their passions and irregular impulses; but there is a class of positive checks, which come into operation in the successive stages of advancing civilisation, such as result from the corruption of the atmosphere of large towns from defective drainage, or the corruption of the air in dwelling-houses and work-rooms from bad ventilation, which have hitherto been almost overlooked. The extent to which the longevity of a population is reduced by the ravages of such scourges has only of late been made known in England, through the labours of the Sanitary and Health of Towns Commissions, and the results appear to be of sufficient importance to warrant a distinct dis-

cussion of them in the subsequent course of these lectures.

Inquiries to the same effect have been carried on in France by M. Villermé, M. Benoiston de Châteauneuf, and others, in Belgium by M. Ducpetiaux and M. Quetelet, and the subject is very justly acquiring a national importance, and in our own country it is to be trusted that it will, before long, attract the attention of the legislature.

It is a melancholy fact, in connection with the growth of communities, that the health of the infant population of large towns should be liable to be insidiously undermined by the contaminated air which they breathe, not merely within the dwellings of their parents, but even in the streets; but it is a still more melancholy fact, that the industrious father of a family, the strong and intelligent operative, should be exposed to be smitten down by fever in a successful career of industry, from his ignorance of the disadvantageous circumstances under which he applies himself to his labour. For it is not always the want of employment which is fatal to the operative classes; it is sometimes the very employment itself, because that employment confines them during the whole day to close and ill-ventilated work-rooms. Thus at Paisley, in May, 1832, during a period when there was almost an entire

cessation of work, and such universal distress, that the aid of Government was required to co-operate with private benevolence, the physicians of the Fever Hospital were surprised by a diminution of at least one eighth in the average of fever cases as compared with the previous five years. When, however, a time of brisk employment succeeded, and the whole population were again at work, a new epidemic broke out. In Manchester, a similar reduction of mortality was experienced in the years 1841 and 1842, which were years of great distress as contrasted with 1840. It seems from a host of similar instances, which are collected in various Sanitary Reports, to be a well-ascertained fact, that the unfavourable effect of a reduction in the supply of food and clothing to our manufacturing population during a period of non-employment, in inducing disease, is more than counterbalanced by the favourable effect of their absence from ill-ventilated workshops, and the accompanying want of means to gratify costly and hurtful propensities, whereby the causes of disease are diminished. The remedies for such evils as these, which are internal to dwelling-houses and workshops, come rather within the sphere perhaps of domestic than political economy, as they originate in defective *private* arrangements. But the evils which result from defective *public* arrangements,

external to the dwelling-houses of individuals, affect the community at large. Sanitary regulations in respect to them may reasonably come under the notice of the State. For it has been found that the neglect of suitable public arrangements in certain districts of our large towns in respect to drainage and the supply of water, has been attended with a moral and physical deterioration of the inhabitants: that those districts are not only the seats of the most terrible diseases, but likewise the abode of the great criminals. "The worst place in the parish of Whitechapel is the place where the most dishonest and profligate portion of the population lives." The Alsatia of modern Rome, for the Sovereign Pontiff still allows of asylums for criminals, (I speak from memory of what was the case in 1834,) is in one of the most unhealthy districts of that city; and this circumstance was alleged to me as an excuse or apology for the system, that Fever within a very few years makes satisfaction to offended Justice. It may be the case that the great criminals of a town population are found in the most unhealthy districts, because the better part of the inhabitants decline to occupy them; still it has been observed that the neglect of decency and comfort which is unavoidable, when the supply of water is inadequate for the purposes of cleansing and draining a

district, has a debasing effect on the human mind. "There is a point of wretchedness which is incompatible with the existence of any respect for the peace or property of others, and to look in such a case for obedience to the laws where there is the slightest prospect of violating them with impunity, is to expect to reap where none has sown." It may not be out of place to observe, that it has been found in town districts where the sewerage is bad, the supply of water deficient, and the means of preserving cleanliness altogether unattainable, that the inhabitants not merely "have not the bodily vigour and industrious habits of a healthy and independent peasantry, but they have not the intelligence and spirit proper to such a race." One of the most melancholy proofs of this is, the quiet and unresisting manner in which they succumb to their lot, and it is the feeling of depression attendant on inhaling the atmospheric poison generated in the neglected districts of our large towns, which leads many to seek temporary relief either in stimulants, whose base is alcohol, or sedatives, into the composition of which opium enters in large proportions. To those who are familiar with the aspect of the population in a country district, where malaria prevails during the greater part of the year, such as Italy so frequently presents to the notice of the traveller,

this coincidence of mental apathy and physical listlessness will not be surprising.

There is a popular mode of regarding the positive checks to population, whether they be those natural to savage life, such as war, pestilence, and famine, or those incidental to the various stages in the transition state of civilised communities, such as unhealthy occupations, the corruption of the air in towns, and various complicated forms of physical evil, that they form a terrible corrective under God's providence to an excess of numbers, or, in other words, to the pressure of population against the means of subsistence. The fearful efficacy of positive checks upon man, in a semi-barbarous condition, cannot indeed be denied. Whole tribes of American Indians have been extinguished by war, when the irruption of an enemy has desolated their cultivated lands, or driven them from their hunting grounds. Forced to seek refuge either in the forest or the mountain, without any portable stores, they have escaped the sword only to perish by famine. In Paraguay, on the other hand, notwithstanding the care and attention of the Jesuits, smallpox and malignant fevers frequently desolated their otherwise flourishing missions, from the fact that few of the natives that were attacked ever recovered, owing to the unfavourable circumstances under

which they were exposed to these scourges. On the west coast of America, Vancouver traversed 150 miles of coast and saw nothing but deserted villages, and the bones of the dead scattered about promiscuously in great numbers, as if pestilence and famine had exercised their united ravages. A people who depend for their food on the occupations of hunting and fishing, and who have probably little, if any, stores, are cut off from their supplies, when attacked by disease; and famine in this case attends on the steps of pestilence, just as inversely in the case of an agricultural people pestilence frequently follows in the wake of famine.

It would seem, however, from the observations of competent enquirers, that the excessive mortality arising from the steady and continuous operation of the peculiar positive checks to which civilised communities are exposed, does not so much diminish the numbers of a population as cause it to deteriorate in physical and moral character. Experience has almost invariably shown, that when the increased action of a positive check does not simultaneously reduce the general productive power of a community, and so affect its means of providing subsistence, the increased mortality will indirectly stimulate the rate of increase by removing the pressure upon the spring of population. In the Fifth Report of

the Registrar-General, p. 234., we have a table of the average rate of deaths and burials in the metropolis during the year 1841; from which it appears, that whilst in the healthiest sub-districts there was 1 death in 56, and 1 birth in 42, in the unhealthiest sub-districts there was 1 death in 33, and 1 birth in 28; whilst the mortality was 66 per cent. higher in the unhealthy than in the healthy districts, the proportion of births was 51 per cent. higher. Again, from a table of the average number of marriages, births, and deaths in different large divisions of England and Wales, it appears that in Lancashire and Cheshire, where the mortality is raised 44 per cent., the marriages and births are raised 21 per cent.; whilst a comparison of the five most unhealthy and the five most healthy divisions exhibits the same fluctuation, though to a less remarkable extent. Thus the marriages and births are 12 per cent. higher in the five divisions, where the mortality is raised 15 per cent.; and the excess of 12 per cent. in the births furnishes a number of births more than equal to the number of deaths. To the same effect in France, M. Bossi, in his Statistique du Département de l'Ain, from documents during the years 1802–4, furnishes this result as to different localities. In healthy mountainous districts, where there was 1 death in 38, omitting fractions, there was

1 marriage in 179, and 1 birth in 34; whilst in unhealthy, marshy districts, where there was 1 death in 20, there was 1 marriage in 107, and 1 birth in 26. M. Quetelet, in his essay Sur l'Homme et le Developpement de ses Facultés, supplies a comparison between the great capitals of Europe to the same purport. Thus, whilst in London there was 1 death in 46, there was 1 birth in 40; in Paris, 1 death in 31, 1 birth in 27; in Vienna, 1 death in 22, 1 birth in 20.

The preventive check, therefore, seems to be invariably relaxed with an increased intensity of the positive check. One obvious reason for this is suggested by Dr. Griffin in his Report on the Sanitary Condition of the City of Limerick, where the births average about five to a marriage, and furnish even a greater proportion in the worst conditioned districts. "I find that as the poor nurse their own children, there is in general an interval of about two years between the birth of one child and that of the next; but if the child dies early on the breast, this interval will be much shorter; and if this occurs often, there will be a certain number *born as it were for the purpose of dying;* and these being soon replaced, the same numbers may still be preserved, as if there had been few or no deaths, or only the ordinary number." The increased fecundity of the parent will inevitably in this

case be attended with diminished strength in the offspring, from the interval between each birth being reduced.

On the other hand, it has been observed, that where the influence of positive checks has diminished, the operation of preventive checks is proportionately increased. There does not seem to be any invariable rule as to the relation of these two results to each other, in the way of cause and effect. Thus much, however, is certain, that they act and react upon each other; and in whichever direction the impulse may first be given, their mutual connection is soon perceptible. One of the best illustrations of this very important fact is furnished from the Records of the City of Geneva, where registers of the deaths, with some occasional gaps before 1616, have been kept with the greatest care ever since the year 1549, and of the marriages and births in addition, since the year 1693. M. Edouard Mallet, in his "Recherches Historiques sur la Population de Génève, pendant 1549—1833," published in 1837 in the "Annales d'Hygiène, vol. xvii., has given a series of tabular results, which, from the long period of time over which the observations extend, and the more than ordinary accuracy with which they have been made, merit a careful examination.

Years.	Population.	Deaths. mean.	Deaths. 1 in	Births. mean.	Births. 1 in	Marriages. mean.	Marriages. 1 in	Ratio of births to a marriage.
1695—1710	17,700	623	28	646	27	132	134	4·88
1711—1730	20,000	635	31	667	30	171	117	3·90
1731—1750	21,500	649	33	677	31	186	115	3·63
1751—1770	23,500	691	34	781	30	213	114	3·62
1771—1790	25,000	741	34	756	33	211		

It results from this table, that during each successive period, there has been an augmentation in the total number of the population, a diminution in the proportion of deaths as compared with the population, a corresponding diminution in the proportion of births, and an augmentation in the proportion of marriages, coupled with a decrease in the ratio of births to a marriage. The fecundity of marriages has diminished one fourth during the eighteenth century. An analogous result, though not to the same extent, has been observed in Paris from 1700 to 1790. M. Mallet's own researches during a more recent period, confirm the tendencies above exemplified.

Years.	Population.	Deaths, 1 in	Births, 1 in	Marriages, 1 in	Ratio of births to marriages.
1805—1812	23,250	37	40	161	3·34
1814—1833	27,177	46·92	46·86	141	2·86

It is not unimportant to observe, that, during the last ten years of this period, the number of divorces had diminished one fourth, as this circumstance might considerably affect the proportion of marriages. It should always be kept in mind that the fecundity of marriages may represent a very

different result from the fecundity of the population. The fecundity of marriages, for instance, may decrease in a country where the mortality is great, owing to the increased proportion of marriages for the second or third time; yet the fecundity of the population itself may increase. Mr. Malthus, in his chapter on the Fruitfulness of Marriages, observes, that, with a *given rate of increase*, "it is clearly desirable to find in the registers a small rather than a large proportion of births to marriages, because the smaller this proportion is, the greater must be the proportion of the born which live to marry, and of course the more healthy must be the country."

The same records of the city of Geneva exhibit most satisfactory evidence of the increase both in the probable and the mean duration of life of the population during the last four centuries, as the following tables will show, which have been carefully examined and corrected, where necessary, by M. Mallet: —

From M. Cramer's observations: —

	Probable life.			Mean life.		
Years.	yrs.	m.	d.	yrs.	m.	d.
1560—1600	8	7	26	21	2	20
1601—1700	13	3	16	25	8	2
1701—1760	27	8	17	32	9	24

From M. Odier's observations in continuation of M. Cramer's: —

Years.	yrs.	m.	d.	yrs.	m.	d.
1761—1800	32	4	0	33	7	0
1801—1813	40	8	0	38	6	0

From M. Mallet's own observations: —

Years.	yrs.	m.	d.		yrs.	m.	d.	
1814—1823	45	10	17	mean.	40	11	2	mean.
1823—1833	44	6	6	45 0 29	40	5	22	40 8 7

The excess of the probable life at present above the mean life, is a proof of the very great diminution of mortality amongst the young. With improved medical skill and greater care, the probable may be expected to exceed the mean duration of life; for though the feeble may be preserved to reach an adult state, they will, no doubt, die sooner than the strong.

M. Mallet, in discussing the probable causes of the diminished mortality amongst infants, states some facts in support of the beneficial effect of vaccination, which are worthy of attention. Mr. Finlaison, in his "Report on the Law of Mortality" amongst the government annuitants, seems to consider that the value of Dr. Jenner's discovery consists, not so much in the number of lives absolutely saved, as in the number preserved from comparative discomfort; and that the ravages of the smallpox before the introduction of vaccination have been over-estimated.

"Variolous inoculation," he says, "was little known in general practice before the year 1750; and most people are aware that it never was universal, even among the more enlightened classes, from the natural aversion of parents to superin-

duce voluntarily a loathsome disease, which the child very probably might escape altogether. Now it is an unquestionable fact that there is no perceptible difference at all in the mortality of children from the age of 3 to the age of 20 in the sixty years preceding 1805; that from the age of 3 to 12 the mortality regularly diminishes from about 12 in 1000 to 6, 5, and 4 in 1000; and from adolescence to maturity it rises again. Considering, therefore, the innumerable ailments to which children are liable, besides that of the smallpox, it is not in my power to believe that the smallpox in that period was so fatal a scourge as it is supposed to have been, unless indeed its whole severity fell upon infants under three years of age, and on the children of the poorer classes exclusively: because, with very great deference to better judges, I am unable to conceive a lower rate of mortality than 4 or 5 per annum in 1000, which was the case when the smallpox had full sway."

On the other hand, M. Mallet's researches during the four last centuries tend to show that whilst the mortality between the ages of 10 and 60 gradually decreases in each century, owing as he conceives to a gradual improvement in the domestic and social habits of life, accompanied with better food and clothing, more airy dwellings, and better medical and hygienic regula-

tions, the mortality under ten years has decreased in a rapidly accelerated ratio during the present century since Dr. Jenner's discovery: —

Age.	xvi cent.	xvii.	xviii.	xix.
1	25·92	23·72	20·12	15·12
2	8·40	6·99	4·85	4·34
3	4·67	5·05	3·55	2·32
4—5	5·36	5·24	4·64	2·62
6—10	7·59	6·60	5·75	3·63

If we admit the conclusion at which Duvillard, in his investigations "Sur l'Influence de la Petite Verole," arrived, that 25 out of 26 cases of smallpox occurred amongst children between the ages of three and ten, to represent the general law, it will be seen from the above table, which forms a portion of a more complete one inserted in M. Mallet's memoir, that whilst the mortality between those ages decreased only one third from the 16th to the 18th centuries, it has diminished at a remarkably accelerated rate during the present century. The experience, indeed, of several physicians in particular localities has given some countenance to the idea, that the reduction of the mortality by smallpox is more than counterbalanced by the contemporaneous increase of deaths amongst children from other diseases, (Dr. Robert Watt's Observations on the Mortality amongst Children at Glasgow during 1703—1812, in his Treatise on Chincough, 1813,) and that the smallpox itself may have been the

development of some evil principle in a particular form, which, when opposed and put down in that form, exhibits itself in a state of increased activity in some other. What may be the proper scientific solution of this question, and whether or not medical science can do more than merely modify the form in which the fatal result shows itself, must be answered by those to whose province such discussions more peculiarly belong. This fact, at least, the registers of Geneva satisfactorily prove, that the causes prejudicial to human life, particularly in the early years, are not necessarily of a permanent character, and that their operation is capable of being very materially checked.

The general result, which the miniature picture of a state at Geneva presents in such a clear and definite outline, is that with an augmentation of material prosperity, and a diminution of mortality, marriages have come to be contracted with more prudence, and at a later period of life; so that, though the proportion of marriages has increased, the proportions of births to the population as well as to the actual marriages has been reduced; but at the same time a greater number of infants born have been preserved; both of which circumstances may be attributed in a certain degree to the revival of the custom of mothers nursing their own children. In ad-

dition, the proportion of the population that has attained an efficient state of vigorous manhood has been augmented. To a similar effect the statistical returns both of this country and of France show, that with a diminished mortality and an absolute increase of numbers in consequence, the rate of increase in proportion to the numbers is diminished. It may happen either that the positive checks have slackened in intensity, because there is less opportunity for them in consequence of the more prudent habits of the community; or, on the other hand, the preventive checks have come into greater operation, by occasion of the positive checks being mitigated. That the preventive checks should altogether supersede the positive checks; in other words, that men should refrain from marriage until they are able to provide reasonable support for their offspring, is perhaps not to be expected in any community; nor am I disposed to think it would be altogether a desirable result. A great nation must always be capable of making extraordinary exertions, when suddenly called upon to do so, and therefore must possess some reserved store of unemployed labour capable of being called into activity on such emergencies. Again; it is the steady pressure of population against subsistence which stimulates the wit of man to new discoveries, which suggests the en-

terprize and enforces the necessity of perseverance in its execution. The imaginary community of the Utopians has been represented by Sir T. More to have found "their time set off for labour more than sufficient for supplying them with plenty of all things;" but we are at liberty to suppose them to have had very few wants, and most assuredly an existing community, if there were any, so circumstanced, would as a state be but little removed above actual barbarism. The discovery of an artificial want is the first step to exertion, and without exertion in the individual there can be no progress for the nation. If the law of our existence here were to be reduced in this respect to the standard of the Utopians, society would sink into a state of selfish apathy and languor. As long, however, as the instincts of human nature remain unchanged, our race will be continually subject from the law of its increase to the ravages of positive checks; but the intensity of them will diminish with every onward step in civilisation. It is true, that new and highly artificial checks come into play in the successive stages of the growth of communities. Their influence, however, need be only temporary. In the vegetable kingdom the antidote is almost invariably found not far remote from the poisonous plant. In a similar manner, if ever the new and improved combina-

tions of power and industry, which the reason of man devises, are found to exercise in their immediate and accidental results a prejudicial effect upon human life, we may be assured that the same reason is gifted with the capacity of analysing these destructive influences, and of discovering by the side of the causes of increased mortality the means of controlling their operation within due limits.

APPENDIX.

Page 5. *On the Total Average Produce of Grain in England and Wales.*

It is much to be regretted that there are no means of accurately ascertaining the extent of land in England and Wales under grain crops. Mr. Couling, in an estimate laid before the Emigration Committee, supposed the arable land and gardens to amount to 11,143,370 acres. Arthur Young, in his "Eastern Tour," estimated the extent of land under crop in England, exclusive of Wales, at 12,707,000 acres, which Mr. M'Culloch justly conceives to have been too high an estimate, as 1,200,000 acres must be added for fallows. Dr. Beeke, in 1800, arrived at a conclusion very similar to Mr. Couling's. Mr. Stevenson, in 1812, estimated the arable land at 11,500,000 acres; and Mr. Middleton, in his "Survey of Middlesex," supposed the tillage land to amount to 12,000,000 acres. Mr. Comber, in his Appendix to his work "On National Subsistence," calculated the total acres under cultivation in England and Wales to amount, in 1812, to 11,591,000. Mr. M'Culloch, therefore, cannot be very far from the mark in estimating the total quantity of land under cultivation to be at present 12,000,000 acres. The distribution of crops he conceives to be as follows: —

	Acres.
Wheat - - -	3,800,000
Barley and rye - -	900,000
Oats and beans - -	3,000,000
Clover - - -	1,300,000
Roots, turnips, and potatoes -	1,200,000
Hops, gardens, &c. - -	150,000
Fallow - - -	1,650,000
Total -	12,000,000

It is upon this estimate of the quantity of land under tillage, that he proceeds to calculate the total average produce of grain, as follows. It appeared from a Report published by the Board of Agriculture, that the produce of wheat throughout England and Wales was taken, before 1837, at an average of from $2\frac{1}{2}$ to 3 quarters (Winchester measure) per acre, barley at 4 quarters, oats at $4\frac{1}{2}$. Mr. M'Culloch, however, writing in 1837, felt himself warranted in reckoning the average produce of wheat at $3\frac{1}{4}$ quarters per acre, in consequence of the great improvement in its cultivation by the introduction of bone and other artificial manures. On this supposition he gives the following result: —

Crops.	Acres.	Produce. Qrs. per Acre.	Total Produce. Qrs.
Wheat -	3,800,000	$3\frac{1}{4}$	12,350,000
Barley and rye -	900,000	4	3,600,000
Oats and beans -	3,000,000	$4\frac{1}{2}$	13,500,000
			29,450,000

The improvements which have since been carried on in the culture of wheat will probably have raised the amount of the wheat crops very considerably: on the

other hand, I am led to suppose, from very good authority, that the extension of railroads has exercised a very marked influence in reducing the quantity of spring crops. It would be very much to be desired that an annual return should be obtained of the quantity of acres under each description of crop, as well as of the average yield at the conclusion of the harvest, and, in the case of the wheat crop, of the average weight of the bushel of wheat. I am indebted to Mr. Henry Dixon, the eminent land-surveyor at Oxford, for the following account of the rough method adopted by the dealers in corn for estimating the produce of each approaching harvest with reference to speculations in the corn trade.

The present mode of calculating the probable yield of wheat of a given district for the coming harvest is as follows: — About the time that the wheat is blooming, generally about the beginning of June, a person will go round with a gauge secreted in a hollow cane, which forms a triangle when opened, and represents a certain portion of an acre of ground. This is placed over various portions of the standing crop in the best and worst parts of a field: the number of ears of wheat comprised within the triangle is counted, and the probable quality of the grain is taken into calculation according as the spring has been wet or dry. On the former supposition the grain is likely to shrink; on the latter, to harden and come out plump. It may be observed, that if there has been a good general rain during the last ten days of April and the first ten days of May, on the average, no more wet is required for wheat. An expert gauger will form a very accurate estimate of the probable produce of a given district by this method.

The weight of a bushel of wheat is a very important element in the calculation of the probable quantity of

flour. For instance, "in the best wheat counties, and in good years, the weight of a Winchester bushel of wheat varies from 60 to 62 lbs. In the Isle of Sheppey, in Kent (where perhaps the best samples are produced), it sometimes weighs, in favourable seasons, 64 lbs. a bushel. Where the climate is naturally colder, wetter, and more backward, or in bad seasons, the weight of the bushel does not exceed 56 or 57 lbs." (M'Culloch's Statistical Account, i. p. 472.) Mr. Dixon has furnished me with the following table, which has been submitted by him, I believe, to very competent criticism.

"*Produce of Flour from a Bushel of Wheat of different Qualities.*

"A load of wheat (40 bushels) averaging 63 lbs. to the bushel, will produce about $7\frac{1}{2}$ sacks of flour, weighing 280 lbs. per sack. The average produce will consequently be about 55 lbs. of flour from 63 lbs. of wheat.

"The following scale of produce of flour may be taken as about the average, according to the weight and quality of the wheat.

"63 lbs. per bushel, about				55 lbs.	of flour.
60	—	do.	—	$50\frac{1}{2}$	do.
55	—	do.	—	44	do.
50	—	do.	—	37	do.
45	—	do.	—	30	do."

The above table will at one glance show the importance of ascertaining the weight of the bushel of wheat, in regard to any calculation of the quantity of food which the year's crop is likely to furnish.

The breadth of acreage under each species of crop seems to be a subject, for various reasons, well worthy

of inquiry on the part of the state. I am fully aware that it is a very difficult question to determine by what machinery the necessary returns could be procured. Perhaps the means which are employed by the Tithe Commission, or by the Commissioners of the Property Tax, might be most readily made available for such a purpose.

Page 67. *Increased Vitality amongst the French Population.*

I have omitted, by accident, to insert the conclusion at which M. Matthieu arrives in the Annuaire. From the present returns of the population in France, he considers that on the supposition of its being stationary, according to Duvillard's method, the mean duration of life would now be 33 years, whilst Duvillard only gave an expectation of $28\frac{3}{4}$ years. This augmentation of more than four years M. Matthieu attributes to the introduction of vaccination, and to the increase of material prosperity amongst all classes.

Page 78. *Defective Drainage.*

As the lecture in which the effects of defective drainage in increasing the rate of mortality were discussed, does not form part of those which I have selected for publication, I subjoin a few striking facts illustrative of the intensity of the evil. In a memoir annexed by Mr. Chadwick in the Appendix to the Supplementary Report on the Sanitary Condition of the Labouring Population of Great Britain, p. 241., it is stated, " that in the parish of St. Margaret's, Leicester, during the year 1840, the average age at death in the streets that were drained (and that by no means

perfectly) was $23\frac{1}{2}$ years; in the streets that were partially drained, $17\frac{1}{2}$ years; in the streets that were entirely undrained, $13\frac{1}{2}$ years. Though the defective drainage and cleansing was the main cause, it was doubtless not the only cause of this variation. That, however, was a year of heavy mortality, and the average age at death in that and another district during the years 1840, 1841, and 1842, was, in the streets drained, $25\frac{1}{2}$ years, in those partly drained, 21, in those not drained, 17 years."

In the First Report of the Health of Towns Commission, the Rev. J. Gray has furnished an estimate of the rate of mortality in the town of Preston, vol. i. 8vo., p. 179., from which it appears that the rate of mortality varies very greatly according to the cleansing and drainage of the several districts.

Ages.	Well-cleansed Districts.	Moderately cleansed.	Badly cleansed.	Worst Streets.	
Under 1 year	15·5	20·8	38·3	44·4	per cent.
Under 5 years	19·3	31·8	32·2	29·4	
Above 5 years	65·2	47·9	29·5	26·2	

In the same volume, p. 206., Mr. H. P. Holland, in his Report on the Sanitary Condition of the Town of Chorlton-upon-Medlock, in Lancashire, gives the following return: —

Streets of 1st class	-	1 in 46	Rate of mortality.
2d class	-	1 in 39	
3d class	-	1 in 27	

That a more effective system of drainage will be attended with a diminution of mortality, can hardly be doubted after the comparative returns from drained and undrained districts. I subjoin two instances, taken at hazard from the General Sanitary Report, 1842. Mr. Crowfoot, an eminent medical practitioner at Beccles, in Suffolk, reported, p. 29., to Mr. Twisleton, the Assistant

Poor Law Commissioner, that the two towns of Beccles and Bungay, of nearly equal population, and of nearly equal natural advantages of situation, &c., excepting that the inhabitants of Bungay were less closely confined, presented very different results in regard to the mortality of the inhabitants. At Beccles a system of drainage had been adopted about thirty years ago, and no open drain now exists in the place. At Bungay, on the contrary, though the opportunities for drainage are equally favourable, two or three large reservoirs for refuse filth existed in the town itself, and some of its principal drains are open. The result, as gathered from a careful examination of the registers of burials, has been in accordance with theoretical calculation. Whilst Beccles has improved considerably in salubrity, Bungay has retrograded as its population has increased in number.

Years.	Beccles.	Bungay.	
1811—21	1 in 67	1 in 69	Rate of mortality.
1821—31	1 in 72	1 in 67	
1831—41	1 in 71	1 in 59	

It may be as well to guard against the conclusion that neglect of house-drainage is only to be dreaded in towns. Single houses and small groupes of cottages in the country present, not unfrequently, instances of as perilous and disgusting a character.

In the same Report, p. 35., Mr. J. Thomson, of Clitheroe, gives an account of a small cluster of houses, called Littlemoor, the situation of which was remarkably healthy and agreeable, and the soil by no means marshy, as its name would seem to imply. There were six houses, containing twenty-one inhabitants, with a single inadequate, half-choked up drain, the only under-ground outlet for the filth and refuse of these habitations, which had been constructed forty years ago, when a single

cottage alone occupied the spot. The surplus water was carried off by a deep open ditch into a shallow stagnant pool. A pig-sty had been erected in the centre of the open area, where all the filth of the houses was poured out in open channels to be conveyed away by the above-mentioned under-ground drain, and the litter of the pig-sties not only obstructed the drain, but occasioned an additional pool of filth to accumulate. Fever appeared here in the middle of May, and before the middle of August fifteen cases had occurred, of which nine were residents acclimatised, as it were, and six nurses from the neighbourhood. Mr. Thomson, believing the source of pestilence to be connected with the want of drainage, had the sty pulled down, the filth cleared away, and a large under-ground drain constructed, with which covered troughs from each house could communicate; and from the hour of the removal of the filth no fresh case of fever occurred.

It is extraordinary how the existence of so great a nuisance as that of large open drains in the midst of towns, or in their immediate vicinity, is frequently overlooked. There are many reasons why this should happen in our manufacturing towns; but it is rather remarkable that almost immediately adjoining the celebrated Long Walk in Christ Church Meadow, at Oxford, there is a foul and pestilential open drain, at least 200 yards in length, and from five to seven feet in width in the part termed Merton Meadow. In illustration of the probable effects of such a drain, if the wind were to set in steadily for some time from the drain towards Merton College, I must refer my readers to the evidence of Dr. Baker on the effects of a large open drain in producing typhus fever in a row of houses in Litchurch Street, Derby. It may be found in the most convenient form in the General Sanitary Report for 1842, p. 26.

Page 79. *Defective Ventilation.*

The prejudicial effects of the habitual respiration of impure air upon the health of individuals has been repeatedly pointed out by medical practitioners. Sir J. Clarke, in the "Cyclopædia of Practical Medicine," vol. iv. p. 320., observes, "If an infant born in perfect health, and of the healthiest parents, be kept in close rooms, in which free ventilation and cleanliness are neglected, a few months will often suffice to induce tuberculous cachexia," that is, "the constitutional affection which precedes the appearance of consumption." "There can be no doubt," he adds, "that the habitual respiration of the air of ill-ventilated and gloomy alleys in large towns is a powerful means of augmenting the hereditary disposition to scrofula, and even of inducing such a disposition *de novo*."

In illustration of the increased mortality attendant on ill-conditioned dwellings, Mr. P. H. Holland supplies this table from Chorlton-upon-Medlock, upon an average of the five years preceding 1843. (Health of Towns Commission, vol. i. p. 207.)

Houses of 1st class	1 in 52	Rate of mortality.
2d class	1 in 40	
3d class	1 in 29	

Dr. Laycock, in his Report upon the City of York, in the same volume, p. 235., gives the following return: —

	Mortality per cent.	Mean Age at Death.
Best drained and ventilated parishes	40·2	35·32
Intermediate, ditto	52·5	27·79
Worst drained and ventilated, ditto	62·8	22·57

Of the favourable results of an improved system of ventilation as a corrective of the evil, there are on all sides the most undeniable proofs. I select two instances. "In 1832 there were 600 pupils at the Norwood School, amongst whom scrofula had broken out extensively, and great mortality had occurred, which was ascribed to bad and insufficient food. The case was investigated by Dr. Arnott: the food was proved to be most abundant and good; and defective ventilation, and consequent atmospheric impurity, was assigned as the cause. Ventilation was applied by his direction; the scrofula soon after disappeared: and 1100 children are now maintained in good health, where the 600 before ventilation were scrofulous and sickly." — *Health of Towns Commission*, i. p. 78.

In the same volume, p. 70., a more remarkable instance is given from a treatise by M. Baudelocque, "Sur les Maladies Scrofuleuses." At the village of Oresmeaux, about three leagues from Amiens, situated in an open and elevated plain, the greater part of the inhabitants were engaged in weaving linen in their houses, which were for the most part low, and exceedingly close and dark. Humidity was thought necessary to keep the threads fresh, so that air and light were scarcely allowed to penetrate into the workshops. Nearly all the inhabitants were seized with scrofula, and many families, continually ravaged by that malady, became extinct.

"A fire destroyed nearly a third of the village: the houses were rebuilt in a more salubrious manner; and by degrees scrofula became less common, and disappeared from that part. Twenty years later, another third of the village was also consumed: the same amelioration in building, with a like effect as to scrofula. The disease

is now confined to the inhabitants of the older houses, which retain the same causes of insalubrity."

On the defective economy of places of work in respect to ventilation, the General Sanitary Report, 1842, p. 98., may be consulted, from which it will be seen that measures of prevention are both more easy and less costly than measures of relief.

THE END.

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