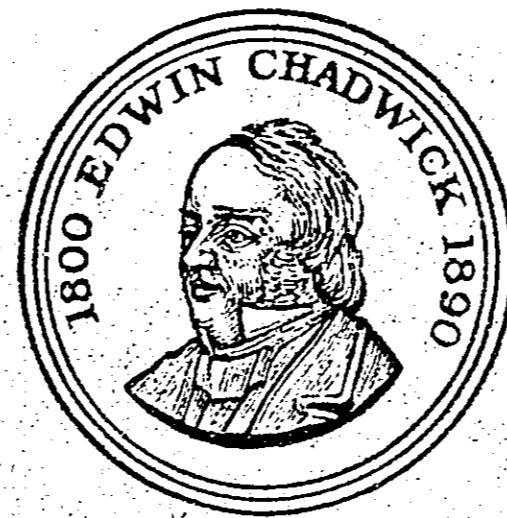
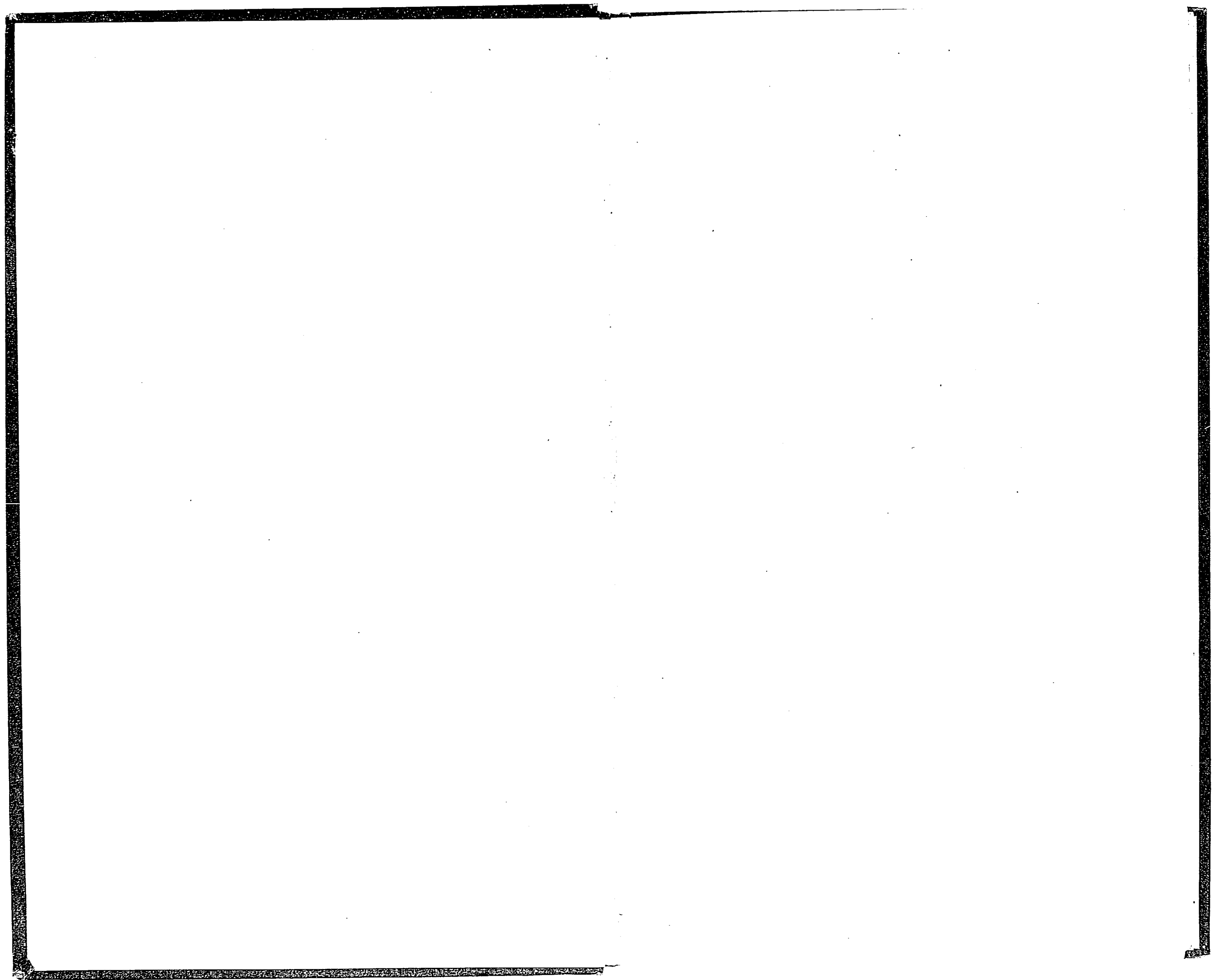


# VITAL STATISTICS EXPLAINED





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# VITAL STATISTICS EXPLAINED

SOME PRACTICAL SUGGESTIONS

BY

JOSEPH BURN, F.I.A., F.S.I.

MEMBER OF THE COUNCIL OF THE INSTITUTE OF ACTUARIES, AND ACTUARY TO THE  
PRUDENTIAL ASSURANCE COMPANY, LIMITED

*WITH A PREFACE BY*

SIR WILLIAM COLLINS, M.D., Etc.

CHAIRMAN OF THE CHADWICK TRUST

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## PREFACE

It was a piece of good fortune that, when the Chadwick Trust was seeking for someone to lecture on Vital Statistics, we were led to approach Mr. Burn. The aim of the Trust has been to secure as lecturers those who are able to speak with authority on the subject they handle, to engage the interest of advanced and post-graduate students of sanitary science, and at the same time to enlist the attention of the public. When the matter in hand is such a subject as Vital Statistics the achievement of this aim is no easy task. To invest figures with attractiveness and popular appeal, and even to awake enthusiasm in his audience was, however, the successful effort of Mr. Burn. His lectures at Liverpool were instinct with the true Chadwickian spirit. Like Farr, who was discovered by Chadwick, he tells his hearers to "keep their eye on the death rate." He shows how this should be standardised to permit of just comparisons being made, and he then proceeds to analyse it as regards age and the several causes of death, distinguishing the preventable from the rest, and showing how potent in reduction are sanitary environment, removal of filth, and the separation of the infected from the sound. For those who wish to venture further Mr. Burn explains, with admirable lucidity, the method of "osculatory interpolation," and develops this further in a valuable appendix bristling with statistics. Figures, we are told,

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never lie, but we are also reminded that liars sometimes figure; but with Mr. Burn as guide we feel we travel in safe and wholesome company, and the Chadwick Trust have done well to rely on him as a faithful figure-head.

WILLIAM J. COLLINS.

July, 1914.

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# VITAL STATISTICS

## INTRODUCTION

THERE is undoubtedly a very general impression that any explanation of statistics must be not only entirely uninteresting, but also so difficult to understand that it can only be suitable for discussion amongst mathematicians. I am hopeful that I shall succeed in showing that this impression is entirely erroneous, and that a record of Vital Statistics is necessarily a record of the most important homely facts which, when properly understood, must inevitably arouse the keenest interest.

The present is a particularly auspicious time to discuss this subject, because the statistics given in the reports of the Registrar-General are now published in a greatly improved form, and far-reaching changes have been introduced into the methods of collecting and presenting the results of our last census.

Of such great importance are these changes, that I think it is not an overstatement of the case to say that, for the first time in the history of our nation, it is possible to discuss and analyse the enormous mass of statistics in a coherent and intelligent manner.

It needs but very little knowledge and explanation to enable any intelligent person to recognise the salient features of these statistics, but a certain amount of



knowledge is absolutely necessary in order to obtain the most useful results, and to make the correct deductions from the figures given. If I succeed in proving how important to the well-being and progress of the nation are the features revealed by the study of Vital Statistics, I shall feel amply repaid for any trouble I have taken.

The study of Vital Statistics is the link connecting the statesman, the historian, the medical practitioner, the statistician, and the actuary, but it appeals to each in a different way. The statesman is concerned with questions relating to taxation, parliamentary representation and economic matters generally; the historian with the rise and decline of nations; and a medical man with obtaining a true conception of the healthiness of any given district, which he can only discover by analysing the rates of mortality and the age distribution of the community. The statistician concerns himself with general sociological conditions, and, finally, the actuary, is necessarily interested in the probabilities of longevity which are the bedrock of all his varied and intricate calculations.

The subject falls naturally into three main divisions:—

(1) The census as an index to the development of national life, with a criticism of the methods adopted in its collection and tabulation.

(2) The annual reports of the Registrar-General, with special references to the number and causes of death. Indications of the progress of sanitary reform.

(3) The preparation of mortality tables: (*a*) national, (*b*) municipal, (*c*) occupational. Practical uses of mortality tables by medical officers and others.

## CHAPTER I

### THE CENSUS AS AN INDEX TO THE DEVELOPMENT OF NATIONAL LIFE—ITS COLLECTION AND TABULATION

As the result of inquiries at the British Museum, I find that there is no tangible evidence of a census of the people having been taken in the ancient Egyptian or Babylonian Empires, though tablets setting forth censuses of cattle, corn, etc., for taxation purposes, dating back to 2500 B.C. are to be seen there. Reference is made to these tablets by Dr. Boscawen in his book, "The First of Empires."

The first record of a periodical census of the population is that of the Greeks, probably introduced by Solon between 658 B.C. and 638 B.C.

The most perfect census in ancient times of which we have any record appears to have been that taken by the Romans. The first enumeration took place in 566 B.C., subsequent enumerations being taken at intervals of five years; then indifference supervened, with the result that the inter-censal period increased first to ten years, later to fifteen years, and eventually, in the time of Vespasian the taking of a census was discontinued.

It would appear that the taking of a census is one of the criteria of advanced civilisation, the censuses just referred to having been taken when the various nations were at the zenith of their power.

The reintroduction of the census, as we know it, is of comparatively recent adoption—the first modern census

being that of Sweden in 1749, followed by that of the United States of America in 1790. The first census for Great Britain was effected in 1801, but only after considerable opposition, it being considered by many in the light of a preparatory measure for some more efficient plan of taxation, or a new scheme with respect to the levy of the militia.

The census of 1801 formed the subject of a bulky volume, entitled "Abstract of the Answers and Returns made to an Act passed in the forty-first year of His Majesty King George the Third, intituled 'An Act for taking an Account of the Population of Great Britain and the Increase and Diminution thereof.'"

On the opening page, there is a Schedule of Questions, addressed not to the heads of families, but to the rector, vicar, curate, or officiating minister, and overseers of the poor. These questions are as follows:—

"1st. How many inhabited houses are there in your parish, township or place; by how many families are they occupied; and how many houses therein are unoccupied?"

"2nd. How many persons (including children of whatever age) are there actually found within the limits of your parish, township, or place, at the time of taking this account, distinguishing males and females, and exclusive of men actually serving in His Majesty's regular forces or militia, and exclusive of seamen either in His Majesty's service or belonging to registered vessels?"

"3rd. What number of persons in your parish, township, or place are chiefly employed in agriculture; how many in trade, manufactures, or handicraft, and how many are not comprised in any one of the preceding classes?"

"4th. What was the number of baptisms and burials in your parish, township, or place in the several years 1700, 1710, 1720, 1730, 1740, 1750, 1760, 1770, 1780, and each subsequent year to the 31st day of December, 1800, distinguishing males from females?"

"5th. What has been the number of marriages in

your parish, township, or place in each year from the year 1754 inclusive, to the end of the year 1800?"

"6th. Are there any matters which you think it necessary to remark in explanation of your answers to any of the preceding questions?"

One can well imagine the worry and perplexity which these questions must have caused. However, at length, a mass of detailed statistics of the most elementary nature was brought together, the net result of which is embodied in a single page containing a table of figures and a few observations. These are given on p. 6.

It will be noticed that in this table of statistics, the last column is obtained by cross-casting columns five and six (headed Persons—Male, Female), but this is quite at variance with the figures in columns seven, eight, and nine. There are, in fact, about one million of persons who are not included in the return of occupations.

In spite of observation 1, the relative numbers of the 1801 and 1811 censuses appear to indicate that the enumeration at the first census was exaggerated.

One is apt now to look back with commiseration on our forefathers in their attempts at obtaining census returns, and it may, therefore, serve a useful purpose if we examine one or two quite recent first attempts of other nations.

With regard to Russia, the first census was taken in 1898, but I understand that the accuracy of the results is not above suspicion. In many cases the facts appear to have been misrepresented. It was only after twenty-four years' discussion that the bad harvests of 1891 and 1892 induced the Russian Government to undertake the labour of a general census. It is rather interesting to notice that the first idea of taking an English census was in 1753, but nothing was done until 1801, when the

SUMMARY OF ENUMERATION  
M.DCCC.I.

	HOUSES		PERSONS		OCCUPATIONS			Total of Persons	
	Inhabited	By how many Families occupied	Uninhabited	Males	Females	Persons chiefly employed in Agriculture	Persons chiefly employed in Trade Manufactures, or Handicraft.		All other Persons not comprized in the Two preceding Classes
ENGLAND.....	1,467,870	1,778,420	53,965	3,987,995	4,343,499	1,524,227	1,789,531	4,606,530	8,331,434
WALES .....	108,053	118,303	3,511	257,178	284,368	189,062	53,822	266,573	541,546
SCOTLAND.....	294,553	364,079	9,537	734,581	864,487	365,516	293,373	833,914	1,599,068
ARMY including the Militia.....	-	-	-	198,351	-	-	-	-	198,351
NAVY including Marines.....	-	-	-	126,279	-	-	-	-	126,279
SEAMEN in Registered Shipping.....	-	-	-	144,558	-	-	-	-	144,558
CONVICTS on Board the Hulks.....	-	-	-	1,410	-	-	-	-	1,410
TOTAL.....	1,870,476	2,260,802	67,013	5,450,292	5,492,354	2,135,805	2,136,726	5,707,017	10,942,646

## OBSERVATIONS

1. The Total Population of Great Britain must exceed the Number of Persons specified in the above Summary, inasmuch as there are some Parishes from which no Returns have been received.
2. The Number of Houses in Ireland has been nearly ascertained by the Collection of a Hearth Money Tax; and therefrom it has been computed that the Population of that Part of the United Kingdom somewhat exceeds Four Millions of Persons.
3. The Islands of Guernsey, Jersey, Alderney, and Sark, the Scilly Islands, and the Isle of Man, are not comprized in this Enumeration. The Total Population of these Islands has been usually estimated at about Eighty Thousand Persons.

prevalent dearth and distress brought the matter to a head.

The data for the first, and, so far, the only Russian census, were taken not direct from the population, but from the local police in each district. Questions concerning taxation and military service, etc., etc., undoubtedly led many people to give untrue answers. It will thus be seen that the faults of the initial English census were very closely reproduced. It would seem that the clerks employed to deal with the mass of data collected were not specially qualified for so difficult a task, but after seven years of hard work the results were published. An examination of these results discloses many anomalies, and, I believe, that it is generally felt that the results are not sufficiently reliable for the purposes of the statistician. A proposal to take a further census in 1915 is at the present time before the Duma, and this will be looked forward to with much interest, as undoubtedly experience and modern tabulating appliances will contribute to greater accuracy.

So early as 1872 a Census Register Act came into force in Japan, by which the dates of birth of the members of each family were recorded in census registers kept by the registrar of each town and village, and every change, such as birth, death, marriage, etc., occurring thereafter was required to be registered. The idea, was, of course, to avoid the difficulties connected with periodical census enumeration, by means of continuous records. However, in 1898, the impossibility of making continuous records had become apparent, and a new Census Act was passed, which for all practical purposes appears to have been based on our own latest census methods.

Reverting to our own system, I have already given a description of the census schedule employed in 1801.

The same form was again used in 1811, but in 1821 a return of the ages of the people was first introduced. This important feature was discontinued in 1831, but was reintroduced in 1841. At the present time it appears inconceivable that the exclusion of this question could ever have been the subject of discussion.

In 1851 the first householder's schedule was issued, and comprised the following particulars: (1) Name, (2) Relation to head of family, (3) Condition (civil), (4) Sex, (5) Age last birthday, (6) Rank, profession or occupation, (7) Where born, (8) If deaf and dumb, or blind.

A criticism often levelled against census statistics is their lack of various useful details, but it should be remembered that not only is any tabulation of detail extremely costly, but any undue elaboration may vitiate other and more important matters. It is also essential to remember that merely to ask an extra question on the census paper does not by any means insure a correct answer being given, and unreliable statistics are naturally worse than useless.

To emphasise how strongly I feel with regard to this important matter, I may perhaps be pardoned for referring to a letter published in the *Times* so recently as January 29th, 1914:—

“ *Re* THE CENSUS FIGURES AND THE DEAF.

“ *To the Editor of the 'Times.'*

“ Sir,—After long and irritating delay, the census figures for 1911 have at last been published, and if those relating to the deaf are any criterion by which to judge the others, their practical utility is not great.

“ Only one simple question was asked in the census schedule as to deafness, and this was not only insufficient but misleading. It was: 1. Infirmity: If any person included in this schedule is (1) Totally deaf, or deaf and

dumb; (2) Totally blind; (3) Lunatic; (4) Imbecile, or feeble-minded; state the infirmity opposite that person's name, and the age at which he or she became afflicted.

“ It will be noted that partial deafness—no matter of what degree—was ignored, and total deafness and deaf-mutism alone considered. A comparatively small percentage of the deaf are totally dumb; therefore the question is misleading to the class of parents from whom the majority of deaf children spring.

“ If the census is worth doing, it is worth doing well, otherwise it is a gross waste of public money. That the figures quoted in relation to the deaf are inadequate is practically confessed by the compilers of the volume, who warn their readers that they are based on ‘no very certain foundation.’ Those whose duty it is to frame the questions in the census schedule would have no difficulty in commanding the assistance of experts, and until such questions are asked as will elicit reliable information, no figures will be obtained that will bear criticism. At present, the result of the parturient mountain is ‘ridiculus mus.’

“ I am, Sir,

“ Yours faithfully,

(Signed) “ MACLEOD YEARSLEY.”

Whilst heartily sympathising with the writer in his desire for more detail, I feel sure that he is hoping to attain the impossible. Undoubtedly expert assistance on any such important matter as this should always be available, but the actual form of the questions asked must inevitably be governed by the hard truths which we have learned from long experience. Had the question been framed to elicit information as to partial deafness, I am convinced that no useful result would have been obtained.

I do not believe that reliable information will ever be obtained from those questions, the answers to which appear to cast reflections on any member of the family. It is surely better that such questions should be omitted altogether, leaving the information to be obtained from other and more reliable sources, than that the question

should be recast in such a form as might lead investigators to base important conclusions on unreliable data.

The census of 1911, the twelfth of the series, is a monument of foresight and enterprise. It is only when it is compared with the first British census that we realise the wonderful advance that has been made. The householder's schedule has been most carefully revised, and nearly all the information that can be relied upon is, in my opinion, now collected. A copy of this schedule is given at the end of the volume.

Undoubtedly the most important facts collected relate to age and sex. With regard to age, it is, I think, preferable to ask for the date of birth rather than the age last birthday. This is no new suggestion, and I am aware that many discussions have been held in reference thereto. I would merely say that for any given person the date of birth is constant throughout life, while "age last birthday" varies annually.

A great improvement has been effected by the amalgamation of the two questions relating to sex and age, for it must be remembered that the particulars of the householder's schedule have to be transferred to summary registers. Prior to 1911 this was done by the enumerators, and in the report of the Census Committee of 1890, we read in the evidence of one of the registrars that "in copying into the enumeration books there were one or two *little* mistakes which I had to correct, where they had put down male for female, but *nothing further than that.*" The enumerator in question was an assistant overseer. If *he* could make such serious mistakes so lightly, what was to be expected from such men as are described in the following extract from the same report:—

"Enumerators are appointed by a registrar, who may appoint personal friends whether suitable or not; or

he may be influenced by charitable motives, as one who appointed ten men principally from amongst his own friends, eight being clerks, one a French polisher, and one a house decorator."

Further:—

"A Bethnal Green registrar appointed a newspaper seller, who lost a number of his schedules on the day of the census, which led to great difficulty and inconvenience, I believe."

Very considerable improvement has been effected with regard to the enumeration. Not only are the enumerators appointed with greater care, but they have been relieved of a portion of their work, viz., the copying of the particulars from the householder's schedule into the enumeration books. They now send the original schedules to the Central Census Office, where the data are dealt with by an efficient staff under strict supervision and the work is facilitated by the employment of the wonderful electrical sorting and counting machine, known as the Hollerith machine.

I am indebted to the proprietors of the machine for the excellent photographs which I am able to reproduce here, and for the information they have furnished as to the construction and working of the machines.

The machines can be best described as a *system*, since different kinds of machines are used to obtain the finished result.

Cards (see diagram on p. 12), form the basis of the system. Upon these cards are printed what are technically known as "fields," each field representing, in the case of Vital Statistics, sex, age, occupation, civil condition, *i.e.*, whether married or single, etc. The fields may contain but one column of numerals, *e.g.*, sex, where male may be represented by the figure 1, and

female by 2; while others may contain two, three or more according to the range of numbers to be recorded.

The system being a numerical one, all facts are translated into numbers, thus, for example, in the census, all possible occupations to the number of about 609 were indexed and numbered, the appropriate number being recorded on the householder's schedule by a staff of clerks.

A hole punched in one column of numerals can be made to represent any one of ten facts, or the combination of two holes in two columns, any one of ninety-nine and

ADMINISTRATIVE COUNTY OR TOWN	URBAN & RURAL POPULATIONS OF SUB-DISTRICT	ENUMERATION DISTRICT	INSTITUTION	AGE GROUPS		TENEMENTS			AGE	SEX	CONDITION	OCCUPATION HEADING	INDUSTRY	BIRTH PLACE	INFLUENTIA	LANGUAGE
				10-20	21-65	SCHEDULE	RMS	CHDN								
0 0 0	0 0 0 0 0	0	0	0	0	X	X	X	0	0	0	X	0	0	0	0
1 1 1	1 1 1 1 1	1	1	1	1	1	1	1	1	1	M	1	1	1	1	1
2 2 2	2 2 2 2 2	2	2	2	2	2	2	2	2	2	F	2	2	2	2	2
3 3 3	3 3 3 3 3	3	3	3	3	3	3	3	3	3	S	3	3	3	3	3
4 4 4	4 4 4 4 4	4	4	4	4	4	4	4	4	4	M	4	4	4	4	4
5 5 5	5 5 5 5 5	5	5	5	5	5	5	5	5	5	M	5	5	5	5	5
6 6 6	6 6 6 6 6	6	6	6	6	6	6	6	6	6	W	6	6	6	6	6
7 7 7	7 7 7 7 7	7	7	7	7	7	7	7	7	7		7	7	7	7	7
8 8 8	8 8 8 8 8	8	8	8	8	8	8	8	8	8		8	8	8	8	8
9 9 9	9 9 9 9 9	9	9	9	9	9	9	9	9	9		9	9	9	9	9

so on. In each field, the right-hand column represents units and, reading from right to left, the second column represents tens, and so on.

To punch the card, it is placed in the key punch and holes are punched by the operator striking keys resembling the keys of the typewriter. The card is punched column by column, from field to field, and can be punched at a speed of from 250 to 850 cards per hour, according to the number of holes to be punched in each. The operation presents no more difficulty than ordinary typewriting; at the Census Office the operators were young girls taken fresh from the elementary schools of the metropolis,

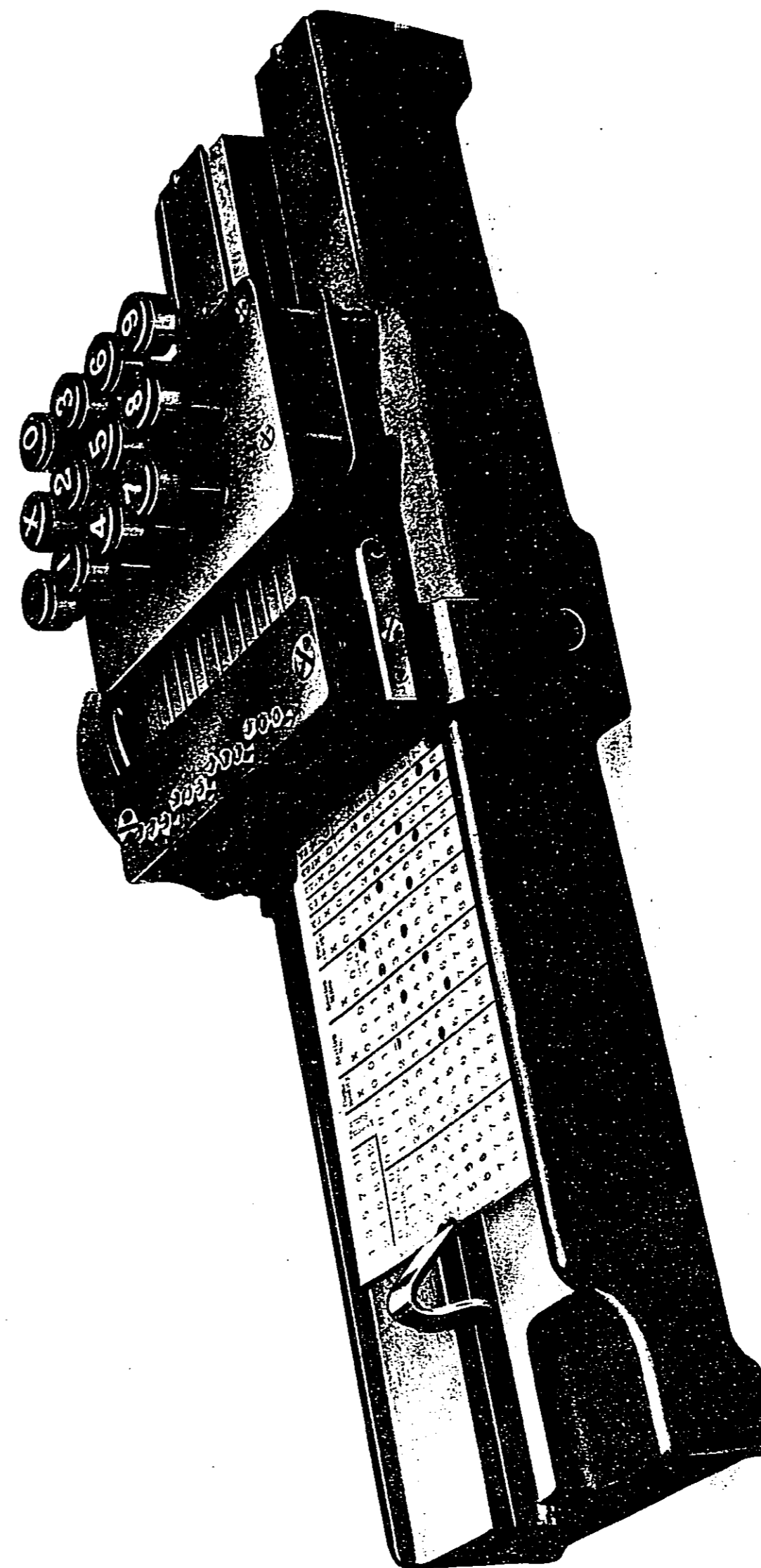


PLATE I.—Hollerith Key Punch

and so expert did they become that they were able to maintain a speed of from 2,000 to 2,500 a day.

The cards were then checked by being "called over" with the original document.

One card was punched for each of the 36,070,492 persons included in the census, and the whole operation was performed within a period of about twelve to fifteen months.

After the cards were punched they were ready for the sorting machine. This machine will sort cards at the rate of 250 per minute, or 15,000 per hour, and one operator can attend to two or three machines at a time, as it is merely necessary to keep it continually supplied with batches of punched cards and to remove the sorted cards at intervals. A batch of punched cards is placed in a magazine at the top of the machine without any regard to order whatever, and through the medium of a very ingenious mechanism they are sorted and deposited into proper pockets, according to the punching appearing upon them.

The mechanism of this machine may be briefly described as follows: Fine steel bands run from the top of each pocket up to the table where they meet just below the first card of the batch. As this card is forced downward, an electrical contact is effected through the hole that has been punched in the card; this operates the machinery so that the bands separate at the correct place and the card falls at once into a shoot which conducts it to the correct pocket. If, for example, the hole is punched over the figure 5, then the bands are opened between the fourth and fifth band, and the space between leads direct into the fifth pocket.

By way of illustration, assume that the census cards are to be sorted into male and female, and each group is to be sorted into ages. First the machine is adjusted to

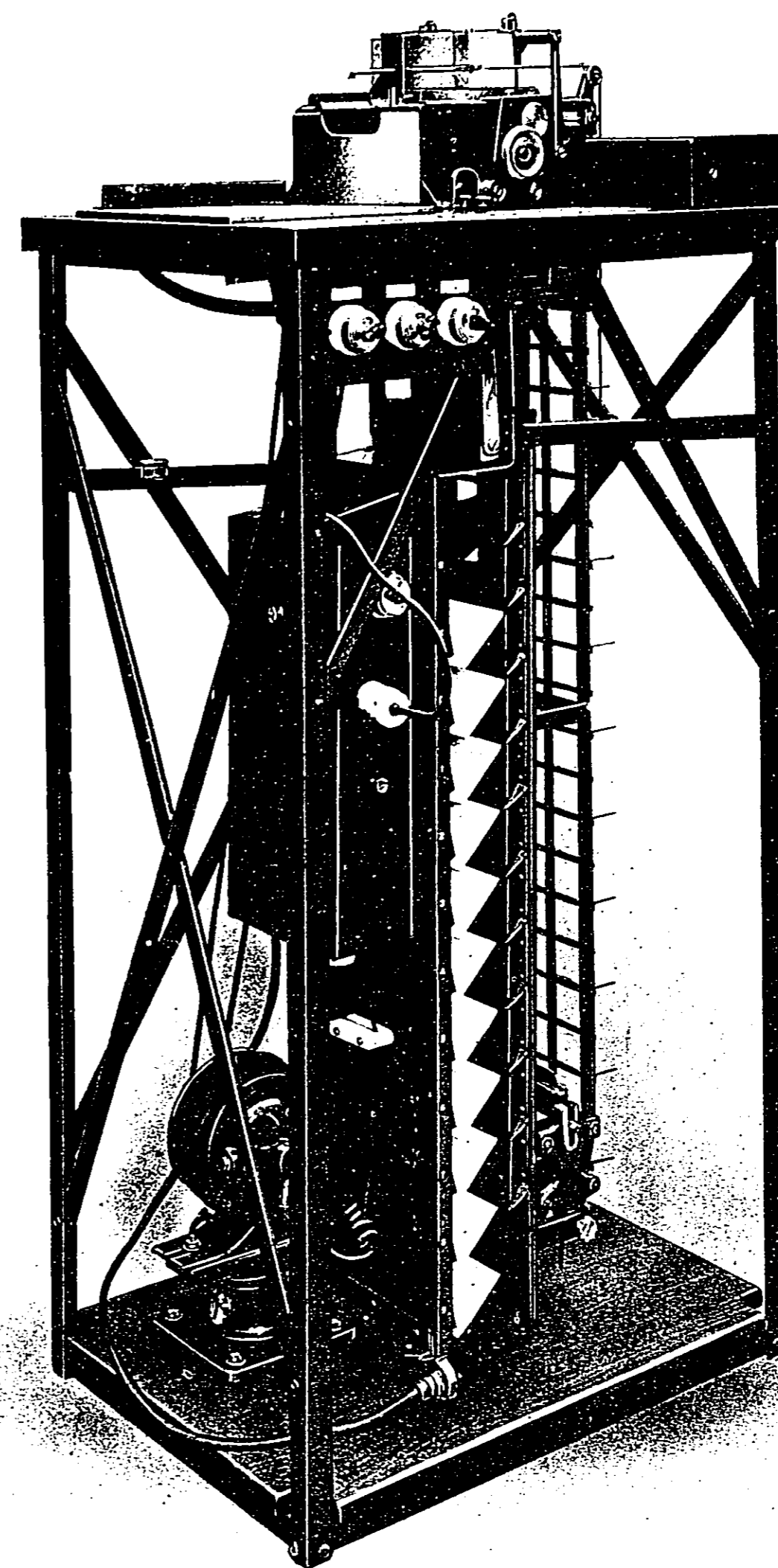


PLATE II —Hollerith Sorting Machine.

operate on the field headed Sex, and the cards are sorted accordingly into the two groups. Next the machine is adjusted to operate on the units column of the age field, and the cards representing male lives are thus sorted into groups consisting of the ages 0, 10, 20, 30, etc., 1, 11, 21,

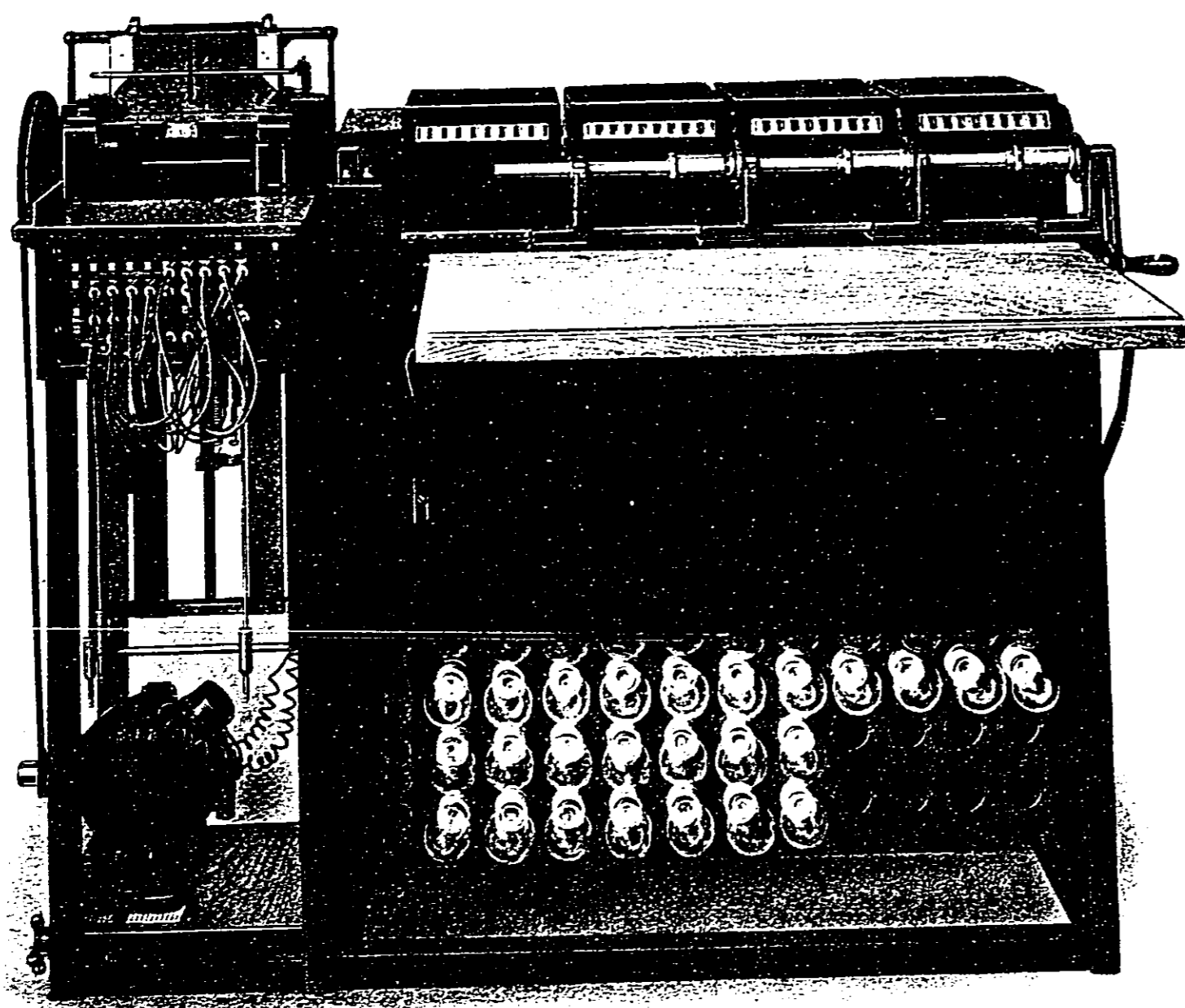


PLATE III.—Hollerith Tabulating Machine.

31, 41, etc., the final group being 9, 19, 29, etc. Each of these groups is again sorted according to the tens column, and thus all the cards for the same age are brought together in three operations at the rate of 5,000 an hour. As there were about fifteen machines installed at

the Census Office, the whole of the 36,070,492 cards were separated into groups according to sex and age in less than 500 working hours. This feat would have been absolutely impossible under the old method.

After being sorted, the cards are counted on the tabulating machine, of which an illustration is given on p. 16. The cards are placed in the magazine, and the machine is adjusted to tabulate the fields required. The current is then switched on, and the facts are accurately tabulated and the results shown on an indicator, from which the totals are read off.

A most useful improvement in the householder's schedule is the extension of the questions relating to marriage. In future it will be possible to refer to our own national statistics when dealing with the many very important questions relating to the fertility of marriage. It may be recalled that in 1911 the Government actuaries, in their preliminary investigations as to the working of the proposed National Health Insurance Act, had to turn to New Zealand for data on which to base their estimates as to the cost of the maternity benefits. I regret that, except in the case of Scotland, the data collected in answer to these questions have not yet been published. I shall refer to the Scottish returns in Chapter III.