AN ADDRESS ON TYPHOID FEVER IN PARIS DURING THE YEARS 1875-1882.*

BY PROSPER DE PIETRA SANTA, M.D., Paris.

YOUR eminent President, Dr. William Strange, having very kindly invited me to take part in the proceedings of this splendid assembly, which will form an epoch in the history of the British Medical Association, I have thought that it would be suitable to direct your attention to-day to one of the questions which, thanks to the researches of physicians and sanitarians in Great Britain, has received the greatest and most successful amount of study.

If I do not absolutely agree with the ideas and doctrines of the English school respecting the etiology of typhoid fever, I have too much confidence in the liberality of your sentiments and the impartiality of your opinions to refrain from submitting both my doubts and my reservations to your impartial consideration.

It is especially with regard to the complex problems of public hygiene, that the necessity appears of promoting the progress of knowledge, not only by the discovery of positive but also by the establishment of carefully observed negative facts, so as to restrain the excessive tendency to generalisation which may attend an accepted doctrine.

The scientific history of typhoid fever does not extend further back than forty years; but, among the eminent authors who have built it up, you must be, with good right, proud to reckon the names of William Budd, Murchison, Corfield, Carpenter, and Strange.

Before entering on the immediate subject of this paper—namely, typhoid fever in Paris during the period 1875-1882—allow me to give a general outline of the subject in three preliminary chapters; viz.:

- I. The present state of the question;
- II. The conditions of this morbid entity in the French army;
- III. Its general manifestation in Europe during, for example, the year 1876.

These preliminary considerations will, I hope, facilitate the exposition of the new facts; and, if they do not entirely justify the conclusions to which careful statistical researches have led me, they will, no doubt, inspire some of you with the thought of verifying and controlling, in the case of London or some other great centre of population, the results which I believe have obtained in the case of Paris. Let us not forget, moreover, that similar researches entered into the programme traced out by Dr. Strange at the meeting last year in the Isle of Wight.

I. No one in the present day could doubt the existence, in the great centres of population, of a fever which, notwithstanding the various denominations which it receives in different countries of the world, possesses a special and characteristic physiognomy, constituting synthetically the typhic or typhoid condition.

In England, as you know quite well, three theories have been proposed, to explain the assemblage of phenomena which constitute the disease.

According to Drs. Budd and Corfield, typhoid fever is an exanthematic pyrexia, which is propagated by specific germs from the intestines of diseased persons, and enters the system by the air, water, and food. Drs. Murchison and Carpenter, partisans of the phytogenic theory, maintain that the transmission of the disease is effected by microzymes, by fungi (microgerms of vegetable nature), or by chemical matters. An intermediate theory admits, for the production of virulence in these germs, a force capable of transforming them and increasing their activity and power.

Dr. Strange regards as an established fact in science the faecal origin of typhoid fever (which on the Continent is called the "English theory"), whether there be direct contagion by the patient's intestines, or whether the morbid material be elaborated in sewers,

in latrines, in privies, in water and soil impregnated with fæces, and also in localities where the air is damp and vitiated.

The popular publications of the National Health Society recognise a constant association between the poison or morbid principle (almost exclusively contained in the alvine evacuations of the patient), and the defective state of the drainage of houses.

In Germany, the conception of the etiology of typhoid fever has been generally dominated by the ideas, more ingenious than true, of Pettenkofer, respecting the oscillations of the layer of subsoil water. None of us would deny the incontestable evidence of low and moist localities in the production of typhoid fever; but at the same time none of us could admit without verification Pettenkofer's theory regarding refractory soils, as soon as we recognised the persistence of the disease in countries of different geological formations, the frequent change of locality of epidemics of the disease through all parts of the French territory, and the accidental and transitory character of the disease in a great number of localities.

In France, eminent hygienic physicians have adopted without dispute the ideas of Murchison and Strange; and one of them, Professor Brouardel, in an official report on the sanitation of Paris, has cited facts which seem to demonstrate the decided influence, on the development of typhoid fever, of exhalations from sewers, of ordure accumulated in dry soil-pipes, of miasms emanating from latrines and cesspits. However, the great majority of French physicians—taking into consideration the numerous and remarkable works of our military medical men; the splendid clinical, necroscopic, and statistical researches of Louis and his pupils; the recent micrographic studies made at the observatory of Montsouris; and the annual reports transmitted to the Academy of Medicine in Paris by the medical inspectors of epidemics—do not hesitate to recognise the following facts.

1. The etiology of typhoid fever is sufficiently vast to supply precise facts in support of all the doctrines.
2. Most diverse causes are capable, in their turn, of giving rise to an epidemic of typhoid fever.
3. The disease is developed spontaneously by infection, or specifically by contagion.
4. The forced attempts at reduction to a single cause, made by certain authors, would vanish before the clinical study of facts, and before the figures of medical statistics.
5. We cannot accept the doctrine of the unicity of the typhogenic poison (proceeding only from the intestinal secretions); for, even if this source be certain, it is not less true that the part taken by latrines and sewers has been singularly exaggerated.
6. In these circumstances, the general opinion of French statisticians may be formulated in these terms. "Living in the midst of excreta, in an animalised and stinking atmosphere, especially in a confined space, more or less closed, such as a house, when putrid materials accumulate, is a wonderfully efficient preparation for the reception of typhoid fever." (Dr. Arnaud.) "The propagation of typhoid fever by the air is certainly possible; but it is necessary to greatly restrict the doctrine which would represent this source of propagation as constant, or as acting in a simple and regular manner."

II. In studying the conditions of this morbid entity in the French army, we will more accurately define the limits of the action of the principal agents or factors. The research which has been bestowed on the causes of typhoid fever in the army, shows that it has produced a lively impression on the military profession.

In the interior of France, typhoid fever invariably constitutes each year the principal cause of deaths from acute diseases. The mortality in the army from typhoid fever oscillates (in average years) between two and three per thousand among the soldiers actually on service.

This receptivity cannot be attributed uniformly to the military condition and to the life of the soldier, or to the fatigues of training; for the disease is rare during campaigns and in time of war; we must, then, admit the interval of special predisposing causes. These are:

1. The age of the soldier (twenty-one to twenty-three), which is the age most liable to typhoid fever;
2. The want of acclimatisation in large towns of individuals, of whom the great majority have lived in country districts;
3. Agglomeration in similar groups, of which each member is exposed in the same way;
4. The previous health of the soldier, who is thus more or less affected by the conditions of his new existence.

Our mode of recruiting, too, well realises these conditions of agglomeration.

* Read in the Section of Public Medicine at the Annual Meeting of the British Medical Association in Worcester, August 1882.

meration of individuals, and of extreme liability to the disease on the part of the subjects themselves.* "It hence results that typhoid fever becomes, as it were, a forced result of the composition of the army; remains permanent in the form of sporadic cases; and reappears in an epidemic form when a sufficient time has elapsed for the immunity resulting from the previous epidemic to disappear, and for the liability to disease on the part of the military class to have gained a certain intensity." (Dr. Lubanski.)

The history of epidemics in the French army formally contradicts the doctrine of simplicity and unicity in the etiology of typhoid fever; it demonstrates, in a peremptory manner, that the causes, far from being universal, appear, on the contrary, as a collection of influences most diverse in character ("comme un faisceau des influences les plus diverses").

The fatiguing duty of the soldier, the emanations from the *fosses d'aisance*, from drains, or from freshly stirred earth, the soiling of the floors or the walls of the dwellings, in a word, every circumstance which checks the action of the elementary laws of health, and which may reach a certain degree of filth or of infection, is in its turn the cause of this or that epidemic of typhoid fever.

"In fact, all these causes are factors of an epidemic when it finds an evil so favourable for its development as subjects first specially predisposed by age, and then collected together in such a way as to fall almost always under the stroke of fatigue." (Lubanski.)

This is the right time to consider the great share which belongs to self-infection in the genesis of typhoid fever.

"Although very numerous," writes M. Léon Colin, the eminent professor at Val de Grâce, "the typhogenic influences possess the common character of being almost constantly capable of being referred to the action of man on man; whether by self-infection, as in cases of transference of a pre-existing disease, as by infection from without, as in the case of external miasmatic influences. It is almost within the power of man to create epidemics of typhoid fever, by submitting to known conditions individuals liable to the affection (especially by agglomeration in unsuitable places, in the centre of large towns, of young individuals of rural origin), and by realising these conditions at certain periods of the year, especially the autumn."

To sum up: the multiplicity of the typhogenic influences, their accumulation in epidemics characterised by rapid evolution and considerable mortality, and, finally, their dissociation and attenuation in French regiments withdrawn from the morbid medium, show clearly that the cause of typhoid fever is without consistence, and capable of being decomposed into several; and that, in the generality of cases, it does not take the form of a single agent presenting the attributes of exclusive or specific causes.

III. In 1876, thanks to the kind co-operation of the eminent medical men who are the directors of the bureaux of hygiene or of medical statistics in the principal towns or capital cities, I was able to draw up a map of the typhoid fever during that period.† In the map of Europe which I have the honour to place before you, the sanitary conditions of each town in respect of the special question which occupies our attention, is indicated by the signs +, -, and =.

The sign = has necessarily relation to the average mortality from typhoid fever, as derived from observations made in recent years. The sign + indicates a greater or less epidemic prevalence of typhoid fever. The sign - shews a more favourable condition; that is to say, the prevalence of typhoid fever was below the average.

The following facts, for 1876, in regard to each town, are also indicated on the map: (1) the number of the population; (2) the general mortality from all causes; (3) the proportion of general deaths to the total population; (4) the number of deaths from typhoid fever; (5) the proportion which deaths from this cause (typhoid fever) bear to the general mortality.

The first fact which comes out in this inquiry is the existence, in all the great centres of population, of a fever which, notwithstanding the various denominations which it receives in different countries, possesses the special and characteristic physiognomy which we call the "typhic or typhoid state." The second fact is the recrudescence, at variable epochs, of the disease which exists everywhere

in endemic conditions; a recrudescence sometimes of sufficient importance to assume the appearance of a true epidemic. A third fact is the coincidence of the greatest number of cases of the disease and of deaths with the period of the year comprised between the months of July and November. A fourth fact, one of very great importance, is the constant and progressive diminution of the endemic prevalence of typhoid fever, both in the number of cases and in their severity, in proportion as works of sanitation and of general hygiene have been extensively and intelligently carried out. In support of this statement, I will cite London, Brussels, Munich, and Zurich, where the percentage of deaths among persons attacked by typhoid fever has fallen from 22 and 20 to 7 and 5. The relative proportion of deaths from typhoid fever to deaths from all causes, taking the average of several years, oscillates between 1.4 to 1.7 and 3.8 to 4 per cent. In London, it is 1.4; in Paris, 2; in Lisbon, 1.65; in Buda-Pesth, 2.5; in Berlin, 2.6; in Zurich, 2.7; in Munich, 3.2; in Brussels, 2.9. In Italy, the proportion is generally higher; in Turin, 4.2; in Geneva, 3.6; in Milan, 2.9; in Bologna, 3.3; in Florence, 1.7.

We now come to the summer and autumn period of 1876. In the majority of cases, the mortality from typhoid fever was lower than the average for the corresponding period of preceding years in London, Madrid, Zurich, Munich, Brussels, Milan, Venice, Bologna, Florence, and Naples. The amount of reduction was 30 per cent. in London, according to the calculation of Dr. William Farr, and 52 per cent. in Brussels, according to Dr. Janssens.

The towns in which the mortality from typhoid fever was in the same proportion as the normal average were Buda-Pesth, Vienna, Geneva, Rome, Naples, and Lisbon.

The towns where the disease was most fatal in the epidemic state were Berlin, Rotterdam, Stockholm, St. Petersburg, Turin, and Paris; but it was especially in Stockholm and St. Petersburg that the epidemic was most fatal. In Paris, the percentage rose to 4.08.

It is not my intention to draw immediate conclusions from this inquiry. These are the elements (but they are precise elements) which I bring forward towards the ultimate solution of this grave question of public health.

Let us proceed, on the present occasion, to study the epidemic in Paris in 1876.

In order to have a starting point for comparison, I have combined the official bulletins of the municipal statistics during the first three years of their publication (1865-66-67). At this epoch, the population of Paris was 1,696,141. The average annual number of deaths during this period was 47,474; and the average of deaths from typhoid fever was 940. This gives a proportion of deaths from typhoid fever to deaths from all causes amounting to 1.9 per cent.

In 1875, the population of Paris was 1,851,792 (according to the census of 1872). The general mortality had risen to 45,556, and that from typhoid fever to 1,048, or a percentage of 2.3 of the deaths from all causes.

These two proportional numbers, 1.9 and 2.3, approach each other very closely, and may be considered as representing the normal average annual mortality from typhoid fever.

In Paris, in 1876, the total number of deaths from all causes was 49,721; from typhoid fever, 1,973, giving a percentage of 4.08—that is to say, not less than double the normal average.

Such is the truth in all its simplicity.

I have represented these results in tables, indicating for each arrondissement the relation of the mortality of typhoid fever to that from pulmonary phthisis and to the deaths from all causes. The most superficial examination of the tables calls forth a feeling of deep sorrow, showing as it does the frightful tribute which is imposed on our life in Paris by that murderous and terrible scourge, pulmonary phthisis. For it, no period is fixed, no social position is privileged, no quarters of the city are free.

This very important table (Table 1.) which I place before you, shows for each arrondissement of Paris:—(1) the population according to the census of 1876; (2) the superficial area in hectares*; (3) the number of inhabitants to each hectare; (4) the number of deaths from all causes in 1877; (5) the death-rate per 1,000 inhabitants; (6) the deaths from pulmonary phthisis; (7) the deaths from typhoid fever; (8) the proportion of deaths from typhoid fever in 1,000 inhabitants.

These various data form the basis of a final table, which, by the eloquence of its figures, gives a complete summary of the ideas which I have had the honour to lay before you. In four special columns are arranged the arrondissements of Paris, presenting at the same time—(1) the place which each arrondissement occupies

* In consequence of the law of 1872, the number of young soldiers present at the same time under the colours has undergone a considerable increase, whence there is a relative augmentation of those who are specially disposed by their age and circumstances to take typhoid fever. (L. Colin.)

† The two questions proposed to my respective correspondents were the following:—1. Has the prevalence of typhoid fever (enteric fever) been the same as, or less, or greater than, what it has been at the same periods in previous years? 2. In what proportions have the modifications been observed, which have marked the progress of the disease?

* A hectare is 2.47 English acres.

TABLE I.—Statistical Table of the Mortality in each of the Arrondissements of Paris in 1877.

Arrondissement.	Population (Census of 1876).	Superficial Area in Hectares.	Inhabitants per Hectare.	Deaths from all Causes (1877).	Death-rate one in	Deaths from Phthisis (1877).	Deaths from Typhoid Fever (1877).	Deaths from Typhoid Fever per 1000.	Degree in Scale of Population.	Degree in Superficial Area.	Degree in General Mortality.	Degree in Scale of Mortality from Typhoid Fever.
I	71,896	190	378	1,019	51.3	140	31	0.43	19	17	17	7
II	77,768	975	797	965	57.5	166	18	0.23	16	20	18	15
III	90,797	168	575	1,405	49.8	222	17	0.18	12	19	16	17
IV	98,293	166.5	630	2,975	45	340	37	0.37	9	18	10	9
V	104,373	249	419	3,095	37	409	54	0.51	6	14	7	5
VI	97,631	311	482	2,337	45.4	300	37	0.138	10	16	12	8
VII	83,672	403	207	2,434	40.5	332	42	0.50	14	10	13	6
VIII	83,993	361	230	1,972	63	282	61	0.73	13	11	19	1
IX	115,689	213	543	1,578	56	184	20	0.17	5	15	15	19
X	142,994	285	501	4,519	42.6	467	88	0.61	3	13	3	3
XI	182,287	361	504	3,537	35	443	34	0.18	1	12	1	18
XII	93,637	568	164	4,086	37.3	363	59	0.63	11	4	8	2
XIII	72,203	626	115	2,197	36.5	170	16	0.22	18	3	14	16
XIV	75,427	464	162	2,964	31.4	209	25	0.33	17	8	9	10
XV	79,677	720	109	3,321	36.4	356	42	0.53	15	1	11	4
XVI	51,299	709	72.3	918	43.5	99	14	0.25	20	2	20	14
XVII	116,652	445	262	2,325	38.8	250	31	0.26	4	9	5	12
XVIII	183,264	519	295	3,173	37.2	344	40	0.26	2	7	2	13
XIX	98,367	565	173	2,353	35.3	241	29	0.29	8	5	6	11
XX	100,063	621	192	2,563	32	332	15	0.18	7	6	4	20
TOTALS	1,988,806			49,620	—	5,689	711	—				

TABLE II.—Showing the Mortality from Typhoid Fever during each Month in Paris in 1875-76 and 1877 to 1881.

Years.	January.	Febry.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	November.	December.	Total.
1875	55	66	62	79	68	89	77	54	89	174	89	144	1,046
1876	91	54	68	72	45	53	84	306	265	188	488	256	1,978
Average	74.5	60	65	75.5	56.5	71	80.5	180	172	181	288.5	200	1,509.5
1877 to 1881	581	571	496	338	381	236	330	183	419	450	360	361	5,017
Annual Average	116	115	99	67	76	57	64	96	84	90	72	72	1,008
Minima	(1878) 38	30	33	33	33	26	(1877) 46	(1879) 51	62	54	(1877) 40	(1877) 45	(1877) 491
Maxima	(1881) 344	274	186	130	189	97	121	217	136	174	142	117	(1881) 2,130

in the general population; (2) its place in the scale of space occupied, so as to indicate the density of the population; (3) its place in the scale of general mortality; (4) its place in the scale of mortality from typhoid fever.

What are the lessons which we may reasonably draw from these data of medical statistics, having always in view the special subject which engages us at present, the etiology of typhoid fever?

1. In the endemic condition (Table II), typhoid fever remained, during the months of February, March, April, and May, below the number 100, and oscillated between 45 and 72. In July, there was a marked increase; the number (84) approached that for January (94). In August and November, the highest numbers were reached—306 and 488. The months of September, October, and December give lower figures—viz., 265, 188, and 256. The disease followed a nearly similar course in 1875; but the deaths from typhoid fever were less irregularly distributed through the first six months of the year.

2. The deaths from typhoid fever were unequally distributed over the twenty arrondissements of Paris. From the indications furnished by the statistical tables (and as if to show the absurdity of *a priori* ideas, and of all considerations which do not embrace the facts as a whole, and do not take into account the complexity of the causes which produce them) we meet with unforeseen results. There is no direct and constant relation between the number of the population and that of deaths from all causes on the one hand, and of deaths from typhoid fever on the other. There is no direct and constant relation between the figures representing the deaths and those which represent the superficial area of each arrondissement. Finally, there is no direct and constant relation between the general mortality and that from typhoid fever, and the density of the population.

Not wishing to abuse your kind attention, I will take the arrondissements of Paris which in 1875 showed the highest and the lowest mortality.

The eleventh arrondissement (Popincourt) occupies the first place as regards population, the first in general mortality, the twelfth in superficial area. It has, however, only the third place in regard of density of population (1 death in 35 inhabitants; 464 inhabitants per hectare).

The tenth arrondissement (St. Laurent) occupies the third place in population and mortality, and stands thirteenth as regards superficial area (473 inhabitants to the hectare: 1 death in 42 inhabitants). It occupies the twelfth place as regards density of population.

The third arrondissement (Temple) is eleventh in population, sixteenth in mortality, nineteenth in superficial area; it has 575 inhabitants to each hectare. Its death-rate is one in 49 inhabitants; that is to say, it occupies the sixteenth place.

Finally, the eighth arrondissement (Elysée) is fourteenth in order of population, nineteenth in general mortality, eleventh in superficial area; it has only 199 inhabitants to the hectare, and stands in the lowest (twentieth) rank as regards mortality—one death in 63 inhabitants.

All these figures are borrowed from the official documents of the Prefecture of the Seine, and from the statistical tables of the *Annuaire du Bureau des Longitudes*.

With regard to the epidemic of typhoid fever in 1876, the information which the Prefect of Police, president of the "Conseil d'Hygiène et de Salubrité du Département de la Seine," has been good enough to communicate to me, shows that the deaths reported (exclusive of those in military and civil hospitals) were: Popincourt, 128; St. Laurent, 86; Temple, 51; Elysée, 18.

In order to gain a better view of the special physiognomy of the epidemic, and to establish more logically the necessity of studying the local circumstances and the topographical conditions of the various arrondissements of Paris, I have arranged a special map showing the following data. The twenty arrondissements are grouped in four categories.

1. Those with one death in 25 to 37 inhabitants (11th, 5th, 19th, 20th, 15th, and 14th).
2. Those with one death in 37 to 40 inhabitants (18th, 17th, 12th, and 13th).
3. Those with one death in 40 to 45 inhabitants (10th, 4th, 6th, 7th, and 16th).
4. Those with one death in 45 to 63 inhabitants (9th, 8th, 1st, 2nd, and 3rd).

I have also indicated, by means of circles of different colours, the arrondissements in which the mortality from typhoid fever was respectively from 1 to 25, from 25 to 50, and above 50.

What is the result of this comparison? It shows that the greatest number of deaths from typhoid fever occurred in an arrondissement (11th) of the first group (in which the general death-rate was highest), in an arrondissement of the second group (12th), in one of the third group (10th), and in one belonging to the 4th group (3rd). These results need no comments; they fully justify the reservations which I have made, and call for new studies, undertaken without partisanship and without previous anticipation.

As a contribution to these new researches, I place before you the results obtained for the period from 1877 to the first half of 1882. The census of the population in 1876, gave for Paris 1,988,806 inhabitants; that in 1881, 2,239,928. For greater exactitude, we will take the average as 2,114,367 inhabitants. Subjoined are the official statistics of the general mortality from all causes, of the deaths from pulmonary phthisis, and of the deaths from typhoid fever.

TABLE III.—Comparative Mortality in Paris in each Year.

Years.	Population Census of 1876.	Population Census of 1881.	Population Average.	Deaths from all Causes.	Deaths from Phthisis.	Deaths from Typhoid Fever.
1877	1,988,806	—	2,114,367	49,625	5,889	711
1878	1,988,806	—	2,114,367	49,501	5,888	515
1879	1,988,806	—	2,114,367	55,188	5,708	605
1880	1,988,806	—	2,114,367	59,458	5,641	1,056
1881	—	2,239,928	2,114,367	59,065	9,519	2,130
Total.....				272,817	32,375	5,017

The mortality from typhoid fever in the twenty arrondissements of Paris was thus distributed during the period from July 1876 to the end of December 1881.

TABLE IV.—Showing the Mortality from Typhoid Fever in Paris in each Arrondissement, in each Year.

Arrondissements.	1876.	1877.	1878.	1879.	1880.	1881.	Total.
I.....	48	31	22	17	31	68	217
II.....	40	18	9	22	27	61	183
III.....	51	17	12	14	51	65	213
IV.....	53	37	24	28	61	78	284
V.....	28	54	29	32	52	88	283
VI.....	26	37	20	20	48	72	223
VII.....	31	42	21	31	61	115	304
VIII.....	18	61	23	23	29	76	229
IX.....	42	21	31	25	48	67	253
X.....	84	88	27	35	58	165	450
XI.....	128	74	31	46	114	178	531
XII.....	98	59	21	44	62	131	430
XIII.....	21	18	25	29	46	60	187
XIV.....	19	25	25	21	52	53	195
XV.....	25	42	22	21	38	93	241
XVI.....	21	14	17	20	38	68	176
XVII.....	43	31	43	53	69	123	367
XVIII.....	42	40	57	44	63	175	421
XIX.....	31	29	31	48	62	143	344
XX.....	20	16	22	33	43	74	208
Total.....	890	711	515	605	1,056	1,965	5,742

To sum up: these detailed conclusions support the considerations which I have laid before you; they impress on us the necessity of new researches, before assigning to typhoid fever a simple, regular, and constant etiology. In the mean time, we must not lose sight of the fact that typhoid fever is an essentially human disease, in the sense that it derives from the internal and external conditions of man the principal elements of its existence.

THE ROYAL SOCIETY.—The following is the list of fifteen candidates recommended for election by the Council of the Royal Society: Surgeon-Major James Edward Tierney Aitchison, M.D.; James Orlington Browne, M.D., LL.D.; Surgeon-Major George Edward Dobson, M.B.; James Matthews Duncan, M.D.; Professor George Francis Fitzgerald, M.A.; Walter Flight, D.Sc.; Rev. Percival Frost, M.A.; David Gill, LL.D.; Charles Edward Groves, F.R.S.; Howard Grubb, F.R.A.S.; John Newport Langley, M.A.; Arnold William Reinold, M.A.; Roland Trimen, F.L.S., F.Z.S.; John Venn, M.A.; John James Walker, M.A.

HYDATIDS IN DOGS.—Dr. Davies Thomas, who is pursuing the study of the development of hydatids in the south-eastern district of South Australia, has, according to the *Australian Medical Journal*, found 40 per cent. of dogs swarming with them.

ABSTRACT OF LECTURES ON PHYSIOLOGICAL DISCOVERY.

Delivered at the Royal Institution of Great Britain.

By JOHN G. MCKENDRICK, M.D., LL.D., F.R.S.E., F.R.C.P.E.,
Professor of Physiology in the University of Glasgow, and Fullerton
Professor of Physiology, Royal Institution.

LECTURE VII.—THE MECHANISM OF SECRETION.

THE old anatomists were familiar with the appearance and position of most of the glands of the body; but, from mistaken notions as to the circulation of the blood, they regarded them as vascular organs, diverticula, or reservoirs, into which the blood might flow, and thus prevent congestions in the event of an accidental obstruction to the flow of blood. Vesalius (1514-1564) first observed that all glands had not simply mechanical functions, and that they separated from the blood special fluids. They also drew a distinction between ordinary glands and those having no ducts, such as the thyroid and the spleen. Another old notion was that all the tissues between vessels and skin were grouped under a general name, *parenchyma*—a word expressing the idea that the blood ebbed and flowed into this spongy-like indefinite structure. Eustachius, a contemporary of Vesalius, Columbus, and Fallopius, first said that all kinds of parenchyma were not alike, and he thereby foreshadowed the notion of differences of intimate structure, not familiar to anatomists until many years after the death of Eustachius in 1574. He paid special attention to the structure of the kidneys, showing that these organs consisted of two substances, the one fleshy, dense in structure, and of a glandular nature, and the other of a tubular character. He also observed pathological changes in the kidney, such as variations in volume, consistence, and colour, and the effects of calculi. He studied also these organs in living animals. For many years, the advanced opinions of Eustachius do not appear to have made any headway, and it was not until the discovery of the circulation of the blood that the crude notion of a parenchyma was abandoned, and it was seen that tissues and organs had a complex and varying structure. Then came Malpighi, who, after observations on the structure of plants, was led to investigate that of glands. In 1665, he described glandular structure as constructed on the plan of follicles or cavities clustered round the ends of ducts or tubes. About this time, the art of injection of blood-vessels was originated, and this led Ruysch, Professor of Anatomy at Amsterdam, the chief originator of the method, to declare that injections into the blood-vessels of glands found their way into the ducts. He therefore assumed that the arteries ended in the ducts, or in the pouches of Malpighi, and he held that secretion occurred in the artery itself.

As regards the speculative opinion on secretion, the oldest notion was that of Van Helmont (1577-1644). Secretion, said he and his followers, is a fermentation; and there is a special ferment in each gland, which attracts from the blood the materials of the secretion. The theoretical conception of the fermentation process in these old times was not very different from what it is now. They knew nothing of specific ferments; they guessed their existence, and supposed that the essential feature of fermentation was a change, or series of changes, occurring without any visible external agency.

A mechanical theory of secretion was first advanced by Descartes (1596-1650). He compared it to filtration, and assumed that the particles of the secretion had a definite form, corresponding to minute apertures or pores in the different glands, each gland accordingly "allowing those particles to pass through it, which possessed the same figures as its own pores." Leibnitz (1646-1716), supported also a filtration theory, but he supposed that the pores of the filter were filled with a special substance, "so as to admit of this substance alone passing through them." It is striking to observe how similar this view is to modern explanations of some of the phenomena of diffusion. The notion of secretion involving chemical operations is attributed by Haller to Keill (1673-1719); but the mechanical theory for many years held its ground.

The lecturer then alluded to various stages of discovery regarding the structure of the kidneys. In 1665, Malpighi described the structures in the cortical portion which bear his name. These he considered to be of the nature of glands, clustered round the ends of the tubes, somewhat in the manner of a bunch of grapes. About