MEDICAL PARIS OF TO-DAY.

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XIV.

LABORATORY OF DR. BROWN-SÉQUARD.

Hæmatoscopy: Dr. Henocque's Instrument for Analysis of the Blood: Reservations as to its Use: Physiology of Hæmoglobin: its Quantitative Estimation by a Direct Vision Spectroscope and without Dilution of the Blood: the Pathological Extremes of Variation: Normal Mean Variation: Spectroscopy through the Skin.

HÆMATOSCOPY, of which the clinical application to the study of the blood, has recently been worked out by the aid of modified instruments introduced by Dr. Albert Henocque in the laboratory of Professor Brown-Séquard, is a method and application of spectroscopy which has been carefully studied by Vierordt and others in Germany, and by MacMunn and other English physicians in this country. Dr. Albert Henocque has applied the general technical conditions of spectroscopic analysis of the blood to clinical investigation, and has introduced certain instruments which he believes to be of practical value.

I may say at the outset what will, I think, be apparent to experts, that there is, in my opinion, a palpable objection to the accuracy of Dr. Henocque's methods arising out of what is known to physiologists and clinical observers as the difference of the personal equation, so that while aiming at great exactness, it will be evident that the hæmatoscope of Henocque depends very much in its application upon the accuracy of observation of the individual who employs it, and his capacity for appreciating scales of colour. This personal equation differs so much in various individuals that it requires a special checking by each person, and thus objections arise to the scientific value of this method on which I need not insist, but which I cannot omit pointing out. With this proviso, however, of which accurate clinical observers will appreciate the full importance, it will be apparent that Dr. Henocque, in following the indications of Vierordt and Preyer, and working out a simple and intelligent form of instrument with accompanying clinical data, has furnished a new resource for clinical observers, which, with due reservations, may well find useful applications in the field of scientific clinical observation. The full report of Henocque's own views on hæmatoscopy, and the technical indications for its application to spectroscopy, and what he calls diaphanometry, and the photography of the blood and milk, are to be found in the monograph entitled *Notice sur l'Hématoscope d'Henocque*, recently published by G. Masson in Paris. I avail myself here, also, of a clear summary of the subject by Dr. P. Regnard, a very competent writer.

The hæmoglobin of the blood, as I need hardly recall to the medical reader otherwise than in brief outline, constitutes $\frac{1}{3}$ ths of the weight of the red blood corpuscles, and since the researches of Preyer, chemists are in accord as to the natural distinction which is to be established between the various conditions of the colouring matter of the blood. Hæmoglobin possesses a special affinity for oxygen, so that 100 grammes of hæmoglobin are capable of absorbing 160 to 170 cubic centimètres of oxygen; it then possesses the bright red colour of arterial blood. It is then known as oxy-hæmoglobin, that is to say oxygenated hæmoglobin; but on the other hand this combination with oxygen is broken up with the greatest facility under certain conditions. If hæmoglobin be put *in vacuo*, oxygen is disengaged from it and it changes colour. It is reduced, that is deprived of oxygen; it assumes a deep violet red colour, the colour of venous or asphyxiated blood. Hæmoglobin is reduced in the human tissues; in the incessant passage of blood through the capillaries it exchanges with the tissues its oxygen; but it is the oxy-hæmoglobin included in the red globules of the blood which serves as the vehicle of oxygen; it absorbs the oxygen of the air in the pulmonary cells, and being transported by the arterial blood into the capillaries, it gives up this oxygen to the tissues; it is reduced not very completely and then returns by the venous channels to the lungs, where it renews this provision of oxygen, which is indispensable to the phenomena of interstitial nutrition, and to the activity of the elementary changes of the tissues. Oxy-hæmoglobin undergoes accidental transformations, modifying its colour and its composition, and these are

themselves characterised by spectral absorption bands easily recognised; such as the combination of hæmoglobin with carbonic oxide or its transformation into methæmoglobin under the action of certain toxic agents such as nitrous vapours, nitrites, and chlorate of potash. The quantity of oxy-hæmoglobin contained in the blood varies according to certain physiological conditions, and especially according to the state of health or disease; hence the importance of ascertaining in what proportions it exists. Various methods have been employed, and among these, one of the neatest is based on the calculation of the quantity of oxygen absorbed by the blood. Preyer, Vierordt, Hüfner and others have applied spectral analysis to the estimation of hæmoglobin, Branly, Lambaling in France, and MacMunn in England.

These are for the most part, however, processes reserved for laboratory study, and the processes of dilution and the difficulty of proceeding have restricted them to scientific uses. Henocque, endeavouring to attain a practical clinical result, has aimed at replacing more costly and bulky apparatus, and reducing the optical part of the apparatus to great simplicity, employing a simple direct vision spectroscope, and making his observations with solar light. He starts from the principle of examining the blood pure, and not more or less diluted with water, as is done in other spectroscopic proceedings, and it is for this purpose that he has invented the little apparatus—simple enough if in practice it be found precise enough—known as the hæmatoscope of Henocque.

Fig. 1.

This hæmatoscope is essentially composed of two sheets of glass of unequal size. They are superimposed in such wise as that, being maintained in contact at one end, they can be separated at the other end by a distance of one three hundred-thousandth of a millimètre, thus limiting a prismatic but almost capillary space. By a special arrangement of nickel clamps the result is attained, that if blood is introduced between the two surfaces of glass it forms a layer, the thickness of which varies, from right to left, from 0 to the three hundred-thousandth of a millimètre; in other words, the slope of the superior mirror of glass is one five-thousandth of a millimètre per millimètre, a scale which is graduated in millimètres, and is engraved on the lower plate. It ranges from 0 to 60 millimètres, and allows the observer to measure the thickness of the layer corresponding to each point of observation. When blood is introduced between the two plates of glass by a few drops being placed at the lower border, it penetrates by capil-

larity, and spreads in a layer of gradual progressive thickness, in such wise that the coloration, which is *nil* at 0, becomes reddish, carmine, and more and more intensely red up to 60. The blood presents then a tint which is regularly graduated from right to left; and it is evident that the tint will be the deeper in proportion as the blood contains a larger quantity of oxy-hæmoglobin or colouring matter; this is the principle of the comparative and even quantitative measure of the richness of the blood in oxy-hæmoglobin. A few drops of blood obtained from a prick on the tip of the finger made with a minute needle suffice for the observation.

Fig. 2.

If the hæmatoscope charged with blood be placed before the slit of a spectroscope, it is possible to study the absorption bands which the oxy-hæmoglobin presents in the divers thicknesses, varying from 0 to the three hundred-thousandth of a millimètre, and consequently it is almost the same as if one examined the gradually varied dilutions of the blood, with this advantage, that there is no mixing or dilution. Thus, with one of the spectroscopes of direct vision, such as are made by M. Lutz, in Paris, and with a hæmatoscope, divers variations of the colouring matter of the blood may be studied.

Fig. 3.

A further step is the quantitative analysis of oxy-hæmoglobin, and the following are the bases for it: When the blood contained in the hæmatoscope is examined with the spectroscope, proceeding from right to left, two obscure bands are seen, which, scarcely visible towards the 0, become accentuated, and soon present a characteristic aspect; placed in the yellow by the right of the D line, and at the commencement of the green beyond the E line, these two bands are bounded by a clear green space; but if

the thickest parts of the layer of blood are examined, the two bands become enlarged, and finally are merged one into the other, and the intermediate space disappears; between these two phenomena a characteristic aspect is observed, which M. Henocque designates under the title of "two bands equally obscure." This phenomenon is defined under the form of the following theorem: Blood which contains 14 per cent. of oxy-hæmoglobin, examined by diffuse solar light under a thickness of seventy-thousandths of a millimètre, with the spectroscope of direct vision, and at a distance of one millimètre, presents two characteristic bands equally obscure, with the intermediate yellow-green space well defined. It is not difficult to comprehend that the precise phenomenon, which is in some sort photometric, being taken as a type or measure, it will be observed in different thicknesses, according as the blood may be more or less rich in oxy-hæmoglobin; and as there is a constant relation between the quantity of colouring matter and the thickness of the observed liquid, it may be understood how M. Henocque has been able to establish a scheme or scale on which may be read directly the quantity of oxy-hæmoglobin for each 100 parts of blood corresponding to the figure of the scale of the hæmatoscope.

Let us leave aside these technical data; retaining only the conclusion that it is not difficult thus rapidly to make a spectroscopic analysis of the blood presenting all the conditions of exactness necessary for the comprehension of physiological or pathological variations of oxy-hæmoglobin in the healthy or diseased man, with sufficient approximation to serve as a guide in therapeutics. It is from this datum, and thanks to the simplicity of the analysis which he conceives to be adequate, that M. Henocque has been able to multiply examinations and to establish certain conclusions, which he supports by upwards of a thousand spectroscopic examinations.

To speak only of man, he arrives at the conclusion that the quantity of oxy-hæmoglobin may vary between 15 per cent. and 3.2 per cent. These are the extreme degrees, and, consequently, exceptional. The one represents plethora, the other extreme cachectic anæmia and approaching death. The true normal is 14 per cent., for the male, 13 per cent. for the female. But these figures are those applying to persons who live in the open air; town dwellers often have to be content with 12 per cent. At 11 per cent. anæmia commences; it is confirmed at 10 per cent. and 9 per cent. attains the second degree from 8 per cent. to 7 per cent.; becomes grave at 6 per cent. (third degree), and is cachectic at from 5 per cent. to 3.5 per cent. It is remarkable that life can be carried on with so small a quantity of oxy-hæmoglobin.

In the same individual the physiological or normal mean quantity may vary in a day by 1 per cent., or a little less; in the female, the menstrual period produces a fall of 1 per cent. to 2 per cent., which is rapidly made good in the healthy state. In the anæmic and chlorotic patients, Henocque considers that this analysis becomes not only a means of defining the diagnosis, but also of ascertaining the effects of medicine. With treatment by iron, the increase in the quantity of hæmoglobin (that is, of the richness of the blood) may be recognised in less than a week.

With other medicines, on the contrary, diminution of this quantity of hæmoglobin may be observed with favourable results; such are the results obtained by iodide of sodium and potassium. Sometimes, also, the moment at which such medication becomes dangerous may be determined by the loss of hæmoglobin. So much for bedside hæmatoscopy. M. Henocque has applied himself also to providing means for appreciating by the spectroscope the transformations of oxy-hæmoglobin in the tissues; in other words, of recognising the reduction of oxy-hæmoglobin in the vessels themselves, and, further, of measuring the activity of the incessant interchanges between the blood and the various anatomical elements of the organs. Reducing a scientific curiosity to a clinical method, he has endeavoured to establish the conditions of regular production and to methodise spectroscopic examination of the blood at the surface of the skin. When the interdigital spaces of the palm of the hand are examined with a direct vision spectroscope with the aid of diffused white light, the solar spectrum is seen by reflection, and by attentive examination an obscure band is recognised in the position of the sodium line D between the orange and the green. This band is thin, not altogether dark, but it masks the yellow space which is placed at the right of the D line. It is, therefore, definite in its position. Sometimes a second and vaguer band may be distinguished in the green space near the E band. These two images are nothing less

than the two bands characteristic of oxy-hæmoglobin; it is the blood of the capillaries of the dermal papillæ, which allow the red coloration of the blood to be perceived through the epidermis. Starting from this point, M. Henocque's method is to select for examination the thumb-nail, in order to establish a unit of observation, and because the circulation in the end of the thumb may be easily arrested. He examined first the ungual surface of the thumb by means of the spectroscope applied near the base of the nail; there is then seen in the solar spectrum reflected by the nail the presence of the first band of oxy-hæmoglobin; he applies rapidly an effective ligature by means of an india-rubber tube around the first phalanx of the thumb, when it may be seen that the band for the first few seconds becomes more marked, but at the end of 20 to 30 seconds it becomes paler and weaker, and suddenly leaves uncovered the yellow space near the D line, which it masked; ultimately it disappears completely, allowing the solar spectrum to be seen continuously at the end of a variable time, generally one minute. M. Henocque calls the moment at which the yellow reappears *virage*, and speaks of the number of seconds which separate the application of the ligature from the complete disappearance of the band of oxy-hæmoglobin as the "duration of reduction."

These expressions need explanation as well as the phenomena which they represent. The ligatures shut into the phalanx of the thumb a certain quantity of blood, which is not renewed by circulation; this blood, being arrested in the capillaries, transmits through the nail the characters of hæmoglobin, but the latter gives up its oxygen to the tissues, the arterial blood becomes venous, the oxy-hæmoglobin is reduced, and even more completely than in normal venous blood; the result is that only reduced oxy-hæmoglobin is seen in the capillary plexus situated under the nail; thus this does not present colorations sufficiently intense to be perceived through the nail or skin.

The duration of reduction may then be measured, and this depends at once on the quantity of oxy-hæmoglobin which the blood contains, and also on the activity of the consumption of the oxygen of the blood. If the quantity of oxy-hæmoglobin be calculated and the duration, we obtain, by dividing the one by the other, the quantity reduced in a second. Experience has shown M. Henocque that this quantity is in the normal state 0.2 per cent., and this is the figure which he takes for the unit of activity of reduction. This, then, is the new notion which he offers of the activity of the chemico-physiological phenomena going on in the tissues, and as a valuable means of taking account of the energy of tissue changes. He believes it to be a new path open to pathogenic research as well as to therapeutic study. He has applied it by his own investigations and those of his pupils to a good deal of work on anæmia and chlorosis, the action of anti-pyrim, acetanilid, of thallin, to the influence of medication by baths, and of various physical agents on the activity of reduction; to the study of the character of blood in poisoning by nitrites or by carbonic oxide, and of the modifications of blood and of tissue-change in typhoid fever.

His results have been laid before the Society of Biology, the Academy of Sciences, and are published in various theses of the Faculty of Medicine, and seem to invite further investigation by any students of clinical medicine and hæmatoscopy who may desire to pursue the subject. The instruments for this investigation which M. Henocque has inspired have been carried out by M. Lutz, and they are figured above.

The French Academy of Sciences has recently awarded a Monthyon prize to Henocque for his work on hæmatoscopy. A considerable number of these instruments are, I understand, already in use in France, and possibly some of our English clinicians and researchers may find it interesting to control the results thus far obtained, and to pursue or to modify this line of work.

ALDERBURY RURAL (Population, 12,548).—*Diphtheria Outbreak.*—Dr. James Kelland's report for the year 1888 gives a very good account of the sanitary operations in this district during that period. The work of inspection was chiefly that instituted on account of the presence of infectious disease, but only two serious outbreaks of disease occurred—one of diphtheria at Woodfalls Downton, and one of scarlatina at Whiteparish. The year was by no means unhealthy, notwithstanding the unfavourable climatic conditions, and the lowness of the death-rate (14.9 per 1,000, as compared with 15.66 in the previous year) is a matter for congratulation. Six deaths were caused by diphtheria.

THE ANNUAL REPORT OF THE MEDICAL OFFICER OF THE LOCAL GOVERNMENT BOARD.¹

(Supplement to the Board's Seventeenth Annual Report.)

THE annual report of the Medical Department of the Local Government Board is always a welcome volume among students of hygiene and pathology. It is always prepared with the greatest care and skill; and whilst it clearly reflects the progress already made in sanitary matters, it indicates the many fresh fields of usefulness and research which are daily opening out before sanitary workers. The small department which Dr. Buchanan so ably directs has done much to improve the health and increase the comfort of the community, and also to further scientific research in matters connected with the public welfare. Its influence has been exercised in an unostentatious manner, but the report for 1887-88, which has just been issued, affords, as previous reports have done, a very good idea of the great variety and extent of the Department's work.

Two Blue Books have been issued by the Department in respect of the year 1887-88, but we propose to refer separately to the second of these volumes, which contains a valuable preliminary report by Dr. Ballard on the causation of "Summer Diarrhoea," and a paper by Dr. G. B. Longstaff on the "Geographical Distribution of Diphtheria."

ADMINISTRATIVE DUTIES.

Vaccination.—The supervision of public vaccination consumes a considerable portion of the time of the Department, and, speaking generally, the result shows that no serious fault is to be found with the existing arrangements throughout the country. In view, however, of the persistent and, unfortunately, in some districts, successful, efforts of the opponents of compulsory vaccination, Dr. Buchanan finds it his duty again to repeat the warning before given by him, that in Leicester and some other counties "there is accumulating a very serious number of unvaccinated children, who will, after a while, if the vaccination laws are not enforced upon their parents, have to pay with their lives very dearly for their parents' luxury of disobedience." "For," remarks Dr. Buchanan, "it is the children of Leicester who will have to bear the brunt of the fatal disease when small-pox gets a foothold in the town. The adults and adolescents are vaccinated well up to the average of English communities, and may be expected to suffer no more and no less than if they lived in another town similarly invaded." In regard to the oft-quoted immunity of Leicester from small-pox in recent years, it is pointed out that Leicester has provided itself with isolation accommodation in a hospital situated outside its own proper limits, and expects very immediate and implicit obedience to orders about seclusion and vaccination of people who have been in relation with any imported case of small-pox. Dr. Cory's report on the Animal Vaccine Station shows an increasing demand for calf-lymph vaccination, a demand which appears to have put a somewhat embarrassing strain upon the present resources of the establishment. Dr. Cory adds an interesting memorandum showing that "insusceptibility" to vaccination has been almost unknown in his practice. Out of some 38,000 primary operations performed by him, only once has he failed twice in an attempt at vaccination. During 1887, from various parts of England and Wales, five allegations of injury to children caused by vaccination reached the Board. Six children were reported to have been harmed, and in each case inquiry by a medical inspector was made. Two children were found to have suffered from erysipelas during their vaccination; in a third case death occurred during the course of a regular vaccination; it happened unexpectedly during the mother's absence, and was not supposed by her to be related to the operation; a fourth case was an example of bromide rash occurring after a fortnight's drugging at a period three or four months after vaccination; a fifth was a case of syphilis undoubtedly inherited from a parent; and in the sixth case the complainant could not be discovered. A plate, showing the "bromide rash" which occasionally follows an undue use of bromide of potassium is included in the report, and has been inserted in this issue. Small-pox in 1887 was not generally troublesome. With the exception of the Sheffield out-

¹ To be purchased, either directly or through any bookseller, from Eyre and Spottiswoode, East Harding Street, Fleet Street, E.C., and 32, Abingdon Street, Westminster, S.W.; or Adam and Charles Black, 6, North Bridge, Edinburgh; or Hodges, Figgis, and Co., 104, Grafton Street, Dublin.

break (as to which a special elaborate report has, we understand, just been issued by the Department), there was a marked immunity from the disease both in London and in the provinces.

Port Sanitary Organisation has received the special attention which it deserves as being our "first line of defence" against the importation of disease from abroad. All the port sanitary districts—sixty in number—have now obtained, or are obtaining, a satisfactory permanent constitution. The sound practical advice which has been given by Dr. Blaxall to the local port authorities in connection with this matter has been of the greatest assistance.

Anthrax.—A report is included of an investigation of the circumstances of an outbreak of anthrax at Arnesby, in Leicestershire. The disease had, in the first instance, affected certain cattle of the district. It appeared to have made a lodgment in a particular field, and group after group of animals placed in that field were attacked at considerable intervals of time. Mr. Spear was not able to identify the occasion of the original introduction of the disease, but he found reason to suspect the drainage from certain tanneries at which foreign skins are occasionally dealt with as having been the original means of introducing the infection. Abundant opportunity for continuing infection of the field appears to have been given by the practices which were followed on the several occasions when animals were stricken. Of the nine men who had the handling of infected carcasses, six suffered under malignant pustule or other evidence of anthrax, and one of them died.

Meat Poisoning.—A report is also included on an outbreak of illness amongst the consumers of a particular batch of pork pies and brawn, in November, 1887, at Retford, in the county of Nottingham. The illness, which supervened after an interval varying from four to thirty-six hours in the several cases, specially affected the stomach and the intestines, and gave rise to symptoms of cerebral disturbance. Among twenty-two families and eighty individuals attacked, only one case terminated fatally. Dr. Klein produced disease in mice by feeding them with one of the incriminated pies. The disease in these animals was characterised by much the same features as those observed in the Retford patients, but, in addition, the animals habitually showed a notable amount of lung-inflammation. Dr. Klein considers that he has identified a particular bacillus operating to give the pie in question its morbid quality. For artificial subcultures made from this bacillus were found to have the same effect upon mice as the original pie; the bacillus was recoverable from the tissues of the animals, and new subcultures made from the recovered bacillus were capable of producing anew the same results upon other experimental mice. Another noteworthy observation in connection with these cases is that the ability of the food to cause disease was an increasing quantity for the first three or four days, and thenceforth a diminishing quantity. Dr. Klein reports that while mice fed with cultures, made three days previously, of the special bacillus of the food, were invariably affected in the way he describes, the material of culture ten to fourteen days old was absolutely without effect on mice. Somewhat similar observations were made in connection with former cases of meat-poisoning, notably in the Welbeck case, investigated by Dr. Ballard, in 1880.

There are a number of other interesting reports reproduced in the present volume (for example, the reports of Dr. Thorne and Mr. P. G. Smith, on "Faulty By-laws at Oxford;" by Dr. Barry and Mr. Smith, on "Back-to-Back Houses;" by Mr. Power, on "Diphtheria at Ealing;" and by the same careful investigator, on "Eels in Water-mains," etc.), but they have already been fully described in these columns at the time of the several occurrences.²

Cholera in Europe.—Dr. Thorne has prepared a summary account of the epidemic of cholera in Italy and Malta in 1887. The case of Malta is specially interesting, as affording one more example of the uselessness of quarantine measures; for, in spite of the enforcement of stringent quarantine, the island became infected with cholera. In the words of the Lieutenant-Governor of the island, quoted by Dr. Thorne, "Those who rest their faith on sanitary measures rather than on quarantine for the prevention of cholera may find confirmation of their views" in the principal facts recorded respecting the Maltese epidemic of 1887. "In the future," adds Dr. Buchanan, significantly, "any enforcement of quarantine at the ports of Malta will be, more conspicuously than

in the past, an affair of policy; it can hardly pretend to be dictated by sanitary considerations."

AUXILIARY SCIENTIFIC INVESTIGATIONS.

Milk Scarletina.—Of the reports on the auxiliary scientific investigations, the most voluminous and important are those in which Dr. Klein continues his account of his researches into the alleged association between a certain form of cow-disease and scarlatina. It will be generally admitted that by the evidence here brought forward he has powerfully supported the view which he enunciated in previous reports. He describes six experiments on cows which had calved three or four weeks previously. In four cases he used subcultures on solid media of streptococcus obtained from the blood or pericardial fluid of a calf experimentally infected with human "streptococcus scarlatinae"; in two cases subcultures of the streptococcus derived directly from human scarlet fever. Each animal was inoculated by subcutaneous injection at the root of the ear. In all the six cases the animals developed ulcers on the teats; several of the animals had considerable fever and constitutional disturbance. Dr. Klein believes these ulcers to be among the very earliest evidences of disease in the animal. They occurred indifferently, whether the cow was being milked by hand or was suckling her calf. The teat-sores showed themselves after an incubation period of from four to nine days from the inoculation; and subsequently a more general affection of the skin was found, accompanied by more or less febrile disturbance, and sometimes by pulmonary symptoms. In the disease thus induced, a number of changes were found after death, distributed among various organs in the fashion of the changes of an acute specific disease, and exhibiting so much of constancy in their own manifestations as to make them, taken as a whole, characteristic of cow-scarlatina. In two of the experiments the streptococcus was recovered from the milk; in one case the milk was drawn with antiseptic precautions during life, in the other it was obtained by incision after death from the deeper parts of the udder. Dr. Klein states positively that the streptococcus is not the *S. pyogenes*, and points out that the cows, having calved three or four weeks, were not in the parturient state. Dr. Buchanan, in his comments on the reports, lays stress on the fact that the sores on the teats appeared to be with difficulty, if at all, transmissible by direct inoculation from the infected animal to man. "This circumstance," he writes, "was hardly perhaps to be anticipated, seeing how readily other sore-teat diseases are so communicable, and how readily cow-scarlatina at Hendon reproduced itself as human scarlatina in the consumers of milk from infected cows."

Differentiation of Udder Diseases in Cows.—Dr. Klein has some observations upon the appearances by which the Hendon cow disease is to be recognised. He remarks that the term "spurious cow-pox" had been used to include every form of udder disease in cows other than the so-called true or Jennerian cow-pox; he claims to have now differentiated from this miscellaneous collection another disease—the Hendon cow-disease. This disease having been only lately identified, the opportunities for studying it differentially, even in its pathological aspects, have necessarily not been abundant; while still less frequent have been the opportunities for observing the clinical manifestations of the disease spontaneously occurring. Dr. Klein considers that it may be distinguished from the Wiltshire disease investigated by Professor Crookshank by the fact that in the case of the Wiltshire disease the visceral changes may be entirely absent, loss of hair is not a common symptom, the sores are flatter and more superficial and the scabs loosely adherent, and the disease is readily transmitted to the milkers. Another cow-disease from which he believes it may be differentiated is that observed in Edinburgh in 1887. The milk from the dairy where these cows were lodged had distributed a form of febrile sore throat among its customers. The sore throat could not be recognised as either scarlatinal or diphtheritic.³ A cow suffering from this disease was brought to London and placed at Dr. Klein's disposal; the disease was found to produce ulcers on the teats and visceral lesions, and to be capable of inoculating calves, so that it bore a greater resemblance to the Hendon disease than did the Wiltshire disease. The inoculation experiments, however, showed that the Edinburgh disease differed from the Hendon cow-disease as regards incubation period, the development and progress of the sores, and the aspect and character of the crusts. From the ulcers of the Edinburgh disease Dr. Klein isolated four micro-organisms, but to only one does he

² See the JOURNAL for October 1st, 1887, p. 725; July 28th, 1888, p. 183; July 16th, 1887, p. 156; September 3rd, 1887, p. 515; etc.

³ Dr. Buchanan quotes the account of this epidemic which was published in the JOURNAL on June 9th, 1888.

attach any pathogenic importance. This, the streptococcus albus, he considers "stands in some necessary relation to the disease."

Morphology and Biology of Streptococcus.—In a third report, Dr. Klein endeavours to evolve some order out of the chaos of streptococci. As Dr. Buchanan truly says there is, except to the eye of an expert bacteriologist, as little difference between one and another chain-forming micrococcus as, to the eye of the ordinary dweller in towns, exists between the swift, the swallow, and the martin. Dr. Klein's report is a very valuable contribution to a most difficult subject, but its details are of too technical a character for reproduction here; he has classified seven sets of characters which are of use in differentiation between nearly allied organisms, and maintains that all seven tests must give identical results before the streptococci can be declared identical. Of the seven distinguishing characters, some are microscopic, some are observed in cultivation; all seven are presented by Dr. Klein as apart from any evidence that might be forthcoming from inoculation of animals and observation of pathological results, which commonly yield more striking criteria. Dr. Klein mentions the characteristics of nine streptococci.

Lead in Public Water Supplies.—Mr. W. H. Power has written a memorandum on lead poisoning by certain public water supplies, which contains a suggestion as to the nature of the action of potable waters on lead which is, we believe, original with him. Coming from Mr. Power, who has already been proved by his previous work to possess a sound judgment as well as a fearless logic, it deserves and will receive attention. The memorandum is founded mainly on the reports by Dr. Sinclair White on the extensive prevalence of lead poisoning in Sheffield. That town is supplied by soft water, which is collected from two separate tracts of moorland, and is stored in two reservoirs, the one supplying the high district, the other the low district of the town. The water had been used for more than half a century, when suddenly, in 1885, a large number of cases of lead poisoning was noticed among persons residing in the higher district. Dr. Sinclair White stated that the high level reservoir was distinctly acid, while the lower was only faintly so; further, he showed that many of the streams running into the high level reservoir were acid, that the higher up they were traced the more acid they became, and that the water in hollows in the peat was still more acid. Further, he showed that this high level water, which had the power of dissolving lead, lost it when kept in contact for a few hours with freshly fragmented Derbyshire limestone. It must here be mentioned that Messrs. Crookes, Odling, and Tidy have expressed the opinion that soft water loses this so-called "plumbo-solvent" power when systematically filtered through beds of broken quartz, which ensures "the efficient silication of the water," a trace of silica in the water being, in their opinion, the only sure way of removing its "plumbo-solvent" properties. Neither of the plans suggested, however, touches the question of the primary cause of this property in the water; both seek to remove the property, not to prevent it. The acidity of the water naturally first attracts attention; the nature of the acid has not been determined, one suggestion being that it is due to sulphuric acid derived from pyrites, the other (Dr. Sinclair White's) that it may be due to organic acids, humic or ulmic derived from decomposing vegetation. Mr. Power's memorandum presents us with two conclusions; one, of immediate practical importance, especially to health officers of towns supplied with soft water, is, in the words of Dr. Buchanan, that "the intermittent character of some of the lead-poisoning outbreaks which have come under review leads to awkward doubts whether towns whose water services are at present irreproachable have as absolute and permanent a security against all danger of lead-poisoning as they believe themselves to have." Mr. Power specially instances Glasgow. The other point is at present of only speculative interest. He thinks that (1) the variability of the plumbo-solvent power of soft moorland water, (2) its action through a chemical change, (3) its limitation at first to particular streams and subsequent extension to a whole reservoir, and (4) the favouring influence of warmth and high pressure, combine to raise the suspicion that the plumbo-solvent property may be related to the agency, direct or indirect, of low forms of organic life.

Chemical Action of Bacteria.—There is this year a further report from Dr. Dupré on his investigation of the consumption by bacteria of oxygen from the dissolved air of water. He reports a series of no less than 200 experiments, which must have demanded the expenditure of a great deal of time and patience. In these

experiments water is sterilised and fully aerated; after the addition of a small quantity of the micro-organism to be studied, and in certain experiments of gelatine, the bottle containing the water is placed in an incubator for ten days; the amount of oxygen remaining in the water at the end of that time is then estimated. The investigation presents many experimental difficulties. Broadly stated, the results with the three organisms used are as follows: *Bacillus subtilis*, in the presence of gelatine, de-aerates the water at all temperatures experimented with, and whether incubated in the light or in the dark; but in the absence of gelatine its action is practically nil. This bacillus, moreover, can remain active after even thirty-two days' keeping in the stock-bottle. *Staphylococcus albus*, freshly added, either alone or in the presence of gelatine, exerts practically no influence (except perhaps in the case of unsterilised Sutton water) on the aëration of water; but after being kept for some time, however, a decided effect of this micro-organism is noticeable. *Staphylococcus aureus* in the light has no influence, either by itself or in the presence of gelatine, but it apparently exerts a marked action in the dark.

Micro-organisms in Water.—What may be called the bacteriology of water has been studied from another point of view by Dr. W. R. Smith, who has sought to ascertain the number of varieties of microphytes occurring in certain samples of water. Water was taken with due precautions to prevent contamination; in one water four different varieties of micro-organism were found; in the other, five varieties; none of them were, so far as was ascertained, pathogenic. This method of examining water must be distinguished from that adopted by Dr. Percy Frankland, which is to ascertain the number of colonies produced in plate cultivations. An estimate of the total number of micro-organisms, not of the number of varieties, is thus obtained.

A New Antiseptic.—Dr. Klein has studied the antiseptic properties of iodate of calcium recommended by Mr. Weaver, C.E., as a disinfectant of uncommon value. It was found to possess disinfectant properties greater than those of permanganate of potash or carbolic acid, but far inferior to perchloride of mercury. It is harmless to the human system,* and may therefore have some therapeutic use. Dr. Buchanan states that it is about eighty times weaker than perchloride of mercury.

Attenuation.—In continuation of previous reports on this subject, Dr. Klein states that by growing anthrax bacilli on gelatine medicated with perchloride of mercury (1 in 40,000) copious and typical crops may be obtained, which, however, are so attenuated that they are not in any degree virulent, even to guinea-pigs. A succession of subcultures in the same medicated nutrient medium can be made with the like result, but the full virulence was regained when from any one of the medicated subcultures new cultures were established in normal gelatine. In every instance material of these new cultures inoculated into guinea-pigs produced in them typical and fatal anthrax. He now advances evidence that inoculation with the material thus attenuated confers on guinea-pigs a certain measure of temporary immunity against inoculation with virulent anthrax.

DR. BARRY'S REPORT ON THE SHEFFIELD SMALL-POX EPIDEMIC.

"An Epidemic in a well vaccinated Town." Dr. Barry's History of the Epidemic: Proportion of Children Vaccinated and Unvaccinated: Relative Proportion of each Class attacked: Relative Mortality · Revaccination.

THE most recent vindication of vaccination is the report which has just been issued from the Local Government Board respecting the epidemic of small-pox in Sheffield in 1887-1888. Not a few converts to the ranks of the anti-vaccinators were gained by the sight of such a "well-vaccinated" town being ravaged by small-pox; whilst Leicester, where vaccination is now neglected, and where a gigantic reckless experiment is being tried, escaped the disease. Those acquainted with the histories of previous epidemics recognised the unsoundness of the inference which the prejudiced and uninformed drew from the comparison; but in the absence of detailed information as to the incidence of the disease upon the vaccinated and unvaccinated respectively, and as to any special agencies that might have been operating to spread the

* Doses of 1 to 2 grains, administered to adults several times daily and for several successive days, produced no physiological effect, except that presence of iodide was demonstrable in the saliva.

infection, a conclusive answer to the contention could not be given. Fortunately, the Local Government Board did not allow such a favourable opportunity to pass of investigating the behaviour of small-pox under comparatively simple conditions, in a community large enough to reward a particularly careful statistical study. Dr. Barry was entrusted with this onerous task, and his voluminous and admirable report just issued is a monument of industry and ability. His aim has been to set out all the facts respecting the epidemic, to give a complete history of the behaviour of the small-pox, and also to give a wholly unbiassed account of every important condition capable of being thought of as having influenced the disease, and to leave the competent student of details to draw his own conclusions from the abundant data thus placed at his disposal.

In March, 1888, a house-to-house visitation of the borough was made by the vaccination officers, and had reference to a population of 275,878 persons out of a total of 316,288, and to 59,807 houses. This "census" took account of 6,088 small-pox cases, and 90 deaths. It showed that less than 1 per cent. of children of school ages were unvaccinated, whilst among people of all ages the unvaccinated amounted to about 2 per cent. This 2 per cent., Dr. Buchanan, in his prefatory memorandum quaintly designates "as so many seventeenth- or eighteenth-century people scattered about Sheffield, for the very purpose of having themselves compared under nineteenth-century conditions of life, with the law-abiding people of the present period."

Every fatal case of small-pox, every case, fatal or non-fatal, that was alleged to have occurred in vaccinated children under 10 years of age; and every case alleged to have occurred after previous small-pox or after revaccination, was personally investigated in detail by Dr. Barry. Stated generally, his results show that, as regards the 70,000 children under ten years, living in Sheffield, the attack rate of the vaccinated was 5 per 1,000, and that of the unvaccinated was 101. The death-rate of the vaccinated children under ten was 0.09, and of the unvaccinated 44. Or, in other words, in 100,000 vaccinated children the mortality was nine, and for the same number of unvaccinated children the mortality was 4,400. Therefore the vaccinated had a 20-fold immunity from attack by small-pox, and a 480-fold protection against death by small-pox. Of the children living in the houses actually invaded by small-pox, the attack rate was 78 per 1,000 in the vaccinated, and 869 per 1,000 in the unvaccinated. The death-rate of the vaccinated was 1, and of the unvaccinated 381 per 1,000. Therefore the protection enjoyed by the vaccinated over the unvaccinated was 11-fold against attack, and 381-fold against death. There was a similar experience with reference to persons over 10; for every 100,000 of those twice vaccinated, there were 8 deaths; of those once vaccinated, 100 deaths; and of the unvaccinated, 5,100 deaths. Then, as to the persons employed in the various hospitals; of 161 persons 18 had had small-pox, none of whom fell ill; 62 were vaccinated only in infancy, 6 of them were attacked, and 1 died. The remaining 81 had been revaccinated, and not one contracted small-pox. Then, as to the troops: there were 830 of all ranks, of whom 12 were attacked and 1 died. The medical officer in charge of the troops informed Dr. Barry that revaccination had been attempted with the 12 men attacked, but that in every case it had been unsuccessfully performed. Then, of the police: 10 of them took small-pox, when a revaccination was ordered, and no further cases occurred. Again, of 290 men employed at the Post Office, all were revaccinated, and during the whole course of the epidemic not one took the disease. The net result in Sheffield was that if the vaccinated children had been attacked at the same rate as the unvaccinated, there would have been 7,000 attacks in place of 353, and 3,000 deaths in place of 6; or up to the conclusion of the epidemic there would have been 4,400 deaths in place of 9. These are very simple, but conclusive, facts, and it will require a great amount of ingenuity to controvert them. The experience of Sheffield is, however, only a repetition of that of London in 1881, of Montreal in 1885, of Leipzig in 1871, and of every other scene of an epidemic of small-pox in recent years.

Dr. Barry's report deserves to be read by every local authority, as well as by the public at large. But it is to be feared that the price at which it is published will militate against its wide distribution. We would suggest that a popular cheap summary of the chief facts should be placed on sale. Such an official summary would undoubtedly be the means of dispelling many of the popular illusions concerning the uselessness of vaccination.

ROYAL COLLEGE OF SURGEONS.

PROCEEDINGS OF COUNCIL.

A QUARTERLY Council was held at the College on Thursday, April 11th, and the minutes of the last meeting were read and confirmed.

Reports were received from the Museum, Library, Finance, and General Purposes Committees; and the same were approved and confirmed.

The recommendation of the Museum Committee, that Mr. Burgess, the artist, be employed for a further period of three months, was approved.

The report from the Jacksonian Committee was read, stating that the prize for the past year had been awarded to the author of the dissertation bearing the motto, "What's to come is still unsure." The President, having opened the sealed envelope, declared the name of Mr. Jonathan Hutchinson, jun.

The same Committee further recommended as the subject of the Jacksonian Prize, 1890, "The Nature and Treatment of Injuries to the Spinal Column, and the Consequences arising therefrom."

The Collegial Triennial Prize has not been awarded, and the consideration of the subject for the next prize was postponed.

A report from the Committee on the extension of the Examination Hall buildings was received and entered on the minutes. In pursuance of the suggestion contained in their report, the Committee were authorised to make the necessary arrangements for the unveiling of the marble statue of Her Majesty the Queen, which is to be placed in the Examination Hall, and will be ready about the middle of May next.

Mr. John Marshall was appointed the Morton Lecturer on Cancer and Cancerous Diseases for the present year.

A donation of £20 was made by the Council towards extinguishing the debt on Holy Trinity Church, Little Queen Street.

A letter was read from Messrs Burton and Co. on behalf of Mr. Lawson Tait proposing that all proceedings in Tait v. Savory should stand in abeyance until the action Steele v. Savory has been disposed of, and that Tait v. Savory should abide the result of Steele v. Savory. The Council agreed to this proposal.

The SECRETARY reported that the Formulæ for New By-laws had been forwarded on the 15th ultimo to the Secretary of State for the Home Department for sanction and ratification.

Mr. Robert Martin Craven was elected by ballot to the Fellowship under Section 5 of the 15th Victoria, applicable to Members of the College of twenty years' standing.

NOTICE.—The Library of the College of Surgeons will be closed from the evening of Thursday, April 18th, to the morning of Tuesday, April 23rd, for the Easter vacation.

ASSOCIATION OF MEMBERS: DRAFT BILL FOR THE REFORM OF THE COLLEGE.

At a meeting, on April 4th, of the Parliamentary Committee, appointed by the meeting of February 28th, the following Draft Bill to Amend the Constitution of the Royal College of Surgeons of England, was unanimously adopted.

Whereas it is expedient to amend the constitution and government of the Royal College of Surgeons of England, and to declare and give effect to certain of the rights of the Members thereof, be it enacted, etc.

1. No Member of the said College shall hereafter be disqualified from being elected to, or holding, any place or office in the College by reason of his not being a Fellow of the College, except as hereinafter provided.

2. The President, Vice-presidents and Council of the College shall be elected by the Members of the College, but the Council shall be empowered to provide by by-law that no Member who shall be of less than ten years' standing shall exercise the said electoral franchise unless he has been admitted to the Fellowship of the College.

3. The Members are, and shall be, entitled freely to meet together within the College at all reasonable times, to consider and resolve concerning the affairs of the College, and any resolutions passed at any such meeting by a two-thirds majority of the Members voting concerning the by-laws or the expenditure of the College shall be binding on the Council.

4. Section 17 of the By-laws of the College and all action taken or to be taken thereunder is hereby declared to be invalid.

5. So soon as may be after the next annual election for the Council, the Council shall make such provision by by-law as may be necessary for fully carrying out the provisions of this Act, and shall have power therein to provide that not more than a fixed number of places on the Council, not being less than six, shall be filled by Members who are not Fellows of the College, and that such Members shall be of twenty years' standing or of such less standing as the Council may deem sufficient, and the Council shall forthwith provide by by-law for voting, at any election, by voting papers, and shall have power from time to time by by-law, to amend the manner of election of Examiners, and to alter the said distribution of places on the Council, and to shorten the term of office of the Members of the Council—provided always that no such by-law shall be binding until it shall have been adopted by a general meeting of the College.