SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 18, 1890.—"On Certain Conditions that Modify the Virulence of the Bacillus of Tubercle." By Arthur Ransome, M.D., F.R.S.

In order to test the influence of light, air, and dry soils upon the virulence of the bacillus of tubercle, the following series of experiments were devised.

It was decided to expose tuberculous sputum—

(*a*) In a locality (Bowdon) where the soil was dry and sandy (about 100 feet in thickness), and where very few cases of phthisis were known to have originated. It was to be placed in full daylight or sunlight, and exposed to abundant streams of fresh country air.

(*b*) A portion of the same sputum would be exposed under similar conditions, in the same place, with the exception that it would be put into a darkened chamber.

(*c*) A third portion would be taken to a small four-roomed tenement in Manchester, on a clay soil, without cellarage, and badly ventilated, but it would be placed on the window-ledge, with as much light as could there be obtained.

(*d*) A portion would be placed in the same cottage, but in a dark corner of a sleeping-room in which it was known that three deaths from phthisis had occurred within the space of six or seven years.

(*e*) Finally, a portion would be exposed to used air coming from a ward in a Consumption Hospital in Bowdon, in darkness.

Two collections of sputum were obtained—

(*a*) From a woman dying of phthisis, collected on April 25. This specimen contained comparatively few bacilli.

(*b*) Also from a woman in an advanced stage of phthisis. This sputum contained abundance of bacilli.

These collections of sputum were divided into portions, and placed in watch-glasses marked A.1, A.2, A.3, B.1, . . . B.10. Some of these watch-glasses were exposed without further arrangement, but others, where there might be a possibility of infection, were inclosed in cages, so arranged that air could reach them through a thin layer of cotton-wool.

These watch-glasses were then exposed for five weeks under the conditions already noted, commencing on April 29, 1890, with the exception of B.9 and 10, which were started on May 2. Most of the specimens were withdrawn on June 3; but one, B.10, was divided on May 12, and a portion—B.10.(*b*)—was introduced into a glass bulb and exposed for several minutes each day to a current of ozonized oxygen.

All the specimens were then inclosed in a box, and forwarded to the Pathological Laboratory, Owens College, where Dr. Dreschfeld, the Professor of Pathology, had kindly undertaken to carry out the necessary inoculations. The animals used were rabbits, kept under favourable hygienic conditions. The dried sputum was mixed with sterilized water, to form a pasty mass, and this was inserted into the subcutaneous tissue of the back. All the instruments used were made thoroughly aseptic.

None of the four specimens of sputum exposed to fresh air and light on a dry soil conveyed the disease, but one of the three portions exposed under similar conditions in darkness produced tubercle.

Of the two exposed in the cottage in Ancoats, in the light, one produced tubercle; and of the two specimens exposed in the same place, in comparative darkness, one caused tubercle, the other did not.

Lastly, the specimen placed in the ventilating shaft from a ward in the Consumption Hospital, Bowdon, on a dry soil, conveyed the disease; and the portion removed from it after ten days, and exposed to the action of ozonized oxygen, did not produce tubercle.

These experiments are too few in number to justify the statement of positive conclusions, but, so far as they extend, they go to prove that fresh air and light and a dry sandy soil have a distinct influence in arresting the virulence of the tubercle bacillus; that darkness somewhat interferes with this disinfectant action; but that the mere exposure to light in otherwise bad sanitary conditions does not destroy the virus. There are some indications that the cotton-wool envelope interferes with the operation of the external conditions, whether for good or evil.

January 8.—"On the Minute Structure of Striped Muscle, with Special Reference to a New Method of Investigation by means of 'Impressions' stamped in Collodion." By John Berry Haycraft, M.D., D.Sc., F.R.S.E. Communicated by Dr. Klein, F.R.S. (From the Physiological Laboratory, University of Edinburgh.)

The author has held since 1880 that the cross striping seen on examining a muscular fibre by the aid of a microscope is due to the fact that the fibrils of which the muscle is composed are varicose in form, presenting alternating swellings and contractions. The striping, according to him, is the optical effect of their form, and not of their internal structure as is almost universally believed. Recently he has discovered very convincing proof of the truth of his opinions. It occurred to him to endeavour to "stamp" some soft material with muscular tissue, and to examine the "impression" or "intaglio" under the microscope: if this intaglio showed the cross striping, it of course would follow that this could be accounted for by the form of the muscle used as the "stamp." After experimenting for some months, he at last succeeded in his purpose, having found a suitable medium in a moist film of collodion. The properties of this film he found were very remarkable, for with it it is possible to take impressions of details too small to be recognized by any but the higher powers of the microscope. Such a film, pressed for a second or so against the back of the hand and then withdrawn, not only shows impressions of the tiny hairs covering the hand, but when examined under the microscope the minutest details of the imbricated scales of which they are composed come out far more clearly than when the somewhat opaque hair is itself examined. When the film is gently pressed upon some fresh or preserved muscle, the intaglio shows in every detail the striping so characteristic of the muscle, and not only so, but every change in the striping which is known to occur when the muscle contracts can be stamped as well. The intaglio in fact gives the details of the striping in whatever state of contraction or relaxation the fibre, used as a stamp, may happen to be, and it follows of course that these changes in the striping are due to changes in the form of the fibrils. In this case the most current views of contraction have to be discarded, for these explain contraction as being due to osmotic reactions between the substances which were supposed to constitute the cross stripes (these are generally held to mark the position of alternating bands of semi-fluid and solid substances). The author advances a new hypothesis relating to the stripes, which may be described as follows:—As a matter of fact, we find that, in a study of comparative histology, cross striping is found where rapidity of contraction is required; in other words, the fibrils of an unstriped fibre lose their cylindrical character, and become segmented up into tiny particles, each little particle shortening and thickening during contraction, and causing recurrent bulgings which produce the stripes. The reason of this segmentation may not unnaturally be ascribed to the fact that the smaller a contracting particle is the sooner it will reach its maximum of shortening, just as, in the case of the gross muscles, the hare can nearly keep pace with the horse, because its leaps, although shorter, are much quicker. While offering the above explanations, the author does not consider we are yet in a position to explain the phenomenon of contraction itself; and concludes by saying that, if ever we are in a position to express muscular contraction in terms of the inorganic world, it will result from a study of the lower and simpler types of contractile tissue, rather than from the highly evolved tissue of striped muscle.

"On the Reflection and Refraction of Light at the Surface of a Magnetized Medium." By A. B. Basset, M.A., F.R.S.

The object of the present paper is to endeavour to ascertain how far the electromagnetic theory of light, as at present developed, is capable of giving a theoretical explanation of Dr. Kerr's experiments (*Phil. Mag.*, May 1877, and March 1878) on the effect of magnetism on light.

In these experiments, polarized light was reflected from the polished surface of soft iron, and it was found that, when the reflector was magnetized, the reflected light exhibited certain peculiarities, which disappeared when the magnetizing current was off. It was also found that the effects of magnetization were, in most cases, reversed when the direction of the magnetizing current was reversed; that is to say, if the intensity of the reflected light was strengthened by a right-handed current, it was weakened by a left-handed one.

Since a metallic reflector was employed, the results were complicated by the influence of metallic reflection, and it therefore seems hopeless to attempt to give a complete theoretical explanation of these experiments until a satisfactory electromagnetic theory of metallic reflection has been discovered; and this, I believe, has not yet been done.

There are, however, several non-metallic substances (such as strong solutions of certain chemical compounds of iron) which are capable, when magnetized, of producing an effect upon light; and the theoretical explanation of the magnetic action of such substances upon light is accordingly free from the difficulties surrounding metallic reflection. I have accordingly, in the present paper, attempted to develop a theory which is applicable to such media.

The theory, which is due to Prof. Rowland, is founded upon the following considerations:—

It was proved by Hall (*ibid.*, March 1880) that, when a current passes through a conductor which is placed in a strong magnetic field, an electromotive force is produced, whose intensity is proportional to the product of the current and the magnetic force, and whose direction is at right angles to the plane containing the current and the magnetic force. Prof. Rowland (*ibid.*, April 1881) has assumed that this result holds good in a dielectric which is under the action of a strong magnetic force; accordingly, the general equations of electromotive force become

$$P = -\frac{dF}{dt} - C(\gamma\dot{g} - \beta\dot{h}) - \frac{d\psi}{dx} \quad . \quad . \quad . \quad (1)$$

where α, β, γ are the components of the external magnetic force, and C is a constant which depends upon the physical constitution of the medium.

Writing $p_1 = C\alpha$, &c., it follows that, if the medium is isotropic, the equations of electric displacement are of the form

$$\frac{d^2f}{dt^2} = \frac{1}{\mu K}\nabla^2 f + \frac{1}{4\pi\mu}\left(p_1\frac{d}{dx} + p_2\frac{d}{dy} + p_3\frac{d}{dz}\right)\left(\frac{d\dot{g}}{dz} - \frac{d\dot{h}}{dy}\right). \quad (2)$$

The results of the paper agree with Dr. Kerr's experiments in the following particulars:—

(i.) The reflected light is elliptically polarized.

(ii.) When the magnetization is parallel to the reflecting surface, no effect is produced when the incidence is normal, or when the plane of incidence is perpendicular to the direction of magnetization.

(iii.) When the plane of incidence is parallel to the direction of magnetization, and the light is polarized *in* the plane of incidence, the magnetic term increases from grazing incidence to a maximum value, and then decreases to normal incidence.

The principal point of disagreement is, that in all cases the intensity of the reflected light is unchanged when the direction of the magnetizing current is reversed.

I do not think that the results of the theory can be considered altogether unsatisfactory, since they certainly explain some of Dr. Kerr's experimental results; and I am disposed to think that the disagreement is due to the disturbing influence of metallic reflection. At the same time, the question is one which can only be decided by experiment, and it is therefore most desirable that experiments on magnetized solutions should be made.

EDINBURGH.

Royal Society, January 5.—Prof. Chrystal, Vice-President, in the chair.—After the reading of some obituary notices, Prof. Tait communicated a paper on the soaring of birds, being a continuation of a letter from the late Mr. W. Froude to Sir W. Thomson. In the previous part of this letter, Mr. Froude had expressed the view that, when a bird soars or skims without moving its wings, an effective upward current of air must exist, of which the bird takes advantage. In one case, in which a bird seemed to soar in a glassy calm, he found that it was really soaring in the upward currents in the front of an advancing sea-breeze. He explained the skimming of albatrosses along the surface of the sea in a practical calm as due to the upward displacement of the air which necessarily occurs in the front of an advancing ocean-swell. In the continuation of the letter, now communicated, he adduces observational evidence that the birds actually do skim over this portion of the wave, and that they commence to flap whenever they pass away from it, or when the wave passes underneath them and leaves them behind. In the front of a wave, 500 feet in length and 10 feet high, advancing with a speed of 50 feet per second, the maximum speed of upward speed of the air is about 3 feet per second. In the present portion of his letter, Mr. Froude also dealt with the soaring of birds in a gale. He believed this to be due to the same cause as that which is effective in the carrying up of drops of spray to heights of 40 or 50 feet, so thickly as to resemble a dense shower of rain. Vortices are produced in the air over the surface, and the ascending currents in these vortices move more quickly than the descending currents move. Of course, the ascending portion has proportionately less cross-area; but, on the other hand, the resistance is proportional to the square of the speed, so that the upward momentum which is communicated to a drop of water while crossing the ascending portion is greater than the downward momentum which is communicated to it while crossing the descending part. Mr. Froude believed that this fact would explain the soaring of birds in a gale. Sir W. Thomson, however, thinks that this cause, though sufficient probably to account for the raising of the water-drops, will only produce effects of the second order in the suspension of birds. He believes that Lord Rayleigh's explanation—which does not seem to have occurred to Froude—that the bird takes advantage of the greater speed of the wind at higher levels, and its less speed at lower levels, is the true one.—Prof. Tait read a note on impact, in continuation of previous notes on the same subject. He shows that solid bodies may be divided into two large classes according to the effect of impact upon them. In one of these classes the time of impact remains constant, whatever be the distortion, up to a certain limit. When this limit is exceeded, the time of impact becomes shorter as the distortion is increased. This means that Hooke's law is obeyed up to the given limit, beyond which the force of restitution increases at a greater rate than does the distortion. In the other class of substances the time of impact first increases, then remains constant, and finally diminishes, as the distortion is continuously increased. Therefore, in the first stages, the force of restitution does not increase so rapidly as the distortion increases. Cork is a typical example of the latter class; vulcanized india-rubber of the former.

January 9.—A special meeting was held, Prof. Crystal, Vice-President, in the chair.—Dr. John Murray read a paper on the form, structure, and distribution of manganese nodules in the deep sea. He exhibited a number of specimens of the nodules. Fragments of pumice-stone, which have become water-logged and have sunk to the bottom, frequently form the nuclei. In other cases the nuclei are pieces of rock, sharks' teeth, ear-bones of whales, &c. Dr. Murray believes that the manganese is deposited from solution by way of the carbonates. While nodules are of comparatively rare occurrence in the shore deposits—blue muds—where organic life is greatest, they are found in great abundance in deep waters, where life is at a minimum.—Mr. Robert Irvine and Dr. John Gibson read a paper on the occurrence of manganese deposits in marine muds. The authors have found by experiment that manganous sulphide is dissolved and decomposed by sea-water which contains carbonic acid in solution.—Mr. J. Y. Buchanan read a paper on the composition of oceanic and littoral manganese nodules. His paper contained an analysis of nodules from the North Pacific, from the ocean south of Australia, and from the deep part of Loch Fyne. The localities, and attending circumstances, were fully described, as also were the physical characteristics of the different types of nodules. The principal object of the analysis was to determine the state of oxidation of the manganese. It was found that, in the oceanic nodules, the formula of the oxide varied from $MnO_{1\cdot945}$ to $MnO_{1\cdot979}$, so that it consisted of almost pure MnO_2. A slight difference was found in the oxidation of the outside shell from that of the kernel, the outside portions having the formula $MnO_{1\cdot951}$, while the formula of the inner portions was $MnO_{1\cdot974}$. The formula of the oxide in the Loch Fyne nodules varied from $MnO_{1\cdot394}$ to $MnO_{1\cdot562}$, so that these nodules approximated in composition to the sesquioxide, Mn_2O_3. The kernels were much richer in oxygen than were the exterior portions, the formula of one being $MnO_{1\cdot75}$. A number of determinations were made with regard to the moisture, the loss on ignition, and the density of the nodules in the moist, the dry, and the ignited states, from which the apparent density of the volatile products was calculated.—Mr. Buchanan also laid on the table a number of analytical results regarding the composition of some deep-sea deposits from the Mediterranean.—Messrs. Robert Irvine and W. S. Anderson communicated a paper on the action of metallic salts on carbonate of lime, specimens being exhibited.—The reading of these papers was followed by a short discussion on the bearing of some of the above results on the conclusions arrived at in Mr. Buchanan's paper (read on December 1) regarding the part played by sulphides in the formation of the ochreous deposits of the ocean. Mr. Irvine and Dr. Gibson hold that the results which they have obtained show that the manganese could never have been found in the circumstances described in Mr. Buchanan's paper. Mr. Buchanan recognized the importance of the observation, but he suggested that, although very alterable in sea-water, as it is also in fresh water, the MnS might be formed locally; and he also stated that, in his own previous paper, a transient existence alone was claimed for it. The results do not affect his views as to the formation of the ferric hydrates and of red and blue clays. Mr. Buchanan held that we are still in the dark regarding the formation of *nodules*.

PARIS.

Academy of Sciences, January 12.—M. Duchartre in the chair.—On the hypothesis of the spheroidal shape of the earth, and on the formation of its crust, by M. H. Faye. The most recent and precise geodetic measures are brought forward to confirm Laplace's opinion that the earth is an ellipsoid of revolution. Against the objection that all the measures have been made relative to continental surfaces, and most of them in the northern hemisphere, it is urged that contemporaneous measures with the pendulum give values from which the same conclusion must be drawn; and that these have been executed in both hemispheres and on both land and water surfaces. Geological considerations are also adduced in favour of this view.—Note on fly-wheels, by M. Léauté. The dimensions and weights of fly-wheels suitable for electric lighting machinery are discussed.—On a claim of priority in favour of M. Chancourtois relative to the numerical relations between the atomic weights of elements, by MM. Lecoq de Boisbaudran and A. de Lapparent. The authors bring forward a paper presented at the Academy in 1862, and having the title "Vis tellurique; classement naturel des corps simples ou radicaux obtenu au moyen d'un système de classification hélicoidal et numérique," as evidence of M. Chancourtois's discovery of the periodic law.—On the oscillations of a system submitted to periodic disturbances, by M. E. Vicaire.—Remarks on the theorem of the continuity of the gaseous and liquid states, by M. E. Mathias. The object of this note is the verification by experimental results, of Van der Waal's law expressing the relation between the volume, the pressure, and the absolute temperature of a fluid.—Practical solution of the problem of the emergent liquid column of a thermometer by the employment of a correcting stem, by M. C. E. Guillaume. The scale of an ordinary mercurial thermometer is only true on the supposition that the instrument is exposed at least up to the top of the liquid column, to the temperature which it is desired to measure. In order to obtain the necessary correction practically, M. Guillaume has used the stem of a thermometer having mercury in it, and graduated in the ordinary manner. Let a thermometer and a "correcting stem" be placed side by side in a bath, and have the same amount of mercury above the liquid. The thermometer will indicate approximately the temperature of the bath, and the correction will be given by the difference of the thermometer reading and the reading of the "correcting stem" expressed in terms of the former.—Variations of conductivity of insulating substances, by M. E. Branly. It is shown that many dielectrics and metallic powders increase in conductivity when subjected to the action of electric discharges.—Physical properties and molecular constitution of simple metallic bodies, by M. P. Jacobin. The following are among the conclusions arrived at: (1) for the diamagnetic metals the conductivity is sensibly proportional to the sixth power of the number of molecules; (2) for magnetic metals the conductivity is nearly inversely proportional to the sixth power of the distance between the molecules. Similarly, all the physical properties of metals of the same group are stated to depend exclusively on their molecular distance.—On the intensity of telephonic effects, by M. E. Mercadier. The conditions to be fulfilled in order to obtain the maximum effect in a telephone, are: (1) the movements of the lines of force of the field should be facilitated; (2) the greatest possible number of the bobbin wires should cut the lines of force perpendicular to their direction; (3) the thickness of the diaphragm should be diminished until it is just sufficient to absorb the greatest number of lines of force in its neighbourhood; (4) the relation between the volume of the diaphragm induced to the total volume should be as large as possible.—An apparatus of luminous projection, applicable to chemical balances, for obtaining rapid weighings, by M. A. Collot *fils*.—On some derivatives from phenol and naphthol, by M. J. Minquin.—On the production of higher alcohols during alcoholic fermentation, by M. L. Lindet.—New method for the detection of olive oil and linseed oil, also applicable to butters and margarines, by M. Raoul Brullé.—Note on poisoning by mussels, by M. S. Jourdain.—Contributions to the physiology of the root, by M. Pierre Lesage.—Influence of light on the production of the prickles of plants, by M. A. Lothelier.—On the diamondiferous sands collected by M. Charles Rabot in Lapland, by M. Ch. Vélain.

AMSTERDAM.

Royal Academy of Sciences, December 27, 1890.—Prof. van de Sande Bakhuyzen in the chair.—M. Beyerinck spoke of the life-history of a pigment bacterium. This organism (*Bacillus cyaneo-fuscus*, n.s.) is the cause of a much feared, local colouring process in Dutch cheese, called "blue illness"; and of "black glue," a calamity observed in a factory of animal bone gelatine. The natural habitat is ditch water and ground water. *Bacillus cyaneo-fuscus* is a *Pepton-bacterium*, *i.e.* it can be fed with albuminous matter alone. Thence, a solution of ½ per cent. pepton in common water is sufficient nutriment; gelatine or glue, egg albumen, fibrine, and caseine, are also, each alone, sufficient, but they are peptonized, before absorption, by the secretion of a powerful enzyme. This pigment is twofold: (1) deep blue spherites; (2) a dark brown diffusible colouring matter. Thereby a pepton solution becomes fully black. Coming from the wild state, the vegetation power is very active, but, by the culture at the *optimum-temperature* of 15° C. to 20° C., this power weakens. In a first state of deterioration the weakened form cannot be cultivated on solid matter, such as pure gelatine, whereas it will grow still in liquid food with all its ordinary characters. In a further state the weakening process is characterized as well by the loss of the power just mentioned, as by that of the pigment production. A last step leaves the organism almost fully incapable of growth and reproduction. A long exposure of weakened cultures, in excellent but diluted food (½ per cent. pepton siccum in common water), to temperatures between 2° and 5° C., tends to restore the vegetative activity. These observations relate also to many other bacteria, and they are, no doubt, of the same order as the alterations in the virulence of contagious matter, caused by the influence of temperature.

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