ance of the matter, and steps are being taken to distribute these papers among agricultural experimenters.

A paper by Mr. Collins on the errors of milk analysis concluded the session.

The position of agriculture at the British Association is not yet settled. Whatever the council decide to do, it is hoped they will continue to give a separate organisation to agriculture, and thus afford to workers in agricultural science an opportunity—the only opportunity for some of them—of meeting their fellow workers in pure science and discussing their problems. It is necessary to get help from several sides and not simply from one, as from the chemical or the botanical, which seems to be the theory of a sub-section. However, whether lawfully or not (it appears to have been unlawfully) the organising committee has hitherto enjoyed the fullest liberty, and has succeeded in arranging a series of meetings that have proved extremely helpful to agricultural investigators, and promise to play no small part in the encouragement of agricultural research.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

IN addition to the presidential address, which has appeared already in NATURE, there were a number of interesting papers communicated to the section. Physiology was unique in that it was the only section that met at the University; and thus, although somewhat isolated from the other sections, enjoyed the advantage of the laboratories for demonstrations.

There were two joint meetings, one with Chemistry (Section B) and Botany (Section K) on the biochemistry of respiration, and the other with Education (Section L) on speech; the latter will be reviewed in the proceedings of the section of Educational Science. In addition, Dr. Leonard Hill, F.R.S., gave an interesting address on the prevention of caisson disease. The individual papers will be reviewed, as much as possible, so as to form groups in a logical sequence.

The discussion on respiration, held in the meeting-room of Section K, was opened by Dr. F. F. Blackman, F.R.S., who dealt with the subject under three headings.

(1) The series of chemical reaction which take place during oxidation. He took glucose as a typical example, of which the final products are carbon dioxide and water, but the intermediate steps are difficult to follow. Buchner's zymase produces alcohol and carbon dioxide from glucose, but it has been shown that alcohol cannot be oxidised by plants, and hence it must be surmised that some other substance, before the breakdown has reached the alcohol stage, is what is actually oxidised. There are probably many of these fugitive compounds, amongst which may occur lactic acid and di-hydroxy acetone. An alkaline sugar solution, as the result of exposure to sunlight, gives rise to substances which are easily oxidised. He then dealt briefly with oxidases, peroxide formation, and Palladin's hypothesis of respiratory chromogens, which are oxidised by oxidases to peroxides, and then pass on the oxygen to oxidisable material.

(2) The physical chemistry of the processes involved in oxidation. Influence of temperature on velocity of reaction (usually shows a coefficient of about 2·5 within the limits of temperature at which living processes can occur); the uniformity of the respiratory quotient (O_2/CO_2) at different temperatures and the effect of the concentration of the reacting substances were discussed. He illustrated these points by referring to his experiments with green leaves and potatoes (starchy and rich in sugar). The output of carbon dioxide by green leaves is reduced to zero by exposure to sunlight. The potatoes rich in sugar show a greater rate of oxidation than the starchy ones. The conclusion is arrived at that there is a minimal tissue respiration and an excess of respiration depending on the supply of respirable material.

The influence of accelerators, paralysators, and other substances was mentioned.

(3) Special influences of colloidal nature of cell protoplasm. Oxidation and reduction take place side by side, and death of the cell mixes up these two processes. Alterations of permeability of protoplasmic septa may account for changes in physiological oxidation processes.

Dr. H. M. Vernon referred to Dakin's work on oxidation of fatty acids and amino-acids by hydrogen peroxide and traces of ferrous salts. If zymase is allowed to act upon glucose for a short time, then the solution is boiled and oxidase and hydrogen peroxide are added, there is almost complete oxidation to carbon dioxide and water; this suggests that oxidases may act in living cells if organic peroxides can replace hydrogen peroxide. His own experiments on survival respiration (kidney) point to the presence of oxidases, and that certain poisons act by combining with aldehyde or similar groups. Some substances act especially on the "high-grade" process (formation of carbon dioxide) and not so much on the "low-grade" process (oxygen absorption), and thus the respiratory quotient is lowered. In relation to minimal protoplasmic and excess respiration, he directed attention to the fact that minced tissues show at first a greater output of carbon dioxide than when intact, but that the respiration soon falls to a much lower level.

Dr. E. F. Armstrong pointed out that in many respects oxidases differed from the other kinds of enzymes (they are heat stable and not specific in action), that their action can be imitated by colloidal suspensions of inorganic matter, and that traces of inorganic material are usually present in them. There are, however, specific oxidases. He then demonstrated the blackening of laurel leaves by the action of toluol (other chemically inert substances with little affinity for water act similarly), which he ascribed to a general breakdown of the protoplasm with liberation of oxidases.

Mr. D. Thoday spoke about the result of experiments on anæsthetised leaves. Small doses of chloroform cause a temporary increase of oxidation. A large dose causes a diminution in the output of carbon dioxide; with Helianthus and cherry laurel there is a great increase in oxygen intake, which quickly falls off, but with Tropæolum the oxygen intake falls at once. It was suggested that tannins oxidise first, and as there are no tannins in Tropæolum there is no initial increase of oxidation. Probably the result is brought about by an increase of permeability.

Prof. H. E. Armstrong, F.R.S., referred to Leathes' work on the splitting of fats at intermediate points in the carbon chain, and to the formation of peroxides by manganese and iron with hydroxy-acids. Oxidation may take place by decomposing water with liberation of hydrogen; in plants the hydrogen may be used to reduce carbon dioxide to formaldehyde. The leaf surfaces show a permeability similar to that found by Adrian Brown for barley grains.

Prof. Waller and Dr. Reynolds Green spoke, and Dr. Blackman replied.

Dr. Leonard Hill, F.R.S., reviewed the work done in relation to the prevention of compressed air illness. Whilst exposed to high pressure the body dissolves a larger amount of gas than at ordinary atmospheric pressure, and when the pressure is reduced bubbles of gas may be set free in the blood vessels. The solubility of the gas follows Henry's law; owing to the capacity of the tissues to absorb oxygen it is only the nitrogen that is set free in the vessels. The symptoms depend on the portion of the circulation which is stopped by the nitrogen embolus. Different portions of the body saturate at different rates, but work, by increasing the circulation, increases the rapidity with which the body takes up and gives off nitrogen. By analysis of the gases in urine it can be shown that it takes an appreciable time for the body to get into equilibrium with the pressure of the nitrogen in the atmosphere, or, in other words, the blood does not get into equilibrium with the gas on passing once through the lungs.

The relative merits of uniform decompression and decompression by stages were discussed. Long shifts are better than short, as there are fewer decompressions for the same amount of work, and the danger is due to decompression. When symptoms occur they can be abolished, or the danger minimised by recompression to the original pressure.

He recommended that, during decompression, occasional inhalations of oxygen should be taken (to lower the partial pressure of the nitrogen in the lungs, and thus

hasten the removal of nitrogen from the blood) and that exercise should be taken to increase the circulation, and thus remove the nitrogen from the "slow" parts more quickly.

Prof. F. S. Lee, of Columbia University, read two papers. (*a*) "The Cause of the Treppe." During the course of the staircase the excitability of the muscle increases. Clamping the trachea causes a second treppe. Fröhlich states that the treppe is due to slowing of relaxation, so that the increase in height of contraction is only apparent, as the contraction starts at a higher level; but at one stage of the treppe the contractions are not prolonged, while there is no delayed relaxation during fatigue of mammalian muscle. (*b*) "Summation of Stimuli," with Dr. M. Morse. Repeated subminimal stimuli can cause contraction. Traces of lactic acid, carbon dioxide, and other substances that are formed during fatigue increase the excitability of muscle. Gotschlich finds that muscle becomes acid as the result of repeated subminimal stimuli. Prof. Lee suggested that the treppe and summation of stimuli are both due to traces of fatigue substances.

Prof. C. S. Sherrington and Miss S. C. M. Sowton presented two communications dealing with the constant current as a stimulus of reflex action, and the effect of the intensity of the current on the response to stimulation. The preparation used was the isolated extensor of the knee in decerebrate rigidity. Non-polarisable electrodes were placed on an afferent nerve of the limb. A weak stimulation caused a reflex increase of tonus. This is a nearer approximation to the artificial production of reflex tonus than has hitherto been obtained. Otherwise the result of artificial stimulation is a reflex inhibition, as indeed it is with this stimulus when stronger. A stronger stimulus causes an increase of tone, followed by inhibition. A strong stimulus abolishes the preliminary increase of tone, and only inhibition results. In fact, the results obtained are exactly the same as have long been known for the direct stimulation of the opening muscle of Astacus claw. Stimulation occurs at the make and break of the constant current, and not usually during its passage. With a strength of current which gives a reflex increase of tone, chloroform converts the response to inhibition, and as the chloroform passes off the response to the stimulus again becomes an increase of tone.

Dr. J. Tait: (1) "The Conditions Necessary for Tetanus of the Heart." Refractory period of heart consists of absolute and relative refractory stages. The former lasts during systole, and the latter gradually diminishes from the end of systole. The stronger the stimulus the earlier it can be made effective in the relative refractory period. If the stimuli are sufficiently strong they can be effective at the end of systole, and tetanus results. Very strong stimulation causes electrolysis, which produces a series of contractions that gradually die away. (2) "Neurogenic Origin of Normal Heart Stimulus." Excised frog's heart-beat sometimes shows grouped beats (Luciana groups). These are probably due to waves of excitation from rhythm-producing centre. The tendency to grouped beats is increased by lack of oxygen, and the rate and rhythm correspond to that seen in tracings of Cheyne-Stokes respiration; hence the normal heart-beat is regulated by some mechanism similar to that which is affected in Cheyne-Stokes respiration. A constant stimulus with waves of increasing and diminishing strength would, as the strength increased, become effective earlier in the relative refractory period, and hence the increase of rate of beat.

Dr. H. M. Vernon reported the results of some experiments on the combination of poisons with the contractile substance of cardiac muscle. He used the tortoise heart, and perfused it with the various solutions. Alcohol, chloroform, and ether all cause effects proportional to their concentration, and recovery occurs on removal of the drug by fresh saline. Hydrocyanic acid and sodium fluoride cause a marked effect in small concentrations, but the action does not increase much when the strength of solution is increased. Recovery is not good, and is less with the stronger strengths. On removal of the sodium fluoride the heart-beats show remarkable oscillations of amplitude. The vitality of the heart is always permanently injured, as a second test with the same strength causes a greater effect than at first. The season and condition of the heart cause minor differences in the result.

Prof. C. S. Minot, of Harvard University, gave his views on the morphology and nomenclature of blood corpuscles. Present nomenclature not satisfactory. Both red and white cells originate from the primitive wandering cells (mesamœboid). Leucocyte = white cell, and can be subdivided into lymphocyte (young leucocyte), finely granular, and coarsely granular. Erythrocyte = red cell, and they can be subdivided into ichthyoid stage (cells like those in fish with a nucleus showing chromatin network), sauroid stage (like birds and reptiles, nucleus homogeneous, usually called normoblast), and plastid (non-nucleated or mammalian type).

Prof. C. S. Sherrington, F.R.S., Dr. E. E. Laslett, and Miss F. Tozer communicated the results of some experiments indicating the existence of afferent nerves in the eye muscles. The sensory nerve-endings maintain a primitive reptilian type; many "brush" and "creeper" endings are found in the region where muscle and tendon join. No muscle-spindles are found, but a clasping form of ending, which is probably a simple form of spindle. The eye muscles have a greater nerve supply than any other muscles. By cutting the nerves and examining the muscles after the nerves had degenerated it was proved that the third, fourth, and sixth cranial nerves contain sensory fibres in addition to the motor fibres, which are usually stated to be the only kind present. These nerves are therefore afferent-efferent nerves. No sensory fibres to the extrinsic eye muscles were traceable from the first division of the fifth nerve. There are a few small medullated nerve-fibres which do not degenerate after section of all of the foregoing nerves; these are apparently vasomotor, and come from the otic ganglion.

Dr. Dawson Turner and Dr. T. George recorded the results of the X-rays in therapeutic doses on the growing brains of rabbits. The development of the exposed side of the brain was slower than the other side. Fatty degeneration of the irides and loss of weight occurred during treatment. The subject is important, as X-rays are frequently used on children in the treatment of ringworm.

Prof. A. B. Macallum, F.R.S., read three papers: "The Origin of the Inorganic Composition of the Blood Plasma," "The Inorganic Composition of the Blood Plasma in the Frog after a Long Period of Inanition," and "The Microchemistry of the Spermatic Elements in Vertebrates."

The first two deal with the relative amounts of the inorganic salts in the blood. The ratios of these to each other are fairly constant throughout, and agree with the relative amounts of the same substances in sea-water; but there are some variations, and the total amounts of inorganic material are different in the different species. He explains the distribution of the salts as reflecting the composition of the ocean at that epoch when the blood plasma of the species in question ceased to respond to changes in the salts of the ocean. The vertebrate kidney is the factor that maintains the ancestral composition of the blood.

The third paper dealt with the distribution of iron and potassium in the spermatic elements. The iron in the nucleus diminishes through the series spermatogonia, spermatocyst, spermatid, and is absent from the head of the sperm itself. Mode of elimination masked. Potassium abundant in spermatic elements, gathered at anterior and posterior ends in frog, and only in posterior region and in bands in man. No potassium in the head itself.

Prof. W. H. Thompson spoke on the nutritive value of beef extract. Dogs were fed on a constant amount of dog biscuit until their weight was steady. The addition of beef extract caused an increase of weight ten or twenty times as great as the amount of extract added. Boiled egg-white was not nearly so efficacious. Nitrogen apparently not retained, and when beef extract was discontinued the dogs returned to their former weight. The increase in weight is not due to retained water, but to an increased digestion and absorption of the dog biscuits, as the nitrogen and total amount of fæces were diminished.

The reports of research committees were, as usual, of a technical nature. They often briefly referred to papers which have been published elsewhere, and thus are not suited for detailed description here. Arising out of the report on anæsthetics was a brief discussion on the advisability of legislation to improve the training of those who are destined to administer anæsthetics, and to prohibit unqualified persons from administering them. Prof. A. D. Waller, F.R.S., in connection with the report on electromotive phenomena in plants, read a paper describing the method used to estimate hydrocyanic acid in plants and animals, with an application of the method to medico-legal purposes. The committee on ductless glands report on a considerable number of researches, the results of some of which have already appeared. The reports on body metabolism in cancer and on mental and muscular fatigue each contain instructive and suggestive material.

Some interesting photomicrographs of muscle fibres were shown by Dr. Murray Dobie, who published his first paper on the structure of muscle in 1848.

Prof. J. S. Macdonald exhibited the respiration calorimeter on two separate occasions. The heat production of a resting man was compared with that of a man riding a bicycle.

A SUGGESTED RESEARCH FUND FOR TROPICAL DISEASES.

THE *Times* of November 2 publishes the subjoined appeal which Lord Northcote has addressed to the Lord Mayor in favour of the allocation of a part of the fund raised for a London memorial to the late King to the establishment of an Edward VII. Tropical Research Fund. The proposal has received the support of leading representatives of many national interests, including Lord Crewe, Secretary of State for the Colonies, Lord Elgin, Lord Kitchener, and Mr. Joseph Chamberlain.

Letter to the Lord Mayor.

My Lord Mayor,—Having noted that you are taking steps to form a representative Mansion House Committee for the purpose of raising a fund to provide a memorial of the late King in London, and that you are receiving numerous suggestions as to the form which that memorial should take, we desire respectfully to offer the following suggestion for your earnest consideration.

(2) The late King, in his beneficent activity for the welfare of his people, was inspired by two ideals—peace for mankind and war on disease. His work in the former of these directions has been recognised by the world at large; it is in following his lead in the second that we think that a fitting tribute to his memory will be found.

(3) Only recently, but now unmistakably, has the nation become alive to the vital importance of its tropical possessions. Their development proceeds apace, but at a heavy cost in human life and vital energy. Rarely does a mail arrive which does not bring sorrow into at least one home in these islands.

(4) For generations mankind have been willing to accept in a fatalistic spirit the death toll levied upon them by what was vaguely known as "the climate." Now this is no longer so. Thanks to the devoted labours of scientific men—among whom our own countrymen hold an honoured place—we know in many instances what the enemy is and how it is to be met.

(5) Those who are not conversant with the subject will be surprised and almost startled to hear the effect on human life of measures taken as the result of such investigations. We give three illustrations, drawn from the history of three of the greatest scourges of the tropics:—

(*a*) Malaria.—In Klang and Port Swettenham, two towns within the protected Federated Malay States, remedial measures were commenced in 1901. The deaths from malaria were in 1901 368 and in 1905 45. In the surrounding districts, where no measures were taken, the deaths for these years were respectively 266 and 351. In Hong Kong remedial measures were commenced in 1901. In that year the admissions to hospital were 1294 and the deaths 132. In 1905 the admissions were 419 and the deaths 54. In 1904 the United States took over the administration of the zone of the Panama Canal; the deaths from malaria, which in 1906 were 821, had sunk in 1908 to 282.

(*b*) Yellow Fever.—In the city of Havana 35,952 persons perished of yellow fever between 1853 and 1900. The United States Government commenced remedial measures in 1900, and in 1907 only one case of yellow fever was reported.

(*c*) During the last three years steps have been taken in Uganda to stamp out sleeping sickness, an epidemic which in one district alone had destroyed some 200,000 people out of a total population of 300,000. In 1907 the deaths in the kingdom of Uganda numbered less than 4000, and in 1908 they fell to 1700.

(6) It will be seen that, tested by results, these figures are full of promise, and prove conclusively that the measures taken have proceeded on sound lines.

(7) It will naturally be asked: How have these results been achieved? The answer, so far as this country is concerned, is by private effort in close cooperation with the Government. Leaving out of account the Liverpool School of Tropical Medicine, which has been generously endowed by the citizens of that city, the bodies which are responsible for sustained and organised effort are the Royal Society, the London School of Tropical Medicine, the Sleeping Sickness Bureau, and the African Entomological Research Committee, all of which are associated with the metropolis. The first of these enjoys no direct Government support, and has carried out its work by a committee which includes some of the most eminent names in the profession of tropical medicine, who have given their services freely and gratuitously. The London School of Tropical Medicine at the Albert Dock, which owes its establishment, in part, to private generosity, receives an annual grant from Government of 1300*l.* The Sleeping Sickness Bureau is supported entirely by Government, the annual cost being some 1200*l.* The African Entomological Research Committee has recently been established to investigate the insects which convey disease to men, animals, and plants in the tropics, and includes among its members the best authorities on the subject. It receives a Government grant of 2000*l.* a year, and it is working in close cooperation with the Natural History Museum. In addition to the foregoing grants, a grant of 750*l.* a year is made to the University of London for the purpose of assisting work which has an important bearing on tropical medicine.

(8) The three cases which we have mentioned above are those in which the most striking results of scientific research have hitherto been obtained, but it is hardly necessary to say that they cover only a small portion of the field. Notwithstanding the rapid advance of knowledge in tropical diseases, there are many as yet unknown or imperfectly understood. The causation of blackwater fever, of dengue, of beri-beri, and of many other diseases still calls for investigation.

(9) We submit to your committee that no more appropriate memorial to our late Sovereign could be proposed than the establishment of a fund to carry on and extend the work of research into tropical disease. We further submit that it is eminently appropriate that London, the metropolis of the Empire, should take the lead in a movement for giving the full benefit of British administration to these outlying portions of the King's dominion, which have contributed in no small measure to her prosperity in the past, and will, by their development, give still ampler ground for her gratitude in the future.

(10) There can be no class in this great city to which the scheme will not appeal. To the rulers, the missionaries, the philanthropists, and all those who concern themselves with the welfare of the millions of coloured races whom Providence has committed to our charge it will appear of transcendent importance. To those whose kith and kin have gone out to bear their part in the work of civilising our tropical possessions, in whatever station of life, it will appeal no less strongly. To the man of business, in whose profit and loss account the dangers to the health of his employés figure so largely, our proposal will need no further recommendation. The ultimate aim is the creation of a Tropical Britain whose peoples are freed from the scourge of sickness, and where