purposes. Among the exhibits of Messrs. Isenthal and Co. was a collection of pladuram products, a form of tungsten specially treated, which it is hoped to apply to purposes where a hard, inert metal is required. Radio-active preparations were shown by Mr. F. Harrison Glew. The principal exhibit of Messrs. Muirhead and Co. was a Heurtley magnifier for use in cable telegraphy or wireless telegraphy, or wherever it is required to magnify the effect of small mechanical movements. Instruments connected with wireless telegraphy were shown by the Marconi Company, the Ludgate Wireless Company, and Messrs. Graham and Latham, while very complete exhibits of projection apparatus and microscopes for all purposes were shown by Messrs. Carl Zeiss, Messrs. E. Leitz, Messrs. Newton and Co., and other firms. The instruments of Messrs. H. Tinsley and Co. for colour measurement and for lens testing, and the new miniature precision instruments of the Weston Co., are also worthy of mention.

THIRD INTERNATIONAL CONGRESS OF TROPICAL AGRICULTURE.

THE first International Congress of Tropical Agriculture was held in Paris in 1905, and was organised by a number of French men of science interested in this subject. At its close the Association Scientifique Internationale d'Agronomie Coloniale et Tropicale was founded, to promote in every possible way scientific work in tropical agriculture. Branches of this association were gradually founded in Belgium, France, Germany, Great Britain, Italy, Portugal, and elsewhere, until at present practically every country interested, either on its own account or through its colonies, in tropical agriculture, is represented on the Central Bureau of the association, which has its headquarters in Paris. In 1910 a very successful second Congress of Tropical Agriculture was held in Brussels. At the close of that congress M. de Lanessan, formerly Governor-General of Indo-China, who had up till that time been president of the association, retired, and was succeeded by Prof. Wyndham Dunstan, C.M.G., F.R.S., director of the Imperial Institute.

The International Association has decided to hold the third Congress of Tropical Agriculture in London, at the Imperial Institute, on June 23–30 next year, under the presidency of Prof. Dunstan. A strong organising committee, including Sir D. Prain, director of the Royal Gardens, Kew; Sir S. Stockman, chief veterinary officer to the Board of Agriculture and Fisheries; Mr. Bernard Coventry, Agricultural Adviser to the Government of India; Dr. F. Watts, Imperial Commissioner of Agriculture for the West Indies, and other eminent authorities on tropical agriculture, has been at work for some time in preparation for the congress.

It is proposed to devote the afternoon meetings of the congress to papers, and the morning meetings to a series of discussions on important problems of special interest, such as technical education and research in tropical agriculture; outstanding scientific problems in rubber production; methods of developing cotton cultivation in new countries; problems of fibre production; agriculture in arid regions; and hygiene and preventive medicine, in their relation to tropical agriculture. The organising committee will welcome contributions on these or allied subjects.

For further information regarding the arrangements for the congress, the communication of papers, &c., application should be made to the organising secretaries (Dr. T. A. Henry and Mr. H. Brown), Third International Congress of Tropical Agriculture, Imperial Institute, London, S.W.

PHYSICAL CHEMISTRY OF SOLUTIONS.

AS is well known, the progress in the physical chemistry of solutions which has been made during the last thirty years, though extensive and detailed in a certain sense, has nevertheless suffered not a little from the fact that fully 90 per cent. of the investigations have been restricted to the study of the behaviour of substances dissolved in *water*. At the present time, therefore, whilst a very large amount of data has been accumulated upon the subject of aqueous solutions, our knowledge of the behaviour of non-aqueous solutions and solutions formed in mixed solvents is deplorably scanty. Of course, here and there the subject has been attacked, especially within the last decade, and a few general conclusions have been laboriously attained. Many of the rules, however, which serve as a trustworthy guide in the case of aqueous solutions have to be considerably modified or even discarded altogether when we come to non-aqueous solutions. At the same time, it is clear that the problem of solution in general cannot be regarded as in a satisfactory state, so long as generalisations applicable to a large number of solvents at least are wanting.

It is for this reason that we welcome the monograph published by Prof. H. C. Jones, entitled "The freezing point-lowering, conductivity, and viscosity of solutions of certain electrolytes in water, methyl alcohol, ethyl alcohol, acetone, and glycerol, and in mixtures of these solvents with one another" (Publication No. 180, Carnegie Institution of Washington). The present work is to be regarded as supplementary to Publication No. 80 of the same institution. The actual experimental work has been carried out by several investigators, under the direction of Prof. Jones. Each of these investigators, after giving an account of the experimental methods and results obtained for various salts—inorganic salts—in various solvents, pure and mixed, makes a very brief summary of conclusions, the whole field being finally reviewed by Prof. Jones himself in a general discussion, which occupies the last dozen pages or so of the book. As was to be expected, great stress is laid upon the generality of the phenomenon of solvation and much of the work is devoted to the elucidation—naturally with varying success—of the three fundamental factors:—(1) Change in solvation, which changes the mass and size of the ion; (2) change in the viscosity of the solution with change in temperature thereby affecting the friction of the ions in moving through the solution; and (3) change in the number of dissolved particles—molecules and ions.

The publication as a whole is a monument of industry which reflects the greatest credit upon the laboratory from which it emanates. It is sincerely to be hoped that the systematic accumulation of similar data will become much more general than has hitherto been the case.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

THIS has been a year of congresses for physiologists. The International Congress of Medicine, the International Congress of Physiology, and the British Association all took place during August and September. In spite of the fact that the British Association came last, the section of physiology had a very successful meeting.

The president's address was especially interesting, as it gave the views of an organic chemist on the physico-chemical aspect of his work. The address has already appeared in NATURE (October 16, p. 213).

On Monday morning, September 15, the section of physiology held a joint meeting with the section of agriculture. A paper by Prof. Sörensen and a discussion on the physiology of reproduction occupied the attention of the two sections.

Prof. Sörensen dealt with the measurement and the significance of the hydrogen ion concentration in biological processes. He began by pointing out that the hydrogen ion concentration gives more information than the statement of the amount of acid in the solution. Some of the acid may be neutralised or unionised, and hence it does not exert its full acidic power. A similar relation holds between hydroxyl ion concentration and alkalinity.

As the product of hydrogen and hydroxyl ion concentrations is constant at a given temperature, the most convenient method of expressing acidity or alkalinity is in terms of hydrogen ion concentration. Owing to the hydrogen ion concentration in biological processes being very small, he uses the sign p_H to indicate the negative exponent of the normality in respect to hydrogen ions. Thus $2 \times 10^{-6} = 10^{-5 \cdot 69}$; therefore $p_H = 5 \cdot 69$.

The electromotive measurement of hydrogen ions is the standard method, but the colorometric indicator method is more convenient for many purposes.

The use of "buffers," by which acid or alkali formed during a reaction is neutralised without an appreciable change in hydrogen ion concentration, enables one to study the effect of the hydrogen ion concentration on various processes. The cases illustrated were invertase and other enzymes, hæmolysis, and phagocytosis.

The discussion on reproduction was opened by Mr. K. J. J. Mackenzie, who pointed out that the stock-breeder was well trained and ready to absorb sound knowledge, but that the knowledge was not there for him to have. There are many problems of a practical nature and of great financial importance in regard to stock-breeding, but he spoke mainly about two of them.

The first was the problem of the "Free Martin." A heifer born twin to a bull is said to be sterile. Several cases were investigated, and it was found that some were sterile and others fertile. If it could be predicted which are the fertile ones, this knowledge would make a considerable difference to the prices obtained at sales of pedigree stock. Mr. Mackenzie pointed out that twins may result from the fertilisation of two eggs or by the division of one fertilised egg into two individuals. The former would possess two separate amnions, whilst the latter would be contained in a common amnion. Observation at birth of the presence or absence of two amnions and correlation of the observations with the subsequent histories of the offspring might solve the problem which heifers would be fertile. In reply to a question he said that sterility of the bulls was much less important, as they were usually castrated.

The second problem was that of "black belly" in swine. It was considered that this was due to œstrus, and that bacon made from such animals was unwholesome. Investigation showed that the pigmentation is due to skin pigment, and that œstral changes are so slight as to be overlooked in slaughter-houses. If the prejudice to the pigment cannot be overcome, the remedy is to breed swine without mammary pigment.

Problems in milk production and sterility in bulls and stallions were also quoted as subjects requiring investigation.

Mr. Geofrey Smith sent in an abstract dealing with the glycogen and fat metabolism of crabs. The males and females present striking differences. Males have less fat and more glycogen in their livers than do the females. The blood of the male is pink, whilst that of the female is yellow. Infection with sacculina causes disappearance of sexual changes, and the males become like the females in composition.

Dr. L. Doncaster mentioned other cases in which the males and females differ. For instance, in caterpillars, by the precipitin test, the two sexes can be shown to differ more than the same sexes but of different species. He suggested that male and female characters are present in both cases, but that some factor, by influencing metabolism, determines which sex develops. Sacculina apparently causes the same type of metabolism as does the female factor.

A combined meeting with the sections of zoology and botany was held on Tuesday morning, September 16. Prof. B. Moore, F.R.S., gave a communication entitled "Synthesis of Organic Matter by Inorganic Colloids in presence of Sunlight, considered in relation to the Origin of Life."

His view is that the first organisms would not contain chlorophyll, and hence there must have been a supply of organic matter before the organisms could flourish. He demonstrated that from water containing carbon dioxide and colloid, formaldehyde is produced by ultra-violet light.

He then outlined the scheme of development whereby increasing complexity causes instability, and that regions of stability occur by the formation of a new order of substance. As the material becomes more complex, its properties alter. Therefore, although one can trace the relationships from one to another, objects widely separated behave differently.

Æther and energy give rise to the electron, and the electron to the atom. When the atom becomes too large and unstable, the molecule is formed. Combinations occur between molecules by molecular affinities, *e.g.*

$$Na_2SO_4 + 10H_2O \rightleftharpoons Na_2SO_4 . 10H_2O.$$

Molecular combinations form colloids, which are unstable substances, resembling the instability of living organisms, and finally living cells are formed. Social organisation such as that of the hive bees may be the next step, when the individual has reached its highest possible development.

Sir Oliver Lodge agreed with Prof. Moore that new possibilities enter matter with increase in complexity, and that complexity and instability are necessary for life. He also stated that the synthesis of potentially living matter is not the same as the origin of life.

Prof. Armstrong stated that it is not possible to arrive at the production of life. He gave instances of several other ways in which formaldehyde can be synthesised in the laboratory. He did not consider that colloid was necessary for the synthesis. His opinion is that the asymmetry of the chemical composition of living organisms is the only difficult point to understand, but that once asymmetry has been produced, enzymes can direct the asymmetrical synthesis.

Dr. Hopkins, Prof. Leonard Hill, and Prof. Hartog criticised various points, and agreed with Prof. Armstrong and Sir Oliver Lodge in several of their statements.

Prof. Priestley gave several instances of synthesis of formaldehyde without colloids, but he claimed that colloids were important for energy changes in cells. Sugar can be produced by bubbling carbon dioxide through alkali in the light of a mercury lamp. He suggested that asymmetry might be produced by the action of polarised light which is found in the surface layers of the sea.

Prof. Rothera said that the discussion took two divisions: criticism of details and criticism of generalisations. He believed the sequence outlined in Prof. Moore's statement to be quite correct.

Prof. Moore, in replying, said that he did not claim

that the synthesis is new, but he knew that formaldehyde had been produced by ultra-violet light. Prof. Armstrong's examples were mainly reactions, which could be brought about by human agency in the laboratory, but that the conditions were unlikely to occur naturally at an early stage of the world's history. Because Prof. Armstrong has difficulty in understanding the production of asymmetry, this does not obscure the point that energy can be accumulated by synthesis without chlorophyll. The problem of asymmetry would *follow* the production of organic matter.

The new idea is not the synthesis but the point of view, and he considers that under the natural conditions synthesis would be aided by colloids even if the colloid were not absolutely necessary. In many cases, such as synthesis in presence of uranium, colloid would also be present.

Friday, September 12, was devoted to a joint sitting with the subsection of psychology, and the proceedings will be recorded in the report of that subsection.

On one of the reports there was a general discussion, in which Dr. A. D. Waller, F.R.S., Sir Frederic Hewitt, Prof. Gilbert Barling, Dr. McCardie, Mr. F. J. Pearse, Prof. Saundby, and Prof. Vernon Harcourt, F.R.S., took part. These speakers unanimously agreed that there should be some State regulation of anæsthesia.

The present position is that anyone can administer anæsthetics such as chloroform, ether, cocaine, &c., without any restriction. Sir Frederic Hewitt pointed out that a railway accident was followed by an inquiry, but there was no inquiry after a death from anæsthesia. Porters and cloak-room assistants do not drive engines, yet anyone can administer an anæsthetic to another person. The object of this discussion was to urge on the Government the necessity of regulating the administration of anæsthetics. Motions to this effect have been passed by the British Medical Association, the Medico-Legal Society, the International Congress of Medicine, &c.

Dr. Duffield explained the report on calorometric observations on man, by lantern slides illustrating the work done. The carbon dioxide output has been especially studied. During the early stages of work carbon dioxide accumulates in the body, and hence the output rises slowly. At the end of ten minutes the output becomes uniform, showing that the body is sufficiently saturated to give off the carbon dioxide as rapidly as it is formed. After the end of the work the excess of carbon dioxide must escape, and hence there is a slight continuation of the increased output.

Prof. E. Wace Carlier described the histological structure of the post-pericardial body of the skate. It is a small body the size of a grain of rice. The structure resembles that of the carotid gland in mammals, and he considers that it is a chromaffin gland.

Prof. Leonard Hill, F.R.S., gave two communications. The first was a demonstration of his katathermometer, which consists of two thermometers heated to about 120° F. The time necessary for them to cool from 110°–100° F. is recorded; one has a dry bulb and the other has a piece of moist cloth round the bulb. These give an indication of the physical condition of the air, and this physical condition is, in ordinary circumstances, of far greater importance to well being than the presence or absence of respiratory waste products.

His second communication (with Dr. McQueen) was on the pulse and resonance of the tissues. Where the arteries are superficial, the blood pressure, as measured by the sphygomanometer, is lower than where the arteries are surrounded by the tissues. The tissues resonate with the arterial pulsations, and thus the pressure appears higher.

Prof. A. B. Macallum, F.R.S., and Dr. J. B. Colip described the blackening of nerve cells, but not nerve fibres, with silver nitrate. The change is not due to chloride, phosphate, or protein. It is due to some reducing substance which they believe to be an oxyphenol allied to adrenaline. The medulla of the suprarenal bodies gives a similar reaction.

Dr. F. W. Mott, F.R.S., read a paper on the biochemistry of the neurone. He commenced by pointing out that the Nissl granules disappear from the nerve cells of animals fed on white bread and from cells of which the axons have been cut. These appearances can be seen only in fixed cells. Living cells suspended in lymph or cerebro-spinal fluid show no Nissl granules, but the contents appear like an emulsion. With dark ground illumination the emulsion particles appear luminous, but show no brownian movement. No particles are visible in the axon where it is surrounded by the mycelin sheath. Dilute ammonia causes the cells to become irregular, the particles to escape, and to show brownian movement. Acids and some dyes cause appearances like Nissl granules.

Cells placed in methylene blue stain but show no granules. If deprived of oxygen, the cells do not stain blue as the leuco base is formed. On allowing oxygen to enter the tube, the cells stain, showing that the leuco base had been absorbed by the cells.

Dr. J. Tait described experiments on blood coagulation, in which he observed agglutination of corpuscles to the edges of the wound in Gammarus and in tadpoles. Some crustacea have blood which does not coagulate, yet hæmorrhage is stopped as rapidly as in those whose blood does coagulate. It is difficult to understand the advantage of coagulable blood.

Dr. J. Tait and Miss Macnaughton demonstrated the advantages of the heart of the hedgehog for perfusion experiments. It can be removed and kept beating by perfusion with Ringer solution at any temperature between that of the body and ordinary room temperature.

Dr. J. Tait and Mr. R. J. S. McDowall: The muscles which extend from the skeleton to the skin of the back of hedgehogs will contract at temperatures from 0°–40° C., and they require no oxygen supply. A muscle placed in a narrow glass tube filled with Ringer's solution will remain active for hours even if repeatedly stimulated.

Dr. Dawson Turner read a paper describing the effect of treating exophthalmic goitre with radium. He found that the treatment was beneficial.

The following three papers are of cognate interest, and they are therefore described together.

Prof. Georges Dreyer and Dr. E. W. Ainley Walker read two papers on the relation of organs to the general body weight. The normal relation is important, as variations are of interest in studying abnormal conditions. These authors find that the relation of the blood volume to body weight is given by the formula: Blood volume $= \frac{(\text{body weight})^n}{K}$, where n and K are constants. For birds and mammals n is approximately 0·72, and for cold-blooded animals n is 1·3. Therefore, for the former, the determining factor is the body surface, and for the latter the weight of the muscles. Similar relations hold for the area of the aorta and of the trachea.

Altitude affects the blood volume by a variation in the constant K. On going to high altitudes the blood volume decreases and the hæmoglobin content increases, pointing to concentration by removal of water. The hæmoglobin is slightly increased after several

days, and the blood volume also slightly increases. On returning to lower levels the blood volume rises and the hæmoglobin percentage decreases, but neither returns to its original level until several days later.

Dr. H. E. Roaf found, when the weight of the kidneys is expressed by a similar formula, that n is approximately 1·5, and hence the body surface does not regulate the kidney weight. Possibly there is some reciprocal relation to the skin; or, like the blood volume of cold-blooded animals, the kidneys depend upon the mass of muscle in the body.

In concluding this account of the section of physiology, we feel that some reference should be made to a new feature. The section was strengthened by having associated with it the first subsection of psychology.

H. E. ROAF.

GEODETIC OBSERVATIONS AND THEIR VALUE.[1]

IT is not always the greatest inventions, or those which come most prominently before the public, which effect the greatest revolutions in the field of practical science; it is often the perfecting of instruments that have been long in use which is chiefly responsible for progressive results of startling significance. For instance, in the scientific researches of chemical investigators, or in matters relating to pathology and meteorology, it is seldom that a fresh discovery is due to the invention of a new instrument; it is almost invariably the development of the power of assisting observation already existing in the old instruments which has effected new discoveries. This is peculiarly the case with modern instruments used in connection with geodetic work. It is the perfection with which the metal arc can now be graduated with equal divisions representing degrees, minutes, and seconds which has so greatly altered the conditions under which geodetic triangulation can be extended. The improvements effected in base measuring apparatus is another factor in the rapid evolution of earth measurement and map-making all over the world; whilst the improved pendulum for the registration of the varying force of gravity, corresponding to the varying conditions of density which obtain in the earth's crust, renders investigations into the science of isostasy more simple and more certain than could possibly have been anticipated, say, fifty years ago.

These developments in the processes of advancing the practice of geodetic measurement over the surface of the earth are of more importance than is generally recognised, because the direct connection between geodesy and geography is not rightly understood. Geodesy is not a mere abstract science dealing with the shape or the earth and solving mathematical problems connected with its eccentricity, or determining the variable density of the earth's crust by careful investigations into the force and direction of gravity; it furnishes the basis and the framework of all that extension of earth measurement of which the final outcome is the map. Geodesy offers but little field for such form of illustration as will readily fix it in the minds of men as a sound practical everyday working science essentially necessary for the economic and political advancement of civilisation.

Geodesy began with the measurement of arcs on the earth's surface in various parts of the world by the process of extending a series of triangles along that arc from a measured base at one end of it. Rigorous accuracy was the dominant feature of such measurements. The measurement of a base a mile or so in length was effected formerly by means of "compensation bars" of a given length, which were designed with infinite care and armed with mechanism for longitudinal, vertical, and transverse adjustment, and it was a most elaborate and lengthy process. The process was repeated at intervals, if the triangulation series was a long one, in order to ensure results as near absolute accuracy in linear measurement as was possible. It took months to measure a base. Now it is found that by using a wire composed of "compensating" metals and stretched along a series of cradles or supports, the same result can be obtained in about one-tenth the time. The Jaderin apparatus, which includes a wire 25 metres in length, affords the simplest means of obtaining accurate base measurement; but there is still an appreciable defect, due to varying conditions of temperature, which renders it necessary to compare the wires before and after use with a standard measurement. The Eötvös torsion balance represents, perhaps, the latest improvement in apparatus for the measurement of base lines.

Independently of the base, however, the real secret of the facility with which strictly scientific geodetic triangulation can be carried over large areas of new country lies in the improvement in the art of graduating metal arcs, which has rendered the comparatively light and portable 12-in. theodolite equal for purposes of rigidly accurate observation to the old 2-ft. or 3-ft. instrument of the past. In India, where one of the first and most perfect systems of geodetic triangulation has been carried out, it used to be necessary to call quite a large number of carriers into the field to convey the clumsy old instruments from one observing point to the next. Paths had to be cut with much labour and patience through the jungle; roads had to be smoothed out and carried up the sides of the hills. The expense would have been prohibitive but that labour was cheap in those days. The time occupied over the process of completing observations, even at only one station, frequently lengthened out into months. Nowadays there is a new generation of scientific observers educated in English schools, who need lose no time in carrying first-class work through the wild tangle of African hills and forests to determine a boundary; or in threading their way with infinite patience by the rock-bound defiles and snowy heights of the Himalayas to a junction with Russian Surveys on the Pamirs.

It has always been the aspiration of English surveyors to link up the magnificent survey system of India with that of Russia. To a certain extent this was effected by methods which cannot be accepted as scientifically regular during the progress of the Pamir Boundary Commission in 1895. The surveyors did, however, actually close on a determined point common to both surveys (it was the first boundary pillar at the eastern end of Lake Victoria) after carrying an irregular triangulation across the great snowy ranges of the north-west, and the resulting agreement between the two values was almost too good to be altogether satisfactory. The means did not justify the end. It was impossible to ascend the gigantic peaks of the intervening ranges within the limits of the time available, and it was necessary, therefore, to be content with seeing across them here and there, under specially favourable conditions, instead of observing from them. Lately, however, a more regular and systematic attempt has been made to turn those ranges which cannot be crossed, and a direct series has actually been driven round these gigantic buttresses of the north on to the Pamirs. The results of this extraordinary feat are not yet published, but they furnish an example of what may be attempted in these days by the introduction of an improved class of comparatively small instruments.

[1] Abstract of an address delivered at the opening of the 160th session of the Royal Society of Arts on November 19, by the chairman of the council, Sir Thomas H. Holdich, K.C.M.G.