bridge being regarded with suspicion for many years.

Several suspension-bridges, built before 1836, are still in use. In all these the chains are of uniform strength throughout, and the whole weight of the bridge is suspended from them.

The flexibility of these bridges under heavy moving loads is a source of trouble, and of wear and tear of the platforms. Nevertheless, when the chains are pulled by the loads into a line of equilibrium, so long as the anchorages are secure and the towers are sound, the stability depends solely on the tensile strength of the chain, and under these conditions almost all suspension-bridges have a substantial margin of strength or stability.

One of the early suspension-bridges still in use is that across the Thames at Marlow, built by W. Tierney Clark, in 1829. I examined and reported on this bridge some years ago and found it in a remarkably good state. In the development of the stability of suspension-bridges this one is of particular interest, for it was the first built with stiffening girders. The ends of the cross girders in this bridge are all stiffly connected by parapets made in the form of girders, and any cross girders on which a heavy load might rest cannot deflect the suspension chain, as it would do if the parapet girders were not there.

In the modern suspension-bridge the stiffening girder is as important a feature as the chain or cable, and its introduction has made it possible to construct the gigantic bridges in the United States. The interaction of the stiffness or flexibility of the girder with the curvature of the suspension cable is the governing factor in the stability of the modern suspension-bridge.

The latest example of suspension-bridge with its span of 3,400 ft. and others of more than 1,500 ft. compare with Telford's of 570 ft. and the others of 50–200 ft. Cables composed of thousands of steel wires, four times as strong as iron, laid side by side to form cables 3 ft. in diameter, take the place of the iron chains ; and the flexible timber platform, so easily deformed by moderate moving loads, is now replaced by deep steel stiffening girders with upper and lower decks providing double tracks for both electric railways and street trams and road width for many cars.

[1] Paul Séjourné, "Grandes Voutes", 1913–1916.
[2] *Minutes of Proceedings Inst. C.E.*, **172**; 1907–8.
[3] *Engineering*, 1905, 1907. Also NATURE, Jan. 30, 1908.

International Physiological Congress

MEETING IN THE U.S.S.R.

THE fifteenth International Physiological Congress met, under the presidential direction of Prof. I. P. Pavlov, in Leningrad and Moscow on August 8–18. The gathering proved of unusual interest, especially from the social point of view. The members, numbering more than eight hundred foreigners and about five hundred Russians, were given an opportunity to see something of the mechanism of the communistic regime. The several receptions and banquets in the old royal palaces gave the members a glimpse of the almost oriental splendour which surrounded the ruling class under the Czars.

The Russian National Committee and the Soviet Government treated the Congress with unique hospitality. From the initial, informal reception in the magnificent Marble Hall of the Ethnographical Museum in Leningrad, to the final banquet in the Grand Palace of the Kremlin, and the aviation display on the outskirts of Moscow, the entertainments arranged for the Congress were consistently lavish.

The three plenary sessions, at which five scientific papers were read by well-known physiologists, were the outstanding occasions of the Congress. The first plenary session was opened by Prof. Pavlov, who gave the Congress a stirring welcome. The paper delivered at this time by Prof. Walter B. Cannon (Boston) was entitled "Some Implications of the Evidence for Chemical Transmission of Nerve Impulses". It constituted an outline of present knowledge in the field of neurohumours. Both the sympathetic nervous system and its chemical representative, adrenalin, act in a widespread manner. Acetylcholine is the chemical representative of the parasympathetic nervous system. Unlike adrenalin, acetylcholine is very unstable. Thus its action is limited to the region in which it is produced. The action of the parasympathetic nervous system is similarly localised.

The evidence for the existence of two adrenalin-like or adrenergic neurohumours was cited. These were named sympathin E (excitatory) and sympathin I (inhibitory). Langley suggested this concept in 1905. He further believed that the differentiation probably takes place in the effector cells, and this is to-day unrefuted but unproved. Possibly the sympathetic mediator, acetylcholine, has excitatory and inhibitory forms. At present,

however, this substance has never been obtained in a specific form. The action is always either excitatory or inhibitory, depending on the function of the parasympathetic nervous system in the organ involved.

The evidence for the chemical mediation of autonomic nerve impulses at the periphery is convincing in the cases of non-striated and cardiac muscle, digestive and sweat glands. There is certainly suggestive evidence for a chemical mediator, acetylcholine, of motor nerve impulses to striated muscle. The recent work on non-striated and cardiac muscle, showing spatial and temporal summation of nerve impulses, gives strong support for the theory of the quantal production of chemical mediator by each nerve impulse.

The evidence for chemical mediation between neurones is quite convincing in the case of sympathetic ganglia. Synaptic transmission in the central nervous system may be by neurohumours although the evidence for this is meagre as yet. Prof. Cannon ended by commenting on the fact that progress in this field is so rapid that his treatment of the subject was probably not strictly up-to-date.

The secondary plenary session opened with a paper by Prof. L. A. Orbeli (Leningrad) on "Pain and its Physiological Effects". A detailed account of the work of the British neurologist, Henry Head, on the problems of pain was given. Much of Head's work, performed in 1905, has been repeated and verified quite recently in the Soviet laboratories. Orbeli believes that he has shown that sympathetic nerve distribution is regional. Thus one nerve cell branches to give fibres to skin, muscles and internal organs of a given cross-section of the body. He believes that 'referred pain' operates through this sympathetic mechanism.

When a visceral organ is diseased, sympathetic impulses are set up which, travelling to the skin, alter the degree of excitability of the sensory endings there, giving hyperæsthesia or pain.

Sir Joseph Barcroft (Cambridge) presented, also at the second plenary session, a paper on "The Velocities of some Physiological Processes". Dealing chiefly with respiratory mechanisms, he pointed out the necessity of comparing the velocities of the chemical and the physical processes involved. In the ordinary loading and unloading of oxygen the chemical events take place so much more rapidly than the physical that only the rates of the latter need be considered. However, the chemical velocities assume special importance in some cases. Hæmoglobin takes several hundred times as long to part with carbon monoxide as with oxygen. This fact is of prime importance in the study of carbon monoxide poisoning.

Chemical velocities in respiration become specially important in muscles which act rhythmically over long periods of time. In these places oxygen transport from capillaries to tissue cells is accomplished by muscle hæmoglobin (myoglobin), and in some species by cytochrome. Myoglobin is six times as fast as hæmoglobin in its reactions with oxygen. Cytochrome is even faster. This velocity assumes real importance in certain cases, as in the hearts of small mammals and birds, where the heart rate may approach one thousand beats a minute.

The velocities of intracellular oxidations and the catalysts involved were discussed at some length. One molecule of oxygenase, probably the chief intracellular oxidative enzyme, can deal with one hundred thousand molecules of oxygen per second at 10° C. If the molecules are dealt with one after another, the interval between molecules will not be more than ten millionths of a second. Assuming an adequate concentration of the enzyme, this velocity would not constitute a limiting factor for even the fastest physiological process.

The velocity of the chemical process involved in the dissipation of carbon dioxide in the lungs is very slow. Between the breaking up of sodium bicarbonate in the body and the evolution of carbon dioxide there is the slow formation of carbon dioxide and water from unionised carbonic acid. Recently it has been shown that the latter process is speeded up by an enzyme, carbonic anhydrase, which is found in the red blood corpuscles. The bicarbonate obtains access to the enzyme through exchange with the chloride ions inside the corpuscles.

Sir Joseph Barcroft ended by pointing out an interesting discovery resulting from the study of chemical velocities. Consideration of the rate of evolution of carbon dioxide has led the Cambridge group of workers to the conclusion that 2–10 per cent of the carbon dioxide in the blood is present, not as bicarbonate, but in the more active carbamino form.

Prof. L. Lapicque (Paris) delivered the first paper of the third plenary session, held in Moscow, on "Some Recent Advances in the Knowledge of the Nervous Mechanism". The well-known concepts of chronaxie, isochronism and heterochronism were treated. New experimental material was brought forward in support of the speaker's disputed views on these subjects. Lapicque and his colleagues have found that muscles which work together have the same chronaxie; antagonistic groups have different chronaxies. He also finds changes in the chronaxie of peripheral nerves following central nervous activity. Indeed, when a conditioned reflex is elicited it is claimed that the peripheral portions of the pathway undergo a change in chronaxie due to the central activity.

The final paper of the third plenary session was given by Prof. A. A. Ukhtomsky (Leningrad) on "Physiological Lability and the Act of Inhibition". An account was given of the research work conducted in the Russian laboratories in an attempt to show the relation between chronaxie and what they term "functional lability". This "functional lability" is defined as the factor limiting the conduction of impulses in any excitable tissue. It determines whether a tissue is excited or inhibited by a stimulating agent. Both processes, they intimate, are active, and both must be initiated by stimulation.

The general meetings were divided into thirty sections according to subject, five sections usually operating at one time. At these meetings, 485 papers were presented. In the appended table the papers are grouped under twelve subject headings. This table gives some indication of the interests of physiologists in the countries represented at the Congress. The body of material presented was so large and varied, and the time so short, that many members found it difficult to glean much of value from these meetings. An attempt will probably be made, at the next Congress, to rectify this weakness in the programme arrangements.

CLASSIFICATION OF PAPERS PRESENTED TO "THE 15TH INTERNATIONAL PHYSIOLOGICAL CONGRESS"

Subject	Number of Papers Presented From U.S.S.R.	From other Countries
Applied Physiology (industrial)	8	4
Biochemistry	20	69
Circulation and Heart	4	19
Excretion	2	9
General and Cellular Physiology	24	51
Internal Secretion	8	25
Metabolism, Nutrition and Vitamins	4	28
Nervous System and Nerve-Muscle Physiology	65	59
Pharmacology	15	19
Physical Factors in Biology	5	8
Sense Organs	11	13
Sexual Cycle	4	11
Totals	170	315
Total Number of Papers	485	

The U.S.S.R. research centres provided a notable group of permanent demonstrations. In part, these served to show the type of experimental work in progress. The Soviet physiologists are chiefly occupied in researches on the nervous system with special reference to conditioned reflexes, researches in the industrial aspects of work, and researches into the special physiology of the woman and the child. The table summarising the types of papers presented at the general meetings gives further indication of the trend of physiological investigation in the U.S.S.R.

To a large extent, the aim of the permanent demonstrations was to show the expansion of scientific laboratories and personnel under the Soviet regime. This aspect was further stressed when the delegates were taken to visit the various laboratories. The expansion has been amazing. In the days before the revolution there were 24 institutions carrying on physiological research. To-day there are said to be 380 such institutions. The increase in personnel has been correspondingly great. Scientific people cannot but applaud the attitude of a State which so generously supports scientific endeavour. One wonders, however, if such expansion can be altogether sound. The All-Union Institute of Experimental Medicine (VIEM) had a staff of 393 in 1931 which has been increased to 2,200 for 1935 ; the increase in monetary grant has been commensurate. Expansion of this nature is to be found on all sides in the biological and medical sciences. It is a rate of expansion which would hopelessly overtax the highly developed educational facilities of either Great Britain or the United States of America. Just how well the less extensive Soviet educational system equips its scientific workers is a matter for conjecture. It is certain that the body of Soviet scientists know too little about what is going on outside the U.S.S.R. Practically none of them has studied abroad. Foreign scientific journals are scarce. Although the U.S.A. and the U.S.S.R. are comparable countries from the point of view of numbers of workers in biochemistry and physiology, the *Biochemical Journal* has 346 subscribers in the U.S.A. and only 46 in the U.S.S.R., the *Journal of Physiology* has 211 subscribers in the U.S.A. and only 26 in the U.S.S.R. The scarcity of periodicals in foreign languages other than English is apparently even more serious.

There is certainly no lack of interest in the work and opinions of foreign scientists. A well-known English monograph on a physiological subject was recently translated into Russian and printed by the Soviet authorities. Three thousand copies were sold in about a month, a remarkable sale for a scientific monograph in any language. The young Soviet scientist is enthusiastic and eager for knowledge. It is to be hoped that the international attitude shown by the Soviet Government in its treatment of, and its speeches to, the Congress will be extended to the training of its own scientists.

One of the most important features of the Congress was the report of the Permanent International Committee, delivered to the third plenary session in Moscow by its secretary, Prof. A. V. Hill. The Committee regretted the retirement of W. H. Howell (Baltimore) and J. E. Johansson (Stockholm). W. B. Cannon (Boston) and G. Liljestrand (Stockholm) were elected in their places. The other members are F. Bottazzi (Naples), O. Frank (Munich), A. V. Hill (London), L. Lapicque (Paris) and I. P. Pavlov (Leningrad).

The 1938 Congress was invited, by Prof. Hess and the Society of Swiss Physiologists, to meet in Zurich. This invitation, on the recommendation

of the Committee, was accepted by the Congress. Since 1938 is the Jubilee of the suggestion of the Physiological Society that an International Congress should be founded, and since the first Congress was held in Switzerland in 1889, the choice of Zurich is particularly suitable. The Committee, however, was sympathetic to the wish of the Hungarian Physiological Society that the Congress should meet some time in Hungary, possibly in 1941.

The International Committee suggested to the Swiss National Committee that applications for membership in the Congress be not accepted, except in special circumstances, from individuals, but only through national physiological organisations. It further advised the National Committee that, for the sake of economy, the programme, particularly in respect of entertainments, should be simplified.

The International Committee had the support of the Congress in recommending certain changes in programme arrangements. It advised that any registered member be entitled to submit a communication for printing, and that such communications should be circulated to all members some time before the Congress. Any member desiring to discuss any communication should then inform the officers of the Congress. The papers thus chosen for their general interest should be grouped, so that each meeting may form a co-ordinated discussion on a certain subject. There should be no actual presentation of individual papers.

At this third plenary session, the closing scientific meeting of the Congress, the International Committee expressed itself as deeply grateful to their Soviet colleagues for the welcome they had extended to the Congress. Prof. G. Barger (Edinburgh), speaking in eight languages, on behalf of members of the Congress, admirably expressed the general appreciation. D. Y. SOLANDT.

The Species Problem

KING CHARLES'S head was a less recrudescent topic than the species problem, which was recently the theme of the presidential address to the Zoological Section of the British Association, and the text of a symposium occupying most of a morning session. The reason for the perennial airing of the problem is not far to seek; for it is fundamental to all biological science. Taxonomy, begun in the good old days when species *were* species, has to adapt itself to the sliding scale of evolution; and phylogeny and genetics have to attempt to account for the phenomena that once made the Linnean system appear reasonable. Zoology has been driven by the concept of evolution into its proper role of a science that transcends mere description; while palæontology has developed beyond its erstwhile function as a handmaid of geology into an essential part of biological science.

In this inquiry, zoology, labouring under the disadvantage of its ephemeral scope, is concerned mainly with the causes of variation; while palæontology records the effects, as best it may, from fragmentary evidence in which causative processes are matters of inference or speculation. The two sciences have a common aim, but widely contrasted outlook and methods. In the past, they have too often followed their own devices, the zoologist looking askance at the imperfection of fossil evidence and the palæontologist deriding phylogenetic speculations hopelessly at variance with his small, but definite, knowledge.

The problem is summarised in the question: What is a species? All biologists are agreed that a species is an abstract conception; for in real life there is no fixity. If a species is to be adequately defined, the definition must include an account of its birth and breeding as well as of its present state. Hence the answer to the question can be found only in the solution of the wider mystery of the 'origin of species'.

Variability is an essential attribute of organisms, and sexual reproduction merely develops permutations and combinations of differences already present in the parents. If this be granted, the problem is reduced (but scarcely simplified) into that of the causes of variation. Here evidently is a question for the geneticist; although it is doubtful if his experiments, carried out under some measure of artificial control, can give a true picture of natural causes. Zoologists and palæontologists can record the cumulative effects of untrammelled variation, and the truth can perhaps be approached most nearly by deduction from their observations.

Variation may be traced in space and time. The occurrence of local races in geographically separate areas is analogous with the succession of changes which give to fossils their value as zonal indices. But whereas the area of any one type of environment is necessarily much less than the already limited area of the surface of the globe, the time during which such an environment may persist, in one part of the world or another,