normal manner under the conditions of the experiment before their production and, as will be shown later, the functional response to damage was that which is observed when the kidney is damaged *in vivo*.

In the discussion of our results we have called attention to the significance of the method for problems of normal cytology, as in the histological study of functioning mitochondria or in vital staining. To quote from our conclusions, "The tissues or organs thus studied are isolated from the complications of circulatory and nervous mechanisms, their environment is artificially and rigorously controlled and conditions are therefore analogous in a certain degree to those which obtain in the study of tissue culture." It is obvious, however, that such an application of Ludwig's method may eventually go a step beyond tissue culture, for not only can the reactions of cells and tissues be investigated thereby, but as our experiments with the kidney show, the pathological as well as the normal responses in both structure and function of entire organs can be examined.

The outcome of our experiments suggests that such an extension of Ludwig's method to anatomical investigation as we have employed may complement the method of tissue culture and perhaps aid, as Dr. Carrel hopes, in "a rejuvenation of Virchow's doctrine of cellular pathology."

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CHROMOSOMES OF PETUNIA

PRACTICALLY all papers dealing with *Petunia* which have been published during the last four years cite references to show that the typical number of chromosomes for this genus was first recorded in 1927. In the interest of bibliographical accuracy, may I call attention to an abstract[1] published in December, 1924, in which the following statement occurs—"The number of chromosomes is clearly seven and fourteen."

ALICE M. OTTLEY

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[1] Margaret C. Ferguson, "Preliminary Announcement of a Cytological and a Genetical Study of Petunia," *Anat. Abst.*, 28–29, No. 116, p. 137, 1924–1925.

NEWTON'S SAYING

IN the June 12 issue of SCIENCE, Dr. S. A. Mitchell quotes Newton as saying "I have been but as a child playing on the seashore; now finding some pebble rather more polished and now some shell more agreeably variegated than another, while the immense ocean of truth extended itself unexplained before me."

This saying is so important and so often quoted that I think it worth while giving the correct form, which is, "I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble, or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."

CHARLES HERRMAN

SOCIETIES AND ACADEMIES

THE SECOND INTERNATIONAL CONGRESS OF THE HISTORY OF SCIENCE AND TECHNOLOGY

LONDON, JUNE 29 TO JULY 4, 1931

THIS congress was the outcome of a movement started by the Comité International d'Histoire des Sciences, which was organized at Oslo in 1928 and which meets annually in Paris. This Comité secured the cooperation of its parent body, the Comité International des Sciences Historiques, the History of Science Society, and the Newcomen Society for the Study of the History of Engineering and Technology, and was generously assisted by the British Government, the Science Museum, the British Museum, the Royal Society and the Universities of Cambridge and Oxford. Official representatives were present from the universities of twenty-five countries, and numerous members from these universities and several others. The congress was held under the presidency of Dr. Charles Singer (London), the vice-presidents being Professor Gino Loria (Genoa) and Dr. George Sarton (Harvard). The following is the program of sessions and a summary of the papers.

INAUGURAL SESSION, MONDAY, JUNE 29

The congress was opened by an address by the Right Honorable H. B. Lees-Smith, M.P., president of the board of education, who expressed his belief that the greatest events in the history of the world had taken place in the realm of ideas, and particularly in the ideas developed in the minds of men of science and technology. The achievements of science and technology, he said, were now progressing with such rapidity that the mind has become dazed and has almost lost the capacity for surprise. He asserted that science and technology were immeasurably beneficent and at the same time completely merciless, furnishing the world with fearful instruments of destruction in war and with the means for saving the lives of the wounded. He raised the question whether the moral progress of mankind was keeping pace with the material development. If not, another great war like the last would see the end of western civilization.

In his presidential address Dr. Singer urged that the teaching of the history of science should replace the present history of conquest, asserting that the rise of science was the most important event in human history since the fall of the Roman Empire, and that text-books which did not say as much did not teach the truth. The critical years which saw the foundation of the Royal Society, the publication of Hooke's "Micrographia," Newton's work on prisms and his "Principia" were, he asserted, generally referred to in school histories only in connection with battles.

At the close of the Monday session the members were received for tea at the Science Museum by the president of the Board of Education and Mrs. Lees-Smith, and by Sir Henry Lyons (director of the Science Museum) and Lady Lyons. In the evening Dr. and Mrs. Singer gave a reception at the Royal Society of Medicine. This was followed by an interesting and informative address by Professor E. N. da C. Andrade, who impersonated in manner and dress Francis Hauksbee, F.R.S., who died in 1713 and was one of the pioneers in the study of electricity. The address was based upon one originally delivered by Hauksbee under the title, "A Discourse with Experiments on Various Subjects, Giving an Account of Several Surprising Phenomena, Touching Light and Electricity, with many other Remarkable Appearances Not Before Observed," and was illustrated by experiments made by him, in which use was made of the original air-pump which he constructed. In the course of the address Hauksbee's prognostication of the incandescent electric light appeared. Later in the evening there was an exhibit of material from Dr. R. C. Clay's collection of historical optical instruments and from Mr. G. H. Gabb's collection of Priestley relics.

On Tuesday two sessions were held at the Science Museum. The first was devoted to the topic, "The Sciences as an Integral Part of General Historical Study," with Professor Gino Loria (Genoa) as chairman, the opening address being delivered by Professor G. N. Clark (Oxford). The former gave a general summary of the situation, after which the latter, speaking as one concerned mainly with international relations, showed the necessity for studying the history of technology if the problems of war, industry and transportation were to be understood, and asserted that the fundamental principles of politics, philosophy and social organization could not be studied in isolation from those of science. Addresses in the form of discussion of the major topic were then delivered. Sir William C. D. Dampier-Whetham (Cambridge) divided history into four periods, (1) the picturesque (kings, battles), (2) legal and constitutional, (3) economic (the industrial revolution), and (4) that in which science stands supreme. Professor A. V. Hill (London) compared for importance certain military achievements with contemporary scientific discoveries, such as the year of the middle of the Thirty Years War (1628) with the publication of the small Latin treatise of seventy-two pages, by Harvey, on the circulation of the blood; and he asserted that the achievements of Darwin, Newton, Faraday, Maxwell and Rutherford had a more worthy claim in text-books for children than the events now chronicled. Professor A. M. Mosharrafa (Cairo) spoke of the four characteristic aspects of contemporary thought with respect to physical science—(1) the revolutionary aspect, (2) the tentative aspect, (3) the philosophic aspect, (4) the mystical aspect—and asserted that the method of science, in contrast with its outlook, has remained substantially unaltered. Dr. E. J. Holmyard (Clifton College, Bristol) called attention to the fact that the twelve large volumes of the "Cambridge Modern History" contain only fifty pages on the history of science.

The second session was devoted to the topic, "The Teaching of the History of Science," Dr. W. H. Welch (Johns Hopkins) acting as chairman. The opening address (in French) was delivered by Professor Aldo Mieli, permanent secretary of the Comité International d'Histoire des Sciences (Paris), who called attention to the fact that the educative value of the history of science in general culture has been recognized only recently, that the science of to-day is only an instantaneous photograph of a present in perpetual development, and that the history of the subject is bound to have a place in the regular courses in our schools. The discussion was opened by Professor A. E. Heath (University College, Swansea), who took for his thesis the statement that historical considerations gain in importance as science makes life more complex, and hence that the more the physical sciences gain in importance, the greater the need to see them in wider perspective. Professor A. Wolf (London) sketched the story of the introduction of the history of science into the curriculum in London and stated some of the problems involved. Professor David Eugene Smith (Columbia) spoke of the value of the history of mathematics in eliminating the obsolete and in selecting appropriate substitutes. He described the three-year course given by him prior to his retirement from active service. Professor Q. Vetter (Prague) described (in French) the teaching of science in Czecho-Slovakia, speaking of the steps taken in the reform of the schools under the new régime. Dr. F. H. Hayward (inspector, London) proposed the introduction of "Celebrations of Science" in the schools, the purpose being to keep specialists in science in contact with the vast and growing knowledge of other branches, and the general public in contact with the growth of science. Professor M. Stephanides (Athens) spoke (in French) on the history of the sciences in Greece, calling attention to the danger of its becoming merely archeologic in its nature. He described the general plan of his course. Mr. F. S. Marvin (Cairo) described three channels by which the history of science may profitably be taught—(1) by incorporating it in courses in general history; (2) by class and laboratory work in historic experiment and discovery, and (3) by special courses in the history of the sciences already studied—and spoke of the advantages and disadvantages of each. Mr. Thomas Greenwood (London, Birkbeck College) presented the claims of mathematics as a necessary constituent element of both philosophy and technology, stressing the demands of philosophy. M. Emile Meyerson spoke (in French) upon the efforts made in the past to consider the relation of science to history and urged the necessity of training teachers to meet the present needs.

Some interest was aroused in the Tuesday meeting by the request of the Soviet delegation that five of its members might be heard. Each delivered a prepared address and this, with various others of members of the delegation, was circulated in printed form to all present at the congress. The general nature of these addresses (eleven in number) may be inferred from the following quotations from one of those most forcefully presented, that of Professor M. Rubinstein (Moscow Institute of Economics):

> The relations between science, technology and economics under the conditions of capitalistic society and under the socialistic system that is being built up in the Soviet Union, are distinctly different and in many respects, diametrically opposite. The capitalistic system of production and social relations is antagonistic by its very nature. Along with its growth and development there goes on the development and growth of the profoundest intrinsic contradictions that are manifest in all branches of human existence without exception. . . . The social system for one sixth of the world has now become Socialism. And one can not understand anything about the future perspectives of science and technology as well as about the perspectives of their interdependence, without the study of the laws of development, of the struggle and growth of the new socialistic system of social relations.

That each of these papers was manifestly a contribution to Soviet propaganda of socialism, rather than to the history of science and technology, does not detract from their interest.

On Wednesday and Saturday there were no sessions of the congress, a large number of the members visiting Cambridge and Oxford, respectively, being entertained at luncheon and tea at various colleges. There was also an Independence Day Luncheon at University College, London, on July 4.

On Thursday the session was devoted to the "History and Contemporary Interrelationship of the Physical and Biological Sciences," under the chairmanship of Professor William Ritter (California). The opening addresses were delivered by Professor J. S. Haldane (Oxford), Dr. E. S. Russell (Board of Agriculture) and Dr. Joseph Needham (Cambridge). Professor Haldane expressed the view that in the study of each example of life we are confronted by experiences which can only be interpreted as the manifestation of a persistent and indivisible unity, recognized quite naturally and in common language as the life of the organism and the stock to which it belongs, and showing itself in endless coordinated details of form, environment and activity which express it. In physical science we are dealing with what we interpret as separable material parts and events; but in biological science we are dealing with what we can never interpret in this way, since the parts and events are manifestations of the coordinated whole which we call the life of the organism. When Galileo took the first definite steps towards a physical interpretation of our experience he entered upon what proved an extraordinarily fruitful path, but he made a mistake by assuming that his interpretation was "objective" or represented fundamental reality. It has been accepted generally by the scientific world up to the present time, but has made any satisfactory scientific treatment of biology impossible. Dr. Russell was also of the opinion that the influence of the physical sciences on biology has been, on the whole, unsatisfactory. The doctrine of Descartes, that animals may, and for the purpose of science should, be treated as automata, has prevented the development of a real science of animal behavior and hence of animal ecology. Dr. Needham joined in objecting to an interpretation of biology from the purely physical standpoint. Any such demand implies the physics of the future and not only the physics of to-day. The speaker adduced various illustrations to establish his thesis. All through the history of biology we see the pendulum swinging backwards and forwards between more or less crude mechanism and belief in physics, on the one hand, and more or less crude vitalism and the skepticism of physics, on the other. Dr. J. H. Woodger (London) stated that the attempts to understand relationships between physical and biological sciences have been vitiated by the long-drawn-out scandal of the metaphysical quarrels between mechanists and vitalists. He called attention to the method of procedure necessary to lead to safe conclusions, paying a tribute to the work of such scholars as Whitehead and Russell. Professor Lancelot Hogben (London) called attention to the fact that there was never a time when biologists were more confident of the usefulness of physico-chemical methods in arriving at conclusions as to the behavior of organisms, or when there was such wide-spread alarm at the philosophical consequences of admitting that this is the case. This contradiction is due in part to the ecclesiastical origins of Western culture and partly to contemporary social unrest. In our generation materialism has become the official creed of 150,000,000 people, but among men of science the mechanistic tradition is not at present fashionable in spite of its growing strength in laboratory practice. Mr. L. L. Whyte called attention to the new type of fundamental law established by recent atomic theory, particularly with respect to the quantum theory, which became estabilized in 1927 and has not seriously been modified in the last four years.

Professor L. G. M. Baas-Becking (Leiden) asserted that infinity and limitation in space and time, continuity and discontinuity, free will and predestination and the existence of God were kindred and basic antimonies which could perhaps be derived from one another, and that a synthetic solution for one might solve the whole.

The session on Friday was devoted to the topic "The Interdependence of Pure and Applied Science." the chairman being Sir Henry Lyons, director of the Science Museum. There were two opening addresses, the first by Sir W. Napier Shaw and the second by Professor William McDougall. The former considered the expansion of the Socratic distinction between pure and applied science to express the development of science in terms of (1) an observatory for the acquisition of experience, (2) a laboratory for the formation of ideals, (3) a library for the development of cooperation, and (4) an arena for exposition and discussion.

In the discussion, Professor Dannemann (Bonn) stated that a great part of the deliberations were concerned with the question of how natural or technical subjects may be connected with their history. He was convinced that the general synthesis or comprehension of the sciences and their connection with the history of civilization must be the work of one man, and such a work he has already planned. Professor C. H. Desch (Sheffield) deplored the fact that popular interest lay rather in the applications of science than in science itself. The continuity of scientific discovery is the important thing, for inventions are the result of long preparation in pure science. Professor F. G. Donnan (University of London) was of the same opinion and urged the encouragement of theoretical study in the field of industry. Mr. R. V. Vernon (Colonial Office) joined the preceding speakers in the hope that pure science might be encouraged without direct interest in its applications. In particular he expressed appreciation for the attitude shown in government service. Dr. G. Windred called attention to the many examples of the manner in which pure science has produced discoveries of great practical value in the field of electrical theory. Among others was the case of Oersted's observance (1820) of the magnetic effect of an electric current, followed by the work of Biot, Savart, Ampère and Maxwell. Mention was also made of the theoretical work of Kelvin, Maxwell, Chasles, Faraday, Stokes, Wilhelm Weber, Sir J. J. Thomson, Kennelly, Heaviside, H. von Helmholtz, and others. Dr. Marie C. Stopes (London) spoke upon the relation of pure science to the study of the coal situation. Dr. A. Joffe (Leningrad), one of the Soviet delegates whose papers were issued in pamphlet form, confined himself more closely to the scientific question than some of his colleagues had done and specified clearly eight problems "forgotten by physicists yet of importance to technique." Of these the first was "A reversible oxidization of coal" which, he stated, "could three or four times increase the energy available for technical purposes."

Abstracts of papers were also circulated, including one by Messrs. H. E. Stapleton and Hidayat Husain, "Report on the Mā al-Waraqi," an unpublished work of the tenth century on alchemy and its relation to later European treatises. Dr. S. V. Larkey (California) reported on his studies in the field of early English medicine and biology. A statement as to the project for the publication of Newton's correspondence was also circulated, suggesting that 1942, the tercentenary of the birth of Newton, would be an appropriate time for the work to appear. Circulars relating to the proposed scientific section of the Chicago Centennial Exhibition of 1933 were also distributed.

Mention should also be made of the exhibit in the British Museum relating to the First Century of Science in England (Bruno to Newton, 1584–1687). Printed works of twenty-eight scientists were shown. A special catalogue of the portraits of scientists in the National Portrait Gallery was also issued.

Numerous visits to places of interest in London were planned and several receptions were given, notably those at the Royal Society by the president, Sir Frederick Hopkins, and Lady Hopkins; at the Royal Institution by the president and managers; at the Institute of Historical Research, by the director and committee; at the Royal College of Physicians, by Lord Dawson, of Penn, and Lady Dawson, and the one by Dr. and Mrs. Singer, as already mentioned. On Friday evening a banquet was held at which various delegates spoke.

DAVID EUGENE SMITH

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A TRIPLE-SPECTRUM DISCHARGE TUBE

THE mercury-vapor lamp is probably the most generally useful light source for spectroscopic, optic and general instruction laboratories. Many times, however, the supply of lamps is not equal to the demand, and the availability of inexpensive substitutes is very desirable. For this reason the possibilities of the electrodeless discharge were investigated, and it was thought that the results obtained might be of general interest.

A pyrex glass tube A about 20 cm long and 4 cm in diameter was provided with a side tube B and a "sucked-in" thin glass end C.[1] Ten grams each of zinc, cadmium and mercury were placed in the tube. The tube was placed in an oven and baked at 450° C. for several hours, while the gases in the tube were removed by a mercury diffusion pump. During the baking-out process the mercury was kept in B, which was arranged to be out of the oven. Just before the tube was sealed off at D, the mercury was distilled from B to A.

The completed tube was mounted in an asbestos box equipped with two "Glo-coils" as shown in the figure.

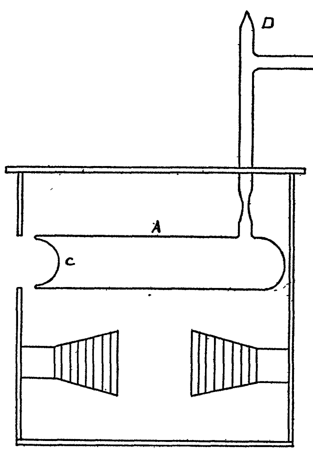

FIG. 1

A helix of 8 turns of No. 8 copper wire was placed around A. The helix was connected in series with a variable spark gap and the secondary of a 1 K.V.A. Thordarson transformer. Three Leyden jars were connected in parallel with the helix. The variable spark gap, which was enclosed in a sound-proof box, is essential to obtain a discharge which fills the entire tube. In order to prevent the mercury from depositing on C while the tube is in operation, the helix should extend well to the end of the tube. Best results are obtained if large-sized wire is used for all electrical connections.

Three quite distinct types of discharge may be obtained with this tube.

(1) If all the mercury is left in A and the tube slightly warmed, a discharge quite comparable in intensity to ordinary mercury arcs results. Mercury and zinc lines are prominent. In the present case the thin glass window transmitted with great intensity ultra-violet radiation to 2,536 Ang.

(2) By heating the tube strongly a large part of the mercury may be distilled to B and the discharge becomes bright green. In this case the visible spectrum consists largely of the strong mercury lines and the cadmium triplets.

(3) If practically all the mercury is distilled to B, the tube may be operated to give a very steady discharge even when cold. In this case mercury, zinc and cadmium lines are present. The cadmium red line—the international standard—appears quite strongly under these conditions.

The result is an inexpensive but brilliant light source which transmits the ultra-violet well and which produces lines extending well into the red—facts which make the tube desirable for spectroscopic calibration. The lines are very sharp, since the tube may be operated at low temperatures and the Doppler effect is small.

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[1] C. M. Slack, *J. O. S. A.*, 18, 123, 1929.

THE ADJUSTABLE DOUBLE SLIT

MR. R. WILLIAM SHAW recently (SCIENCE, Vol. 73, April 24, 1931) described an ingenious mechanism permitting the continuous variation of the distance between two optical slits. A more complicated apparatus with means for adjusting also the widths of the two slits was devised by L. E. Dodd and G. H. Jung. (J. O. S. A. and R. S. I., Vol. 15, p. 181, 1927.) Adjustable double slits have been used chiefly for laboratory repetition of Michelson's stellar interferometer experiment.

The special problem of the adjustable double slit is, as Shaw points out, that of keeping the varying space between the slits closed. Shaw accomplishes this by sliding between the slits a tapering brass plate; Dodd and Jung employ a rolling curtain, similar to a window shade.

A method used here with success may be worthy of record on account of its simplicity. Two thin, rectangular plates, which may be of either cardboard