of experience. Even quite recently the late Sir Oliver Heaviside, a most original mathematician, committed himself to the opinion that "within the last twenty-five years we have erred in attempting to lead the student to a working knowledge of the calculus by first convincing him that the reasoning is sound. It is quite possible that the fundamental principle of the calculus does not admit of deductive demonstration." I gained an added appreciation of the sage suggestion of the Autocrat at the Breakfast Table that a mathematical demonstration is often a *pons asinorum* over chasms which shrewd folk can bestride without the aid of such a structure. I also found this an advantageous starting point for an examination of the devices for bridging the chasm separating the quotient of increments from the quotient of differentials proposed by D'Alembert, La Grange and Weierstrass and his school.

These early experiences were brought back into the memory with vividness and force when, the other day, I stumbled upon an interesting passage in an article in the *Contemporary Review* for June, 1918. The author of the article is the Rev. Dr. D. S. Cairns, an eminent Scottish divine and professor of dogmatics in the United Free College, Aberdeen. Principal Lindsay, to whom reference is made, was for many years at the head of the United Free College, Glasgow. The quotation follows:

> The great and dramatic moments in the progress of science are when its pioneers, after long brooding over the data which set their problems for them, leap far ahead of all verified knowledge and divine the solution, when Newton goes "voyaging through strange seas of thought, alone," when Darwin sees his unifying truth in a south country lane, and Wallace, ill with fever in the southern island, is "stung by the splendour of a sudden thought." The story of the last century is full of such records, and it is not too much to say that the whole fabric of modern science and industry rests upon the truths discovered in such inspired moments. Let me add another not generally known to these histories. My friend and colleague, the late Principal Lindsay, once told me that Lord Kelvin told him that he never thought his way quite up to any one of his great discoveries. He said that he brooded over the facts, which set him his problem, until there came a moment when his mind made a mortal spring out beyond any thing that he, or any man, could demonstrate, and that he knew then in the very marrow of his mind that the solution lay in a certain fact or set of facts. He said further, and this, I think, is of peculiar interest, that he was never able himself to supply the intervening steps, and that before he announced his discoveries he always got Tait or Clerk Maxwell to work out these intervening steps for him. I repeated this story once to two or three distinguished biologists, one Scottish and the other Continental (both of them, by the way, Gifford Lecturers), and they said at once that that was how the great discoveries of science were always made, that the end was seen before the means.

EVAN THOMAS
UNIVERSITY OF VERMONT

ON "THE NEW CYTOLOGY"

IN the March 20th number of SCIENCE Dr. Alexis Carrel has summarized in a general statement of its problems the principles and methods of the new cytology. In particular he emphasizes the point that "structure and function are two aspects of the same thing" that "must be considered simultaneously." As methods to such an end he describes in some detail his use of tissue culture and also states: "There are two ways of preventing the death of tissues and organs removed from the organism. One was originated by Ludwig and the other by Harrison. Ludwig supplied the blood vessels of an excised organ with artificial circulation of a proper fluid." And after describing the difficulties of this technique, adds, "the old method of the physiologists of the nineteenth century is being rejuvenated, and may become one of the most useful tools of the new cytology."

The purpose of the present communication is to call attention to just such an application we have made of Ludwig's method to cytological problems. Our specific problem was that of experimental nephritis, and in its investigation the method of perfusion was applied to the frog's kidney. In the first article of two which will appear shortly in the *Journal of Experimental Medicine,* we describe the functional disturbances of the kidney lesions following the administration of renal poisons not, as is usually the case, to the living animal, but directly to the isolated organs by way of the modified Locke's solution with which they were perfused. In the second paper the structural changes in the perfused tissues are considered and, to quote from our conclusions, "the two aspects of damage (functional abnormalities and structural change) can be correlated to a reasonable degree."

The structural changes in these perfused kidneys were found to be identical with the anatomical lesions which follow the injection of the same poison into the living frog; in fact, an experimental nephritis was produced in the isolated organs. The finer cytological changes involving the nucleus, such as pyknosis, karyorhexis and karyolysis were observed as well as the protoplasmic changes which accompany cell death. Pathological alterations in the granular and mitochondrial elements of cells were particularly well reproduced in the isolated organ, as for example, "cloudy swelling," mitochondrial clumping and other elements of the classical picture of cell damage. Such changes can not be considered mere artifacts, due to the artificial character of the perfused tissue's environment, for the kidneys functioned in a perfectly

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."

JEAN OLIVER

LONG ISLAND COLLEGE OF MEDICINE,
BROOKLYN, N. Y.

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

WELLESLEY COLLEGE

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

[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.