in which would be regarded as recognised and qualifying service; in the case of trade or commercial instructors, five years of practical experience or not more than seven years in special cases; in any university or university college; in any school receiving grants provided by a Government Department; as a supplementary teacher in a public elementary school; in any school in any British Colony or Dependency or in India, aided or under regular inspection by the Government; in any foreign country where there exists an arrangement for the interchange of teachers made by the Board of Education.

The question of salaries for teachers of various grades in technical institutions had been carefully considered, and the following scale was submitted to, and approved by, the meeting, and ordered to be forwarded to local education authorities and the governing bodies of technical institutes for their consideration, namely: Principals in four grades of schools ranging from 1250*l.* down to 500*l.*, and rising by annual increments during five years to 1500*l.* and 750*l.*; heads of departments in three grades ranging from 600*l.* down to 400*l.*, and rising by annual increments during ten years to 900*l.* and 600*l.*; heads of junior technical and commercial schools to be classed as heads of departments; lecturers in three grades ranging from 400*l.* down to 250*l.*, and rising by annual increments during three years to 600*l.* and 400*l.* respectively.

In a paper by Mr. A. Mansbridge on "Technical Schools and their Part in Adult Education," it was urged that a great crusade against the unworthy use of leisure is a pressing need of the time. There can be no better way for the worker to tread in his off-hours than that which leads to the development of his interests or his skill. Technical training can, however, never flourish in a community which does not regard the matters with which it deals as of fundamental importance to the whole health of man. A nation which merely regards it as a means of outstripping others must always be content with superficial achievement. The education of a man lies deeper than the pursuit of knowledge or training. Some turn to the influencing or contemplation of the ideas and movements of men, others to the creation of material things, and each alike serves his generation if the direction be true. Mr. Mansbridge pleaded that the technical institutes should make provision for adult men and women to study in their leisure time the matters, technical or non-technical, in which they are interested, or rather for which they possess the necessary aptitude. He asked that serious attention should be given to the notable Report of the Committee on Adult Education issued in July last.

A paper was read on "Day Continuation Schools" by Mr. H. J. Taylor, of Dewsbury, in which he urged that a hearty response should be given to the invitation of Mr. Fisher to local education authorities to establish these schools voluntarily on the lines laid down by the Board of Education in its recent circular, namely, that such schools must give as great a measure of liberal education, both physical and mental, as opportunity and time afford. Mr. Taylor contended that the most effective way in which the conditions could be met was by arranging for a complete day each week for groups of boys and girls, and cited the efforts of the Dewsbury Education Committee and of the employers of the town (without reducing the wages of their employees) to establish such a school as illustrating its possibility.

A further paper was read by Dr. R. S. Clay, of the Northern Polytechnic, London, in which he advocated an ampler provision of scholarships throughout the whole sphere of education by the institution to each ten thousand of the population of six junior scholarships from elementary to secondary schools, six industrial scholarships, three intermediate scholarships to enable the recipients to continue their education at the secondary school until the age of eighteen or nineteen, one senior scholarship to the university or the technical institute, and one post-graduate or research exhibition tenable at the close of the graduate course.

Resolutions were adopted dealing with lengthened vacations, so that teachers of special subjects should have facilities for keeping in touch with industrial developments; maximum teaching hours for ordinary lecturers and heads of departments; the appointment of a consultative committee comprised of representatives of industry, and including representatives of universities and technical institutions, to advise the university and technological branches of the Board of Education on all matters affecting the relationship of university and higher technical education to industry; and, finally, the provision that should be made in the preparation of schemes required by the Education Act of 1918 for the continuation of study on the part of science teachers by means of suitable tutorial courses of science lectures and practical work, together with facilities to attend meetings of scientific and technical societies and to visit special educational centres and industrial works.

The Einstein Deflection of Light.

THE idea of detecting the Einstein deflection by measures of two neighbouring stars has occurred to many people, and Prof. C. V. Raman writes to suggest that the apparent distance of the two components of a binary star may be influenced by the effect. It seems, therefore, worth while to examine the conditions, and to try to discover whether any sensible effects are to be expected.

First, it is easy to show that where the linear distance between the two stars is small compared with their distance from the sun, then the angular shift of the further star, due to the Einstein effect, is diminished as seen from the sun in the approximate ratio: Distance between the stars/their distance from the sun. That is, it becomes absolutely evanescent, and the effect suggested by Prof. Raman is non-existent.

Secondly, let the two stars be at different distances from the sun; for simplicity, take the distance of the

FIG. 1.—To illustrate the production of an image of a distant star by the gravitational bending of its light by a nearer one.

nearer star as half that of the further; let their angular diameters be 0·002″ and 0·001″ respectively, and let the angular distance between them be 1″. Then the light from the further star passes the nearer star at a distance of 1000 of its radii. If the bending of a grazing ray be 2″, the bending in the actual case is 0·002″, and the apparent shift as seen from the sun 0·001″. It appears that in no case where the two star-discs are sufficiently far apart to be easily separable is the Einstein shift appreciable.

A second Einstein effect has been imagined, viz. the formation of an image of the distant star on the reverse side of the nearer one. From C, the centre of the latter, draw tangents CA, CB, and produce them backward to DE. Then DE is one-millionth of a second. Now it is only along the arc DE that the Einstein image is produced, and the radial diameter

of the image can easily be shown to be of the same order as DE; whence the angular area of the image is, say, one-millionth of the area of AB; and since no optical arrangement can increase the surface brilliancy of an image, the latter is fifteen magnitudes fainter than AB, and therefore utterly invisible.

It is only when two stars approach each other so closely that their discs are almost in contact that any sensible Einstein effect occurs; and since the two discs are in this case absolutely inseparable, the visible effect would be simply a slight brightening. In view of (1) the rarity of such close appulses, (2) the impossibility of predicting them, and (3) the transient nature of the brightening, which would last for only a few days, the prospect of detecting such a phenomenon is very small.

The outburst of novæ cannot be explained in this manner, as some have suggested, for it could not possibly produce a ten-thousandfold increase in light; moreover, the light-curve before and after maximum would be exactly symmetrical, which is assuredly not the case with novæ, the increase of light being much more rapid than the decline.

It is to be noted that even if some brightening were observed in an appulse, it would be impossible to say whether the light-bending followed the Newtonian or the Einstein law. A. C. D. CROMMELIN.

The New Zealand Institute.

THE publication of the fifty-first volume of the Transactions and Proceedings of the New Zealand Institute marks the commencement of a new epoch in the history of that very vigorous scientific organisation. The volume itself compares very favourably with those of past years, and its contents show that there is at least one part of the British Empire where pure science is being cultivated as strenuously as before the war. We are glad to see that the institute is receiving more support from the New Zealand Government, while the large membership of the nine constituent societies scattered throughout the Dominion clearly indicates the influence which it is exerting upon the New Zealand public.

The volume opens with obituary notices and portraits of three distinguished New Zealanders—Alexander Turnbull, who devoted his leisure to the collection of a magnificent library, bequeathed to the Dominion, including 32,000 bound volumes, dealing especially with the history of the Pacific Islands; Henry Suter, known throughout the scientific world as a distinguished student of conchology, and author of the "Manual of the New Zealand Mollusca"; and Thomas Adams, who did great work for his adopted country in the promotion of scientific arboriculture.

Of the numerous original memoirs which the volume contains, it is not too much to say that they embody a large amount of information of high scientific value, and if they relate almost exclusively to matters of local interest, dealing chiefly with the fauna, flora, and geology of the islands, this is only as it should be, for it is in these fields that the New Zealand man of science finds his magnificent opportunities. Where there is so much to choose from it is difficult to single out particular contributions for notice, but the attention of zoologists should be directed to the very interesting discovery of a second species of New Zealand frog, *Liopelma Hamiltoni*, found by Mr. Harold Hamilton on Stephen Island, in Cook Straits, and described (with excellent coloured illustrations) by Mr. A. R. McCulloch, of the Australian Museum. This species is closely related to the long-known but rare *Liopelma Hochstetteri* of the North Island, the only previously known New Zealand amphibian. In the botanical field Dr. J. E. Holloway continues his admirable studies on the genus Lycopodium, while geology is well represented by papers by Dr. P. Marshall, Mr. R. Speight, and others. In the department of geophysics Mr. A. W. Burrell contributes a very interesting account of a working model to demonstrate the manner in which ocean currents may be caused by the rotation of the earth.

In conclusion, we may note that the institute has decided to elect a body of fellows, limited to forty in number, who are to have the privilege of writing after their names the letters F.N.Z.Inst.—a distinction which we do not doubt will have a real value in the world of science.

The Geology of the West Indies.

EARLY in 1914 Dr. T. Wayland Vaughan, of the United States Geological Survey, paid an official visit to several of the smaller West Indian islands, partly with help from the Carnegie Institution of Washington. Besides studying the stratigraphical geology of the islands and making notes on their physiography, he also collected large series of fossils which were sent for detailed examination to Washington. He thus obtained material for a valuable contribution to our knowledge of the Tertiary sedimentary rocks which form the greater part of these islands, and made possible satisfactory comparisons with the corresponding geological formations of the southern United States. Dr. Vaughan has already published several preliminary notes on his results, and an especially important memoir on some fossil corals and the formation of coral-reefs. His final report, however, on the details of local geology and the general conclusions are deferred until all the fossils are examined and described. He has just edited a series of these descriptions, which has been published by the Carnegie Institution (Publication No. 291, 1919) in a small volume illustrated by beautiful photographic plates.

Calcareous algæ from the Eocene limestone of St. Bartholomew and from the Oligocene limestone of Antigua and Anguilla are described by Mr. Marshall A. Howe. Lithothamnium and related forms are well illustrated by enlarged sections. The Foraminifera are not only described with excellent figures by Mr. J. A. Cushman, but also discussed from the geological point of view. Some of the larger orbitoid species make correlations possible with corresponding rocks both in continental America and in Europe, while the small Miocene species allow very definite correlations with Panama and the coastal plain of the United States. The Bryozoa, described by Drs. F. Canu and R. S. Bassler, are of Upper Oligocene and Lower Miocene age, and notes are added on the distribution of those species which occur in other parts of the world. The Eocene and Oligocene mollusca, described by Mr. C. W. Cooke, are of great geological importance, and comparisons are facilitated by faunal lists. The account of the Decapod Crustacea, by Miss Mary J. Rathbun, is almost entirely new, only two species of one genus (Ranina) having previously been recorded from the Tertiary formations of the West Indies. A few genera are distinctively American, but some have close affinity with those at present living in the Indo-Pacific region.

We congratulate Dr. Wayland Vaughan and his colleagues on the thoroughness with which they are accomplishing their task, and we look forward to the publication of the concluding sections of this great contribution to the geology and palæontology of the Central American region.