

tems that are now and have been for ages, undergoing whirling impact. This has at last been confirmed by observation, in the double drift of two majestic streams of stars, described by Sir David Gill before the British Association.

It is only during the last few years that Bickerton's ideas, and even some of his phrases have been finding their way into astronomical works.

Newcomb, in "The Stars," 1902, gives a whole chapter to the structure of the universe and yet the most likely form, the spiral, he entirely omits to consider. But this idea appears without any reference to its originator in two or three books published last year.

In his "Astronomical Essays" Gore gives an entire chapter to "The New Cosmogony," by which he means the "Panetesimal Hypothesis" of Chamberlain and Moulton. The essential part of this theory is that suns and systems are evolved from spiral nebulae. A spiral nebula, he says, may possibly have been formed by the "grazing collision" of two solid masses, or by the near approach of two bright stars. Thus the importance of the spiral in stellar evolution is becoming recognised more and more.

In discussing any theory of cosmical evolution to-day the question naturally occurs to the mind: "How will it be affected by the acceptance of the electron theory, which is causing us to modify our ideas on so many fundamental points? Will the electron theory supersede the theory of impact?"

Probably quite the reverse. It will doubtless enlarge and extend it in some directions, but by directing attention to it, will be more likely to lead to its earlier recognition. The electron theory shows us that we have in the matter about us an epitome of the visible universe. A small portion of the atmosphere or of any comparatively rare gas, affords a model of our great galaxy, whilst a tiny solid organism may be a miniature copy of the great nebula in Andromeda, which is probably a universe much mightier and more wonderful than ours.

Modern researches are all tending to show the unity, infinity and immortality of the cosmos. Poincaré d'Albe in his delightful book, "Two New Worlds," gives very good reasons for such a belief.

In "The New Knowledge," published last year, Professor R. K. Duncan says: "The heavy elements of matter are undergoing a steady and inevitable decomposition with the continuous production of inter-elemental energy. Now, if the lighter elements were at the same time undergoing the reverse process, were, in fact, synthesizing themselves into the heavy elements with the absorption of energy so that as much energy was collected up by them in their growth as was 'wasted' by the decomposition of the heavy elements in their decay, the universe of matter would keep its available energy constant; it would constitute a conservative system, having neither beginning nor end." Thus we find in the infra world an exact parallel to selective molecular escape and the aggregating power of a high potential in ours, and the one leads to the permanence of matter as the other to the stability of the cosmos.

We have, then, in the impact theory as developed by Professor Bickerton a remarkably complete explanation of the manifold processes at work in the visible universe. During the thirty years it has been seeking recognition it has had none of its deductions contradicted. On the contrary, it has been able to predict the sequence of most complex phenomena many years before they were confirmed by observation. Surely such a theory is worthy of serious consideration. It is so fertile in suggesting new directions for research that had it been accepted as a working hypothesis a quarter of a century ago there can be no doubt that it would have proved a most important factor in accelerating astronomical progress.

## Another Appreciation.

C. W. Adams.

(To the Editor of PROGRESS)

Sir,—It is recorded of Sir Isaac Newton, that, when asked how it was that he had gained such a thorough knowledge of the law of gravitation, which binds the whole universe together, he replied: "By making it continually the subject of my thoughts." This is the method pursued by every true student of science, and there is no doubt that Professor Bickerton has made the "Evolution of the Cosmos" the subject of his thoughts for the last thirty years, during which period, in season and out of season, he has never ceased to proclaim his firm belief in the birth of new world from the collision of old ones. I have

read with very great pleasure, and increasing interest, the lucid articles from Professor Bickerton's pen, that have appeared in three successive issues of PROGRESS, during the months of April, May and June, in which he proves, step by step, that all the phenomena of a new star can be satisfactorily explained by his theory.

But "a prophet has no honour in his own country," and frequently not in his own lifetime, as it was in the case of Galileo, who was thrown into prison and otherwise persecuted, because he asserted that the earth moved round the sun, and not *vice versa*.

A few years ago I was reading up the subject of periodic and temporary stars in a standard work on astronomy, where it was stated that the observed phenomena had been explained by four different hypotheses which I need not give here, as the article concluded with the statement that not one of these hypotheses would satisfactorily account for the various changes that had been observed.

Now, Professor Bickerton's theory accounts in a most wonderful manner for every change that has been observed in temporary and variable stars; and not only that, but as long as a quarter of a century ago, he actually predicted what would be the successive changes observed in the appearance of a new star, and his predictions were verified in a most remarkable manner in the case of the two stars Nova Persei and Nova Aurigae.

For my own part I never accept the conclusions come to by some of the greatest thinkers of the present day, that the ultimate doom of the Sun, Moon and Stars, in fact, of the whole visible universe, was that they should "go out into blackness and darkness for ever." Surely the Creator of the universe, in His infinite wisdom, would not make a system that was hable to "run down" like a common clock.

It seems very strange that a theory that explains so many details of the evolution of the Cosmos (and in such a satisfactory manner), should not have met with a more ready acceptance from the scientific world; and the only reason I can assign for such a state of things, is the feeling of jealousy among professional men that a man who is not a professional astronomer should venture to criticise their writings, and strike out into an entirely new line of thought.

But this is not all that Professor Bickerton has to complain of. I have myself noticed in various magazines of late years, articles from different writers giving variations of Professor Bickerton's ideas on the subject, but putting them forward as their own. I had no doubt when I read them that they were inspired by Professor Bickerton's writings, and I notified him, through the post on each occasion, so that he might take the necessary steps to assert his claim as the original expounder of the ideas put forward.

It is the duty of every citizen of New Zealand to do his best to see that we render "honour to whom honour is due," and not leave the vindication of Professor Bickerton's claims to the next generation—I am, etc.,

C W ADAMS.

## Professor Bickerton in Reply.

(To the Editor, PROGRESS)

Sir,—I have to thank Dr Kennedy for taking the trouble of trying to understand impact. That so able an astronomer should have misunderstood so much, tells me that his assertion is right, that the theory is far from being as simple as I think it is. I suppose that it is a natural error that an originator should think his work simple; clearly it must be simple to himself, or it would not have occurred to him. I will try to make some of the ideas plainer, but many of Dr Kennedy's misconceptions are clearly due to oversights in his own reading. Thus of the spectra of temporary stars he says I only explain two, yet I fully explained the cause of the black line spectrum; the cause both of the broad blaze bands, and of their dark companions. I showed in detail why the black lines died out without lessening displacement, and why the blaze lines lasted months without lessening width, and the cause of the final planetary nebular spectrum. Dr. Kennedy suggests that shells expanding under pressure, would not continuously expand, but I show the expansion of the shells is due to atom sorting, not to pressure, and I showed clearly why the velocity will not appreciably diminish.

I did not explain why some of the bands had dark lines down their centre. This is a common peculiarity of spectra, and due to several causes. I did not explain it, as it is not especially characteristic of new stars. I, however, suggested a revolving molecular swarm. A bright nucleus shining through a revolving shell of vapour, would be one way in which such a result would be produced.

With this exception, so easily explained, there is no single case of the many sequences of spectra that Dr Kennedy refers to, but was actually described in detail in PROGRESS. For dynamical reasons they were placed in different articles, and this is probably the reason my critic has overlooked some of them.

Dr. Kennedy objects to the illustration of the term "Kinetol." From the definition he gives, it is clear he misses its meaning altogether. Had he read carefully, he could not possibly have called the exact illustrations I gave in PROGRESS "absurd." Energy is half the square of the velocity multiplied by the mass. Kinetol is half the square of the velocity—in other words, the energy of unit mass. The distance a body can travel against uniform gravitation is the kinetol; hence the examples I gave of doing work against gravity. Molecules of hydrogen and oxygen at the same temperature have equal energy, whilst the kinetol of hydrogen is sixteen times that of oxygen, that is to say, a hydrogen atom will travel sixteen times as far as oxygen against uniform gravity. A hydrogen atom, at the same temperature as an oxygen atom, although it has the same energy has four times the velocity, yet it has sixteen times the chance of escape, that is sixteen times the kinetol. Kinetol is a new dynamical term of supreme importance in simplifying problems of projectiles and in making molecular astro-physics plain. Kinetol explains the persistence of the speed of hydrogen in temporary stars, a continuity of uniform speed that is proved by the constant displacement of the black bands and the constant width of the blaze bands. Although this persistence was foretold thirty years ago, it has puzzled, and is still puzzling, other astronomers, besides Dr. Kennedy, perhaps more than any other discovery connected with temporary stars. For any given elementary gas, the kinetol is proportional to the temperature. In different gases at the same temperature, kinetol is inversely proportional to their atomic weight. At the same temperature hydrogen has about ten times the mean velocity of the other elements. In a small ratio third body, the hydrogen may have one hundred times as much kinetol as will cause it to escape, hence it will have a final kinetol of one ninety-ninth of the whole. Each atom will keep this permanently unless it loses it by doing some kind of work.

The whole theory of selective molecular escape, that is, of atom sorting, depends on kinetol. The time it takes to occur depends on the velocity, but the actual separation depends on the varied kinetol of the elements at the same temperature. Consequently, almost all the sequences of the varied phenomena of the spectra of new stars, being phases of atom sorting, depend on kinetol. The actual displacements and widths of the bands depend on velocity, but the primary cause is the unequal distribution of energy between equal masses of different elements. In other words, on the different energies of unit masses, that is, on the kinetol.

With regard to the different widths of the bands, due to different elements referred to by Dr Kennedy, photographs show that the different widths of the band actually are in the spectra. What elements they belong to, I do not know. I have sent scores of letters, asking people, but I do not get answers. I suppose my communications do not appear simple to them, and as they come from a "nobody" they go into the waste paper basket. I believe the respect Dr Kennedy's good work has gained for him in the astronomical world would enable him to get the lines identified. Of course, if as Loekyer thinks, calcium and other elements break up at stellar temperature, then these "proto" elements will have higher kinetol than those calculated from our present idea of indivisible atoms. That is where a correct theory comes in. It correlates knowledge. As Sir David Gill suggests, astronomers will give such information about molecules to physicists when once the spectra of new stars is read aright, as to over-repay the debt we now owe them. We can deduce the kinetol from the speed identified by the width of band. From that deduce the atomic weight of the "proto" elements.

Is it possible that this tremendous pressure of hundreds of millions of atmospheres and temperatures of many scores of millions of degrees may cause the elements of small atomic weight to absorb energy, and be locked into "proto" elements, which, as the temperature cools, become the elements themselves? It would be a wonderful correlation if it were so.

Besides these points discussed, Dr. Kennedy says, that before I can consider the theory demonstrated, there are many things I must explain. I have read everything I can find about new stars, yet there is absolutely no point that I know of that the theory is not competent to explain.—Yours, etc.,

A. H. BICKERTON.

Wainoni Park, Christchurch.