thus obtained exceeds by 0·33″ the value generally adopted for eclipses, while the moon's semi-diameter is a very little less than the mean of the two values adopted in the calculations of the *Connaissance des Temps*. The discussion also shows that the first exterior contact was in the mean observed six seconds too late, and the last three seconds too early, while the observations of the interior contacts were not affected by any such systematic error.

Details of the calculations will be published later in a memoir.

THE SPECTRUM OF NOVA GEMINORUM NO. 2.—The spectrum of Nova Geminorum No. 2 is the subject of a long communication by Prof. F. Küstner in *Astronomische Nachrichten*, No. 4654. Some time ago Dr. Giebeler, his assistant, published the results of a series of measures he made (*Astronomische Nachrichten*, No. 4582) of the fine sharp absorption lines in the nova spectrum, concluding that they gave an indication of the presence of radio-active elements. This paper contains an investigation by Prof. Küstner of the same and other negatives taken at Bonn of the nova, and the measures he secured and those of Dr. Giebeler are given together. The subject is discussed in considerable detail, and we can only here direct attention to the conclusions to which he has arrived with regard to the origins of 241 lines which are contained in his list. Thus he concludes that there is good evidence for the presence of uranium, titanium, and blue argon—that radium, manganese, and zirconium may be present, but that there is no evidence of the emanation, iron or vanadium. As regards calcium, helium, and magnesium he finds that certainly absorption lines observed corresponded to calcium H and K, probably also *g*, fairly certain He 4471·66, and questionable Mg 4481·34. It may be added that the wave-lengths of the enhanced lines of Lockyer were included in the investigation, and that little evidence was found for lines to be assigned to their origin; thus he rules out the presence of enhanced iron, titanium, and manganese. This paper should be read in connection with that recently published in the Monthly Notices of the R.A.S. by Prof. Newall and Mr. Stratton, who corroborate in the main the enhanced-line spectrum of the nova as first put forward by Sir Norman Lockyer in the case of Nova Persei.

SCIENCE, POLITICS, AND PROGRESS.

WE gave last week an account of the annual meeting of the British Science Guild and a summary of the report adopted at the meeting. We are glad to be able to supplement that article with abridged reports of the speech delivered by Lord Sydenham in proposing "that the best thanks of the British Science Guild be tendered to Viscount Haldane for his services as president since its foundation, and that Sir William Mather be elected to succeed him," and the reply made by Sir William Mather.

By the retirement of Lord Haldane, remarked Lord Sydenham, the guild was about to sustain a very severe loss, for in Lord Haldane they found a great leader and an inspiring power which had been of the utmost value in promoting the progress of the guild. It might be that there was a certain incompatibility between science and politics which the guild must strive in time to remove; or possibly science had not yet been brought to bear upon the delicate process of Cabinet making as it certainly should be. At least the spectacle of a Minister of the Crown who was a whole-hearted believer in the benefits of science and who could proclaim those benefits with knowledge and experience was a rare, if not a unique, phenomenon in this country. In Lord Haldane they had had an educationist who had long ago realised what technical education had done for other countries, and realised the deficiencies of the British Empire and had striven to remove them. And now the pleasant duty had been imposed upon him of proposing the election of his old friend Sir William Mather as their second president. The career of Sir William had been spent in the successful application of science to industry, and not only to processes and machines, but to men. It was in Sir William's great firm that the standard of forty-eight hours a week labour had long been adopted, and it was not an accident that for fifty years no strike had occurred in his business. As a member of Parliament, he was a persistent and consistent advocate of technical education. The guild has before it important national work. He (the speaker) felt confident that in Sir William they would have a most worthy successor to Lord Haldane.

Sir William Mather said he felt the deepest gratitude to the members of the guild for having so cordially elected him as their new president, but when he was first appealed to by Sir Norman Lockyer to take office he had some reluctance in assenting. He, however, had a great interest in the movement, for the British Science Guild claimed to teach the vital importance of using scientific methods in the common things of life. Those of them who were engaged in applying the fruits of scientific research and discovery furnished by the brilliant students of natural science realised the immeasurable debt the country owed to those who, in the long and patient work of laboratory experiment and the solitude of study, revealed the secrets of nature, and declared the scientific laws by which they might be adapted to the uses of man. The producers and manufacturers of the things that were used and consumed by the human race, and were necessary to its higher progress and happiness, had neither the time nor the requisite training to seek in the hidden treasure-house of nature for the sources of higher development. This was the work of the scientific explorer, and the guild embraced men who felt it to be a patriotic duty to encourage both the scientific explorer and the practical expert in the promotion of national prosperity and continual progress. They were beginning to realise in the twentieth century that there were latent forces in human beings as well as in nature that need to be exploited whereby their national welfare might be enhanced. The evils they deplored, the misery and suffering they saw among their fellow-creatures, were all preventable, and education in this matter became the most important thing in the world.

The British Science Guild had made education one of the chief objects of its study in relation to the training of children in their earliest years before the rational faculty became active, and this propaganda would be continued, for by this means only could the nation rise to higher achievements in removing the causes of poverty, misery, and disease, which affected the national progress, notwithstanding the wealth, power, and industrial prosperity which scientific discoveries had yielded to those who had been able to use them. It was not incompatible with individual ambition in the acquisition of wealth and power that the chief aim of the nation should be to encourage and support other means of adding to the contentment and welfare of the whole people. One of the most retrogressive conditions of present-day life in England was the recurring and increasing outbursts of passionate discontent amongst the working classes resulting in incalculable economic loss from strikes and lock-outs, and the deplorable absence of good feeling, sympathetic interest, and even patriotic effort between

employer and employee. But did anyone consider that this was a normal or inevitable condition of things? Surely not. It was the result of human forces ignorantly applied and producing woe where the common weal should prevail. Both parties in the struggle usually displayed an equal amount of ignorance, but with a truly educated people all industrial progress should be admittedly dependent on the perfect accord between capital and labour in the pursuit of an end mutually advantageous. The lamentable condition of things had been of late the subject of Parliamentary and Government concern. Admirable means, including the recommendation of the principle of the minimum wage, had been devised and must be continued, but meanwhile the whole nation was being kept in a condition of inefficiency compared with what they knew would be possible were the whole industrial population of employers and employed working together in perfect accord and with the common aim of producing the most perfect products at the minimum of cost and maximum of benefit to both labour and capital. Such accord would, he believed, be found to lie in some system of profit-sharing between employer and employed, which if scientifically applied would most certainly lead to increased efficiency and contentment.

He submitted, therefore, that it would be a proper function of the British Science Guild to study and, if possible, to initiate by some considered recommendations a new order of industrial organisation, based on scientific principles of management, in which full justice would be done to all the interests involved in developing to a condition of maximum efficiency the great resources of the nation.

At the banquet of the British Science Guild, held on Monday, May 26, the following speech was delivered by Sir David Gill, K.C.B., in proposing the toast of the guild:—

I have been asked to propose the toast of the British Science Guild—and I rise to do so with much pleasure, because I feel and know that the objects for which it was founded are most worthy, and because in many directions the guild is doing good and useful work.

The aims and objects of the guild may be summarised in a few words, viz. to bring science and scientific habits of thought to bear upon the problems of everyday life and administration. The guild has no politics in the ordinary sense of the word. It belongs to no political party—its object is to help any party, be it Radical or Conservative, or any department of State, any Parliamentary Committee or individual administration with advice or assistance based on scientific knowledge.

It is sad to think how very few of our leading politicians—how very few, indeed, of our members of Parliament—have any serious knowledge of science; and yet it is upon science, and largely upon science alone, that the whole progress of our modern civilisation depends. I would be the last man in the world to deny the advantages of culture as it was understood 100 years ago. I mean the civilising, the refining, and the elevating influence of literature, art, and philosophy, apart from modern science based on experiment and observation. But it is not by progress in the older directions that we have to look chiefly for the modern betterment of mankind—the betterment of the health, the comfort, the safety, and the convenience of the great body of our fellow-citizens. We must go back to the days of Greece for the sculptures that in the present day we strive to emulate; and the like is true of the architecture of Greece and of our early cathedral builders. We have to go back to Giotte for reverence in painting, to Holbein, Titian, Giorgioni, Rembrandt, and Velasquez for other qualities in art that we cannot equal in the present day. In literature it is the same story—Homer, Virgil, Shakespeare, Dante, and Milton are not of our day, nor have we since seen their like. In philosophy I doubt if we have made much real advance since the days of Plato.

But in science what has not the progress been in recent days? That is a story known to you all, and I need scarcely dwell upon it. Tycho Brahe, Kepler, and Newton have laid the foundation of the fair superstructure of modern dynamical astronomy; and Stokes, Kirchoff, and Bunsen have laid on a no less sure foundation our present-day knowledge of the chemistry of suns and worlds other than our own. Chemistry and physics have advanced with giant strides within the last century, and in the present day we see the dawn of a knowledge of the constitution of the atom.

The invention of the steam engine is, by comparison with the fullness of art in the days of Greece, a thing of yesterday, and so practically is the scientific coordination of the laws of heat and electricity, the invention of the dynamo, and the transformation of energy into light and heat and *vice versâ*. The mythical æther is used to convey our wireless messages around the world, and we can travel on sea and land with a rapidity, comfort, and luxury almost undreamt of by men of only fifty years ago. We can travel, if we so desire, under the sea or over the sea, or we can fly in the air.

Medical science has made marvellous strides. Pain and suffering have been diminished and life has been prolonged. All these are steps in the progress of mankind, in the betterment of the conditions of life, which we owe to science and to science alone. I am aware that there is still a school of men who contend that we are no happier or better for this progress. I need scarcely say that I do not agree with them, but I do not propose to bore you with arguments on so trite a subject; the simple fact remains that if we, in these little islands of ours, do not progress with the times by the aid of science and the cultivation of our manhood, we shall be left behind in the race of progress—a strong man armed will come upon us and our inheritance will another take.

That is absolutely certain; so that whether the men of old were wiser and happier without science is not a question that requires discussion. The simple alternative is whether, in face of the competition of other nations, we of this presently great Empire are to be content to give up our place and power, or whether by the successful cultivation of our manhood and our science, we shall keep our place among the nations. Since science is so important to our existence as a nation, is it not strange that amongst our leading legislators there are so few who have any reasonable acquaintance with science?

I do not speak so much of the ordinary member of Parliament—he, poor man, in the present day, has got very little to do with the government of the country. He may have his convictions, he may have devoted time and knowledge and thought to the preparation of a useful Bill—but the chance of getting it even discussed by the House of Commons is small indeed; he may be thankful if he is not compelled by the crack of the party whip to vote for something that is in total opposition to the principles of his own Bill.

The real government of the country lies thus in the hands of a comparatively small number of men, and too often of men who have been selected for fluency of speech, readiness in debate, and a certain personal magnetism that appeals to the masses, rather than for the qualities of the highest statesmanship and sound scientific knowledge. The politician as a rule has had an eye to politics from an early age, and his reading has gone in the direction of history and

political economy, generally to the entire neglect of the more exact departments of science, and, above all, he prefers votes to history, political economy, science, or anything else. The instincts of the man of exact science are indeed opposed to those of the normal party politician. The man of science must be very sure of his grounds before he makes a statement, and must rigidly compare all existing facts with any theory before he declares the probability, or his personal conviction, of its truth. Above all, he must be careful to avoid the influence of preconceived views of his own or the views of his friends before he draws his inferences from observed facts. Where would the party politician be if he based his action on such grounds? He would soon be hounded out of his party, or reduced to slavish submission by the party whip.

So long as we have party government I fear there is no escape from the predicament. The object of the Science Guild is to provide some partial remedy at least for this undesirable state of affairs.

When Ministers have on any particular subject recognised the need of scientific advice they always have the Royal Society to which they may apply, and from that society they can always obtain sound advice on any subject that involves exact science. But it needs some scientific knowledge to know when sound scientific advice is required; and too often Governments do not know when they should ask for such advice, or they may know enough to realise that acceptance of the advice they require might involve expenditure that would not purchase votes or might lead to action that would be unpopular with some of their constituents.

Now it is here that a body like the Science Guild may rightly and does most rightly and properly come in. Unlike the Royal Society, it does not wait to be consulted. As a non-political body, it desires no party advantage from its action. Therefore when a Bill is in course of preparation or discussion in which it is clear that scientific advice has been neglected or not demanded, the Science Guild refers the matter to a competent committee of its own, and tenders advice without solicitation. It does not stump the country to proclaim its views; it leaves to the Government or the member who fathers the Bill the responsibility of adoption or non-adoption of its advice; it leaves to others to use any further pressure that may be required, based upon the views of the Science Guild.

Our guild is yet young, and it takes time before the elector at large can realise the due weight of its views. But no one can question the competence of its committees; the men who compose them are well known for their scientific standing and sound practical common sense; and, as time goes on, Governments will more and more find the importance of listening to the advice so tendered. No man was more sensible of this than was Lord Haldane, who has been our president since the formation of the guild nearly seven years ago. It is with much regret we learn that the pressing duties of his high office have compelled Lord Haldane to resign the presidency of the guild. We are most grateful to him for the services he has rendered, and for the recognition he has given to the value of the work aimed at and done by the guild.

We all, I am sure, are gratified to know that the Rt. Hon. Sir William Mather has consented to fill the chair vacated by Lord Haldane's retirement. He, as we all know, has taken a prominent part in the promotion of technical education throughout the country. He has been an able and active member of the guild, and we all have confidence that in his hands and under his inspiring influence the work of the Science Guild will grow and flourish.

JOINT MEETING OF BRITISH AND FRENCH ELECTRICAL ENGINEERS.

DURING the joint meeting of the British and French Electrical Engineering Institutions, held in Paris on May 21–24, a wide range of subjects was discussed. The greater part of the time was devoted to electric railway traction. The electrical equipment of purely urban and suburban railways has already become almost a mere question of economics and technical detail; the broader engineering and scientific problems are solved. So far, however, the replacement of the steam train by the electric train on main lines has only been limited, and this is a work for which the electrical engineer is making ready. Its consideration cannot be deferred until the improvements in the economy of generating and distributing electrical energy, and converting it into mechanical energy on the train, are such that there can be no other reasonable method than to burn the coal at the pit's mouth instead of the locomotive furnace; for in the meantime the "electrification" of suburban lines must continue, and the railway engineers naturally desire to equip their lines on some system which will lend itself to main line traffic as well as suburban, without extensive alterations being necessary when the second part of the problem is taken in hand. For this reason, the presentation and discussion of six papers on electric railways by French electrical engineers of high repute was particularly well timed.

The chief reason for different methods in dealing with urban railways pure and simple and main line railways may be summed up in two words, viz. distance and locomotives. On an urban or suburban line, the energy required is spread over a comparatively small geographical area; while on a main line the energy has to be transmitted over a considerable distance. Again, the traffic on an urban or suburban line is mainly passenger traffic, while a large proportion of the traffic on a main line is for the conveyance of goods.

In the majority of suburban lines a comparatively low electrical pressure (500 or 600 volts) is carried on the conductor along the track; this means a proportionately large current is required, but the voltage-drop and loss of energy which this entails are not serious on account of the small distance between the power station or substation and the train. Partly to facilitate the conveyance of this high current from the conductor rail to the train, and partly to enable trains to be conveniently subdivisible into lengths corresponding with the density of traffic at various periods of the day, the "multiple-unit" system is employed, in which there are two or more motor-coaches on each train, each taking current from the "live" rail conductor, but all controlled from the cab of the front motor-coach.

On long main lines, on the other hand, it is obviously more economical to transmit the energy to the train in the form of a higher potential and lower current, and this is the more desirable owing to the necessity of using locomotives, at all events for the goods traffic, which entail transmission of the whole of the current to the train at one point or one set of contacts with the live conductor. Therefore, other things being equal, a high-pressure single-phase current, as is being used on the London, Brighton and South Coast Railway, and also to some extent on the Midland Railway, and on several American and German lines, is indicated as the solution to the problem so far as main line traffic only is concerned; it is easy to generate and transmit, and requires only one live conductor, which is overhead. On the other hand, the overhead work introduces complications and expense for suburban traffic in which there are many