the grass was literally burnt off the earth, and the mortality among stock was great. The railway trains carried supplies of water from lakes and rivers to all stricken points along the lines, selling it at the rate of twenty-five cents a thousand gallons. The water supply of many towns entirely failed, the inconvenience experienced was acute everywhere, and many agriculturists were ruined.

"All through our own South the drought has been remarkable in its length, and some odd situations have occurred. In Kentucky the beds of many streams that have never before been dry are now full of dust, the mud having become baked hard, and then broken by the wind. At Uniontown, Kentucky, the Ohio was so low that an old coal vein under the river-bed was worked, and thousands of bushels of coal were taken out. In many places along the Ohio, Mississippi, and other streams, old wrecks have been uncovered by the lowering of the water, and the residents along the banks have recovered lots of more or less valuable cargo and junk. At Milton, Kentucky, there is a large sandbar on which many a barge of coal has struck and foundered. This bar was entirely uncovered recently, and the people living near by went to work with ordinary field ploughs and turned up tons of coal. In Maine and other eastern States the drought has been severe. The ice crop promises to be short, because lots of lands have gone almost dry, and there is no water to freeze. These general conditions have existed all over the continent, and in the north-west the situation is as bad as in the east and south."

The Pressure of a Saturated Vapour as an Explicit Function of the Temperature.

IN NATURE (October 24), Mr. Donnan observed that the "Law of Diameters" in combination with any equation of state, such as Van der Waal's, which applies to the region of coexistence of liquid and vapour, supplies an (empirical) expression for the maximum pressure of a vapour at any temperature T in the form of an explicit function of this temperature and known constants.

Led by the same thought, I have found the equation for the vapour tension.

The "Law of Diameters," in combination with the law of Maxwell-Clausius and the equations:

$$\zeta_1 + \zeta_2 + \zeta' = 3\zeta_\kappa$$
$$\zeta_1\zeta_2\zeta' = \frac{p}{ac}$$

{ζ_1 = density of the liquid, ζ_2 = density of vapour, ζ' = density lying between ζ_1 and ζ_2 (labile state)}

gives me

$$p = \mu\frac{(T - T_0)^3\left(\frac{T_\kappa}{T_0} - \frac{T_0}{T_\kappa}\right)}{3\frac{T_\kappa}{T_0} - 4\frac{T_0}{T}}$$

{T_0 = temperature, at which the tension of vapour is nil.}
T_κ = critical temperature.

The method of Mr. Donnan gives:

$$p = 3p_\kappa e^{1 - \frac{T}{T_\kappa}\left\{\frac{24}{27}\frac{T - T_0}{3T_\kappa - 2T_0 - T} - \frac{(T - T_0)^2}{(T_\kappa - T_0)^2}\right\}}.$$

If the "Law of Diameters" were consistent with the equation of state, the formulæ would be the same. G. BAKKER.

Schiedam, Holland, October.

Metallic Resistance and Radiation.

A RESULT published by Dr. Aschkinass, to the effect that the electrical resistance of thin metallic sheets like tinfoil is affected by the impact of radiation (electric waves), is often quoted; but, so far as I know, it has not been confirmed. My own experience tends to disprove it; but if any one has succeeded in confirming it, perhaps they would give us the benefit of the information. It is easy, of course, to get spurious effects with bad joints, in accordance with the discovery of Branly; and I see in your "Notes" (p. 60) to-day, that a Japanese experimenter, Mr. Mizuno, is of the same opinion.

November 22. OLIVER J. LODGE.

"L'Arithmétique Amusante."

IN the review of the above book (NATURE, November 7), mention is made of the curious fact that $8 \times 123456789 + 9 = 987654321$. It may be of interest to point out that this is not an isolated numerical curiosity, but is, I find, one of a group of similar curiosities which are included in the following easily proved theorem.

If the number formed by writing down in ascending order beginning with unity the first n digits of any scale whose radix is r be multiplied by $r - 2$, and n be added to the product, the result is equal to the number formed by writing down in descending order the last n digits of the scale beginning with the last. WILLIAM LUCAS.

MR. LUCAS'S theorem is quite correct: the cases for $r = 10$ have been given by E. Lucas in his "Théorie des Nombres," i. p. 28, as well as (if I remember rightly) in the "Arithmétique Amusante." M. E. Lucas was probably acquainted with the general theorem; whether he published it, or whether it has ever been published, I cannot say. G. B. MATHEWS.

Upper Bangor, November 19.

The Society of Medical Phonographers.

THE address of Dr. Gowers on "the art of writing in relation to medical and scientific work," delivered to the Society of Medical Phonographers, which was mentioned in your issue of August 8, and was published in the *British Medical Journal* for October 7, has been reprinted by the Society. There are a few spare copies, and any scientific worker, who is interested in the subject, can obtain one by sending a penny stamp to Mr. Wm. Holmes, printer, Ulverston.

It may be of interest to state that the number of members of the Society is now 202. I shall be glad to know the name of any scientific worker who uses shorthand.

JAMES NEIL, Hon. Sec.

Warneford Asylum, Oxford, November 22.

THE ROYAL COMMISSION ON SECONDARY EDUCATION.

IT would be difficult to produce a document more typically English than this Report, dated August 13, 1895, of the Royal Commission appointed on March 2, 1894, "to consider what are the best methods of establishing a well-organised system of secondary education in England, taking into account existing deficiencies, and having regard to such local sources of revenue, from endowment or otherwise, as are available, or may be made available, for this purpose, and to make recommendations accordingly."

That our country does not possess even an approach to a system, let alone a *well-organised* system, of secondary education, is in itself a sufficiently remarkable circumstance; but some may think it even more remarkable that, having recognised this, a task so difficult as that before the Royal Commissioners should have been entrusted so recently as last year to persons who, however worthy individually, as a body but very imperfectly represent the vast interests involved in such an enquiry. More than a quarter of a century has now elapsed since the publication of the report of the Schools Enquiry Commission appointed in 1864, and in the interval science has not only advanced with giant strides, but has also been applied to industrial purposes to an extraordinary extent, with the result that a revolution has taken place affecting not only all our actions, but our very modes of thought also, and requiring us to take cognisance of many entirely novel conceptions and considerations. Meanwhile also, our national prosperity has received a most severe check through the competition of those who have been quicker than ourselves to avail themselves of scientific discoveries and methods of working; and the probability is great that such competition will rapidly increase in severity and become unbearable unless we, as Huxley said, "organise victory"—to do which, however, we must march very fast, as we have both to overtake those who are already far ahead of us, as well as go quickly when we come up with them. It was therefore imperative that in considering the organisation of

secondary education, we should fully take into account and avail ourselves of the teachings of science. And it is consequently just cause of complaint that only a single representative of science—Sir Henry Roscoe—should have been placed on the Commission.

NATURE may also well object to the limited construction put by the Commissioners upon the reference submitted to them—that they should have understood it to so confine their enquiries as to lead them to think that it was not their function to include either an examination and description of the instruction now actually given in secondary schools, or a consideration of what subjects it ought to cover, and by what methods it should be given; and that consequently they should have mainly restricted themselves to what they call the external or administrative part of the subject. This, to the ordinary mind, is not unlike leaving out of account the weapons used in modern warfare, as well as all questions of tactics, in considering the organisation of our defensive and offensive forces; as education must in the future be the arsenal in which our weapons both of defence and offence will be mainly fashioned, the parallel can scarcely be said to be wanting in appositeness. It is all the more remarkable that the Commissioners should have taken so narrow a view, as on the second page of the Report they say that the object they had before them was nothing less than to complete the educational system of England, now confessedly defective in that part which lies between the elementary schools and the Universities.

Among those who have studied the conditions of English education and compared it with the best foreign systems, who are aware of the state of English public feeling on such matters, and who also take into account the altered conditions under which we now live and work, the impression is strong, however, that nothing is more wanted here than a clear declaration of policy which would serve to form public opinion and lead it into the right direction as regards the character of education most suited to the times. Although confessedly a practical people, we continue to allow our children to receive an education bearing little relation to the practical needs of life; the reason being, probably, that we do not sufficiently recognise that we owe our success almost entirely to innate good qualities, and that Englishmen have been helped in a comparatively small degree in what they have done by their school training.

It should have been easily within the powers of the Commissioners to have properly discussed such questions, and it is surprising that it should have been found difficult "to secure the help of those who, while not directly or professionally connected with secondary schools, had studied educational problems." And besides hearing witnesses belonging to the class of "educational statesmen and thinkers," workers might perhaps have been listened to with even greater advantage—when the theoretical evidence tendered by some is contrasted with that of an accomplished and experienced worker like Miss Beale, for example, there is no difficulty in deciding which is the more valuable. If also the opinions of a few experienced instructors at the universities and elsewhere, who have to do with large numbers of average students from secondary schools, had been invited, material would have been accumulated of importance in determining our future educational policy, and which probably would have led the Commissioners to open their eyes very widely: information as to the previous places of education of undergraduates at the universities is of little use in comparison with information as to the quality of their attainments.

Not a single scientific witness was called! Yet, if among the memoranda on particular topics invited from persons believed capable of furnishing valuable data or views, memoranda on the place of science in education and the kind of teaching required had been invited, there would not only have been no difficulty in securing such, but the documents would have had a high value. The mere fact that technical education was included in the enquiry, and indeed occupied a very considerable share of attention, is in itself sufficient evidence of the necessity of taking such a subject into consideration. But the Commission was clearly so constituted that it could not appreciate the importance of such action being taken, composed as it was very largely of men who cannot be regarded as belonging to the modern school of educational thought. Consequently, and most unfortunately, it has contributed little, if anything, towards the understanding of the difference between true scientific teaching—not merely of science, but of all subjects—and the sham article with which this country has so long been flooded; the wearying fight to bring this home to all concerned must therefore be continued with unremitting vigour. And this is the more disappointing, as it is so clear that, had the Commissioners advanced but very little further, they could have helped us in this direction also; for how otherwise are we to interpret the following admirable conclusion to the summary appended to the second section of the Report, that relating to the present condition of secondary education in England?—"In every phase of secondary teaching, the first aim should be to educate the mind, and not merely to convey information. It is a fundamental fault, which pervades many parts of the teaching now given in England, that the subject (literary, scientific, or technical) is too often taught in such a manner that it has little or no educational value. The largest of the problems which concern the future of secondary education is how to secure, as far as possible, that in all schools and in every branch of study the pupils shall be not only instructed, but educated. The degree in which this object may be attained will be largely influenced by the action of the authorities who prescribe the qualifications to be required in teachers, the conditions under which their work is to be done, and the means by which their work is to be tested."

Surely it was the duty of the Commissioners to take the first step towards solving what is admitted by themselves to be the largest of the problems concerning the future of secondary education—it is not likely that another Commission will be appointed to do this!

The Franco-German War first drew the attention of the world to the extraordinary value of exact training and scientific organisation. The lesson was most taken to heart by the Germans themselves, and by carefully training the *officers* of their army of industrial workers, they have since come off victorious in many important engagements with rival manufacturers and traders. An almost deeper lesson has recently been given to the world by the Japanese. Unless *we* are prepared to entirely disregard such lessons, we must introduce drastic reforms into our whole system of education. Scientific ways of working—scientific habits of thought, must be made national habits. The change would be nothing like so absolute as that made by the Japanese in their system of working, and if such a nation could entirely alter its front, it should not be beyond our power to do what is so clearly essential to our continued existence in comfort, let alone prosperity.[1]

[1] I cannot refrain from quoting the following conclusion to a striking article on the "Far Eastern Question" in to-day's *Times* (November 27). "Although nothing can excuse the short-sighted folly of our manufacturing classes in not providing for scientific research in the various branches of industry, yet it is the duty of a wise Government to take measures to counteract the folly of classes when it threatens the general interest. In one word, Great Britain stands at this moment in imminent danger of being beaten out of the most lucrative fields of commerce, simply because it does not recognise, while other nations do, the value of scientific organisation in the field, in the workshop, in the laboratory, and in the conduct of national policy." The *Daily Telegraph* has recently published an interesting series of letters—"Lessons in German"—conveying a similar lesson. We have waited long for the daily press to assist us: such evidence that the gravity of the situation is at last attracting attention is therefore most valuable.

To have conveyed this lesson to the nation should have been the first duty of the Commission. It is difficult to discover a sentence in the Report which indicates that they appreciate the gravity of the situation in which we are placed! Englishmen require but to be led properly at starting—when once they understand what to do, they will help themselves. The extraordinary outburst of educational activity which the country has witnessed during the past twenty years is proof that we are not behind in our estimation of the value of training; but the amateur fashion in which a very large proportion of our new enterprises have been conducted, shows only too clearly that an ideal is wanted to guide our labours: if we had this, co-ordination of means would naturally follow. We realise, in fact, that our army must be drilled, but we want a new national drill-book, in which the tactics to be adopted are *broadly* indicated. The Commissioners have only advised us as to the construction of barracks, and the choice of a staff; still, if we follow their advice and not only choose our staff, the Minister and his Educational Council, wisely, but impose on the latter in the first instance the task of most carefully framing the outlines of a system of tactics, all may yet be well.

Whatever may be the shortcomings of the Report in these respects, all who study it must agree that it is a work of the very highest value, drawn up with great skill, and that the recommendations embodied in it merit the most serious consideration.

In addition to the Report, there are three volumes of minutes of the evidence tendered by eighty-five witnesses; a fifth volume contains memoranda and answers to Commissioners' questions; two others are devoted to the reports of Assistant Commissioners; and the remaining two contain a summary, an index and statistical tables.

As the Commissioners point out, a mastery of the details is essential to a comprehension of the problems they had to solve, and an appraisement of the solutions they offer. Perhaps those who can read between the lines may be inclined to draw inferences in some cases different from those arrived at by the Commission; and it is clear, also, that the evidence is not all equally trustworthy—at least one of the Assistant Commissioners' reports having called forth what appear to be just protests.

The opening section of the Report contains a very brief, but most instructive, historical sketch of the gradual development since 1867 of the various agencies which have induced progress; four are chiefly referred to: the Elementary Education Act of 1870, the Science and Art Department, the various new University Colleges and the women's colleges, and the Technical Instruction Act; the work accomplished by voluntary effort, and the great increase in public interest in educational matters being also specially mentioned. Most hopeful in tone, this section is sadly wanting in scale; while no distinction is made between the work done under the Science and Art Department and by the University Colleges, the reference to University Extension is of the roseate order usually made by its extreme advocates. It is unfortunate that no attempt to estimate the relative values of the different elements of our educational "system" is included in this or the following section.

The second section deals with the present condition of secondary education in England, under the three heads: authorities exercising control, the existing supply of secondary teaching, and bodies which examine or inspect. The problems which the survey suggests are then considered, and, among others, the defects are pointed out in the present system of science and art grants, in the supply of schools, and in the provision of scholarships; but, unfortunately, under this last heading no attempt is made to take fully into account the bad, as well as the good, effect on scholars and schools of scholarships: the subversive effect they have produced at our universities is so generally recognised by competent observers that this subject should have been carefully considered. In discussing the internal organisation of schools in this section, stress is laid on the need of training for secondary teachers. This, perhaps more than any other portion of the Report, requires most careful study in connection with the evidence, and remarks on it must be reserved for a future occasion. The measures to be taken in the training of teachers will undoubtedly be the most vital point in any future legislative action arising out of this Report; for given good teachers, good work will necessarily be done, whatever the conditions may be in other respects.

A most important paragraph occurs in the summary to this section, which will need to be very carefully discussed, viz. that "In organising the supply of schools, it will be of the utmost importance to provide adequately for the literary type of secondary education, no less than for the scientific and the technical." One question to be considered is whether there should not be a *mean* type instead of distinct types throughout all the earlier stages, at least, of secondary education. Unfortunately this issue seems never to have been presented to the Commission.

The third section, which is by far the longest, is devoted to a review of the evidence, and a discussion of the suggestions made by certain witnesses.

The fourth, and practically the most important, contains the recommendations which are unanimously brought forward by the Commissioners. The primary recommendation, to which probably most interest attaches, is that of a *Central Authority* calculated to bring the State into a fitting relation to secondary education—words deserving of special notice. The proposal made is essentially English in spirit, and thoroughly calculated to fall in with our belief in a decentralised system of local self-government giving the maximum opportunity to individuals. "So far from desiring that secondary education should be a matter for a department of State to control," say the Commissioners, "we propose to leave the initiative in public action to local authorities, and to prevent even those authorities from superseding the action of individuals. So far from attempting to induce uniformity, we trust that a free and spontaneous variety, and an open field for experiment and enterprise of all kinds, will be scrupulously observed. We conceive, in short, that some central authority is required, not in order to control, but rather to supervise the secondary education of the country, not to override or supersede local action, but to endeavour to bring about among the various agencies which provide that education a harmony and co-operation which are now wanting."

The Central Authority proposed is a Minister responsible to Parliament presiding over a department formed by merging into one body the present Education Department, the Science and Art Department, and the Charity Commissioners. Apart from other advantages, the appointment of a Minister of Education must have the effect of impressing on public attention the immense national importance of educational affairs; and much as we have been indebted in the past to the several departments which it is suggested should now be fused into one, their methods are too inelastic to suit modern needs, and the proposed change is probably one which will meet with the approval of all true friends of education.

It is further proposed to associate with the central authority an Educational Council, not exceeding twelve members, of whom one-third might be appointed by the Crown; one-third by the four universities of Oxford, Cambridge, London, and Victoria; whilst the remaining one-third might be co-opted from among experienced members of the teaching profession. This proposal will probably be viewed in very different ways, but it appears to be one which is eminently calculated to pre-

serve the educational freshness of the central authority, and limit within reasonable bounds the display by it of those peculiarities which are too frequently manifest in all official bodies; through such a body, the interest of the Minister, and through him of the country at large, in current educational problems would be awakened and maintained, and he would become fully open to influence from without; at the same time, it should minimise the tendency to subordinate educational to political interests. But to secure these ends, the Council must contain a large professional element, and its members must not in any case be mere men of affairs, but fully acquainted with educational requirements.

It is impossible now to discuss the remaining recommendations.

At the outset, the Commissioners state that they have felt very strongly the need of dispatch, in order that the country may without delay derive advantage from legislation framed on proper lines. It is to be supposed that the late Government would have acted promptly in the matter, and it is to be hoped that its successors will be at once ready to appreciate the vast importance to our nation of well-considered legislation in the direction of the scheme put forward by the Commissioners. It would probably be difficult to prepare one in which due provision is more fully made to conserve what is good in our present system, while permitting the fullest play to the agencies which determine progress.

To conclude, in the eloquent final words of the Report, "it is not merely in the interest of the material prosperity and intellectual activity of the nation, but no less in that of its happiness and its moral strength, that the extension and reorganisation of secondary education seem entitled to a place among the first subjects with which social legislation ought to deal."

HENRY E. ARMSTRONG.

PAGAN IRELAND.[1]

TO Colonel Wood-Martin is due the credit of the first attempt to co-ordinate the vast stores of archæological lore which lie buried in the publications of the various Irish societies. The subject is a really fine one, and it was time that the data of Irish archæology should be collated and presented in a convenient form. This the author has accomplished. There are two ways of regarding a book: the one is to expect the author to write the book in the way you (whoever "you" may happen to be) would like to have it written, and the other is the acceptance of the author's position, and to deal with the work from that point of view. It is not difficult to discover the ideals which the author has in this instance placed before himself. "In order to arrive at the truth, it is desirable to test the opinions and conclusions of those who, by a careful analysis of the probabilities and facts recorded by them, have travelled over the same ground before. . . . Antiquarian research in Ireland may, with advantage, be directed towards filling in the social history of primitive man; articles which are the result of the handiwork of the aborigines illustrate, with much exactitude, life in the olden days. . . . If material objects be accepted as proofs of the pagan ideas and customs of the aborigines, surely the evidence of still existent superstitious observances of the peasantry, which can be traced to a pre-Christian source, ought to be received with, at least, the same authority. . . . It is to be hoped that research into the past, on these lines, may contribute to the reconstruction of early history." This is a sound method of treating archæology; our author clearly recognises that the value of archæology, whether it be of objects made by man, or of folk-lore, lies in the use to which it can be put in deciphering the early history of man, and he admits that in Ireland "we have made but little progress in higher scientific archæology; and the ancient antiquities of Ireland still remain in an unclassified condition." This is a refreshing admission, and the justification of this statement is only too apparent to those who know the present unintelligent arrangement of the magnificent collections of the Royal Irish Academy, now housed in the Dublin Science and Art Museum. The splendid opportunities for archæological research which exist in Ireland, are woefully neglected, and it is to be hoped that Colonel Wood-Martin's book will serve to stimulate an interest in this fascinating and promising field of inquiry. We are glad to note that he refers to the "vandalism" of the Board of Works with regard to ancient monuments; but a great deal more has yet to be said on this subject.

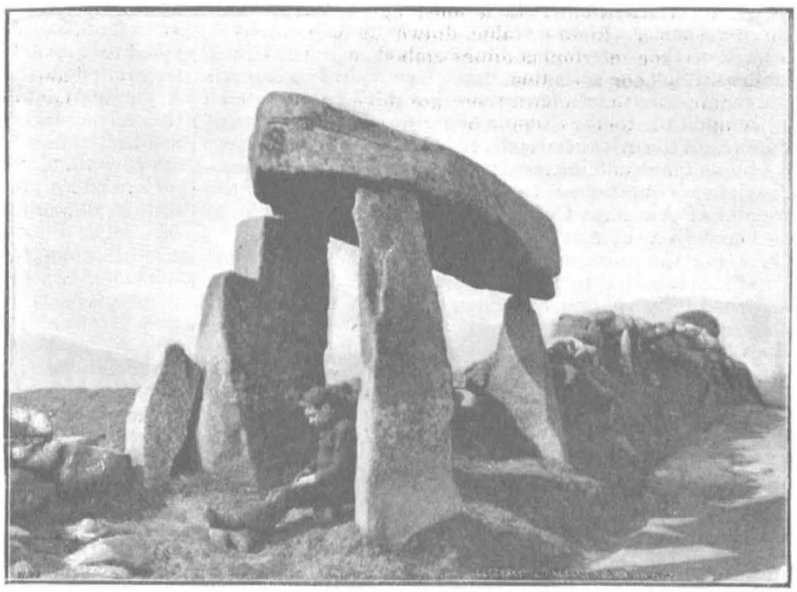

FIG. 1.—Legananny Cromleac, Castlewellan, Co. Down, 10 feet in height. (From Welch's Irish views.)

In his chapters on "Early History," "The Disposal of the Dead—Were the Aborigines Cannibals?" and "Traces of the Elder Faiths," the author deals with customs and beliefs as recorded in ancient accounts, or as witnessed for by actual remains, or as perpetuated in an attenuated form in folk-custom. The facts here collected together are most interesting, and throw considerable light on the early social condition of Ireland, a good deal of which will be new to the ordinary reader.

The author is very weak in his account of the ethnology of ancient Ireland; but this is a matter in which the author, not being a professed anthropologist, is not so much to blame, and there is yet much investigation to be done before we can speak with certitude. At

[1] "Pagan Ireland, an Archæological Sketch. A Handbook of Irish Pre-Christian Antiquities." By W. G. Wood-Martin, M.R.I.A., author of "The Lake Dwellings of Ireland," "The Rude Stone Monuments of Ireland," &c. 689 pp., 410 figs., and map. (London: Longmans, Green, and Co., 1895.)