

diminishing the amplitude of the vibrations. Lashing or shrouding is therefore a palliative against vibration, and not a cure. It is the practice of the Westinghouse firm to lash all reaction blades above 1 in. in length, and very long blades may have three or four rows of lashing wire.

As is well known, air in excess of that which is required to ensure complete combustion of the fuel under a boiler carries away heat wastefully to the chimney, and the boiler and its flues are less efficient in absorbing the heat which has been produced. Engineers, therefore, test flue gases for carbonic acid, as an unduly small proportion of this corresponds to unnecessary excess of air. This is generally done by ascertaining the reduction in volume of the flue gas after treatment with a solution of caustic soda. These wet chemical methods, of course, work well enough, but the lower-grade type of engineer does not take kindly to them. The Underfeed Stoker Co., Ltd., of Coventry House, South Place, E.C., however, has put on the market, at a cost of five guineas, an extremely neat pocket apparatus, called the CO₂ thermoscope, in which no liquids are used. A measured charge of the gas is passed through a charge of powdered caustic soda contained in a copper cap looking like a detonator, but sealed at both ends. The ends are first pricked and then the cartridge is placed within the hollow bulb of a mercurial thermometer contained within the instrument. The zero of a sliding scale is then set to the mercury index and the piston of the instrument is pushed home so as to drive the gas through the cartridge of caustic soda. This heats up the cartridge, and the thermometer, acting as a calorimeter, shows directly on the scale the proportion of CO₂ present. Provision is made for eliminating the effect of temperature on the volume of the gas taken. As in the wet process, SO₂ counts as CO₂, but in this case in a higher degree in consequence of the greater heat of combination.

OUR ASTRONOMICAL COLUMN.

THE QUESTION OF RADIUM IN THE CHROMOSPHERE.—Bulletin No. 27 of the Kodaikanal Observatory contains an important statement by Mr. Evershed regarding the recent communications concerning the presence of radium and the elements of the inactive group in the chromosphere. One of the recent communications concerned a comparison made by Mr. Dyson of the lines of radium and the emanation with the bright lines in the chromospheric spectrum as observed at eclipses; this comparison indicated many apparent coincidences of wave-length, and he suggested that these elements may be revealed by their emission lines, although not by their absorption lines, as is the case of helium. In the first part of the paper Evershed deals with the comparison of the chromospheric lines with those of radium and the emanation. He employs for the chromosphere the spectra he obtained during the eclipse of 1900 for the ultra-violet region of the spectrum and the spectra (glass positives from the original) secured by Dr. Mitchell at the eclipse of 1905; these latter are, as he states, "the finest that have ever been obtained in the less refrangible region." In the second portion he devotes his inquiry to the question of the presence of neon or argon in the chromosphere, using the

wave-lengths of the chromospheric lines as obtained by himself, Lockyer, and Dyson, and discusses the spectra thoroughly.

The result of his inquiry, to use his own words, is to show "that with the best eclipse material now available and the most recent measurements of the lines of the elements in question, the evidence is of a distinctly negative character as regards radium and the emanation, as well as neon and argon, and the probability is that not one of these elements can be recognised in the sun by a study of the emission spectrum of the chromosphere any more than by a comparison with the solar absorption spectrum." He further states that he has also examined the spectra of krypton and xenon, and also finds no evidence for their presence in the chromosphere.

DEDICATION OF THE NEW ALLEGHENY OBSERVATORY.—The corner-stone of the new buildings for this observatory was laid by Mr. John A. Brashear on October 20, 1900. The director at that time was Prof. F. L. O. Wadsworth. The work of building and transference has been completed, and the observatory dedicated with religious solemnity and handed over to the trustees of the University of Pittsburgh. We have lately received (Misc. Sci. Papers, Alleg. Obs., N.S., vol. ii., No. 2) an account of the dedicatory exercises and presentation which took place on August 18 of last year, and were referred to in NATURE of September 19, 1912 (vol. xc., p. 89). It is a pity that such stimulating scenes do not mark the history of astronomy in England. The various speeches are given in full, and in an appendix is given the speech made when the corner-stone was laid. Happily, Mr. John Brashear, to whose personal endeavours the new observatory owes so much, has lived to see crowned the works he then put in progress.

GENERAL INDEX TO THE MEMOIRS OF THE SOCIETY OF ITALIAN SPECTROSCOPISTS.—The fortieth anniversary of the above society and the completion of forty volumes (1872-1911) of the memoirs have been celebrated in a manner "modesta ed utile" by the preparation and publication of an *Indice Generale delle Memorie*. The index is made "per Autori. e per Materia." The latter part is not an alphabetical list of titles juggled on the change-ringing system adopted in some catalogues, but consists of a number of natural divisions of the subject forming heads of lists of papers arranged chronologically under author's names. Prof. A. Ricco is responsible for the grouping. Other members of the staff of the Astrophysical Observatory of Catania have assisted.

NATIONAL ASPECTS OF EDUCATION.

SEVERAL notable utterances relating to our national scheme of education have recently been made by Lord Haldane and other members of the Government. Apparently the intention of the Government is to introduce a measure which will organise our educational institutions and forces on a national basis, and in the spirit worthy of a great modern State. Among the developments adumbrated are the raising of the leaving age of compulsory attendance at primary schools, the abolition of the "half-time" system, compulsory attendance at continuation schools, the correlation of primary and secondary schools, improvement of the status of teachers, increased number of provincial universities and of facilities for entering them.

The development of national education along such lines as these signifies a substantial increase of expenditure; and as the contributions from rates for educational purposes have reached breaking-point in

most districts, the main part of the increased burden will have to be borne by the State. Since 1870, the proportion of the cost of education borne by the rates, in comparison with that contributed from national sources, has grown very considerably; and a readjustment of the load is imperative. Lord Crewe referred to this disproportion in the course of a speech at a dinner given to Lord Haldane by the Eighty Club on April 4, and he remarked:—"We cannot coordinate our system without incurring a heavy cost, and the question the Government will have to put is: Is the country prepared, when it has seen our proposals, to say that the benefits which those proposals offer justify a further expenditure, which cannot be small, upon national education." Lord Haldane has also acknowledged (in his speech at Manchester in January last) that "One thing is quite certain—what is about to be done for the coming generation must not be done at the expense of the ratepayer." In various speeches since the opening of the campaign at Manchester he has referred to the national responsibility for the development of our educational resources, and the national advantages which will accrue from it. Speaking at a joint meeting of secondary-school and technical teachers at the University of London on March 29, he said:—"The expenditure on education is productive expenditure, which we are justified in making a sacrifice to incur with the certainty that we shall get it back with compound interest."

It is refreshing to find our Ministers accepting the principle that increased provision for education must come from the State, and that the nation will benefit by the additional expenditure. Not many years ago Lord Haldane, in an introduction to Sir Norman Lockyer's collection of addresses on "Education and National Progress" (1906), suggested that the private donor should be encouraged, but that the motto of the Chancellor of the Exchequer as regards expenditure upon matters connected with higher education and research should be *Festina lente*. "I do not mean," he wrote, "that the Government ought not to spend public money generously upon the universities. I mean that it should not be spent unless and until a case for the necessity of such expenditure has been clearly made out."

We may be permitted to conclude from his recent utterances that Lord Haldane is now of the opinion that a case has been made out for increased national provision for our educational forces. He knows as well as anyone that the great advances being made in education in other countries constitute a formidable menace to ourselves, and that the State can wait no longer for like developments if it desires to maintain a leading position among progressive peoples. What Lord Haldane and other members of the Government have been saying recently as to the responsibility of the State for educational progress has not only been said in New South Wales, but put into practice by the Labour Government now in power. The official pronouncement of the New South Wales Government upon education may appropriately be quoted here; it reads:—

"The present Government, recognising that economic reforms are of little value without increased educational facilities, attaches supreme importance to educational reforms. 'A man might have access to land, facilities of travel, industrial energy, credit, economic security, and justice, and yet true equality of opportunity might be lacking. The society where all these liberties have been won might be sunk in the stagnation of conservatism, and might even breed new forms of inequality and tyranny.' Every improvement in economic conditions should be accompanied by an effort to raise the standard of intelligence, and this will only be achieved by the State

NO. 2268, VOL. 91]

recognising its ever-increasing responsibility to provide increased educational facilities."

The article by Prof. H. S. Carslaw in NATURE of April 3 shows how the policy outlined in this manifesto has now been carried out in New South Wales; and the reforms there instituted are much the same as those urgently needed in the mother-country. To attempt to describe in detail the many directions in which our educational system requires organisation, improvement, and extension would take the present article beyond reasonable limits, but reference may be made to a few matters mentioned in recent speeches.

Much has been said of the work of the elementary school in relation to after-life. The great difficulty here is to know what the life after school is to be. More than 40 per cent. of the boys leaving London schools go into irregular employment; not so much perhaps on account of any want of fitness to learn a trade as because of the ease with which such "blind-alley" occupation can be found, and the relatively higher wages which can be obtained. It is not the province of the elementary school to prepare for any particular occupation, but so far as possible to guide the child to appreciate what is best in life, to train his hand and eye to work together, and to make him trustworthy, alert, and adaptable in whatever calling he may be placed. There should certainly be more manual work in schools, but its aims and methods should be educational and not technical. To attempt specialisation in an ordinary school, from which the boys leave to enter fifty or more different occupations, would lead to hopeless confusion. Manual dexterity can be trained in schools at an age when it is most easily acquired without attempting to teach the processes of particular occupations. The effect of giving more time and attention to work of this practical nature would perhaps be to increase the dignity of manual labour, and to lead ambition into industrial rather than clerical directions.

In rural districts the difficulty in making the elementary-school curriculum less bookish is the teacher, who frequently has no special aptitude for the work, and has rarely received a special training. So long as there is no inducement for teachers to qualify themselves for work in rural schools, no improvement can be anticipated. At present the rate of pay is lower than in town schools and the opportunities of advancement are fewer; so that young teachers naturally object to become earmarked for country schools. Exceptional qualifications are demanded without any inducement being offered to teachers to obtain them. The teacher in a rural school is expected to have the spirit of a naturalist, the manual dexterity of an artisan, the experience of a horticulturist, and the culture of a university graduate, and for these admirable qualities he will receive the pay of a second-rate clerk. It is unreasonable to expect that many men and women possessing such attributes will have no higher ambition than that of teaching in country schools.

One of the reforms contemplated by the Government is the raising of the age below which attendance at school is compulsory, and the abolition of the "half-time" system. At present, a child can leave school immediately it reaches the age of fourteen years, irrespective of the standard in which it may be at that time. About 10 per cent. of the children in public elementary schools leave each year, and they are usually in Standard VI., so they have had the full opportunities of whatever education the schools are giving. Partial exemption from school in order to go to work during certain hours of the day can be obtained at the age of twelve by obtaining an attendance certificate, or at eleven in agricultural districts

if the standard of exemption fixed by the local education authority has been passed. This is the "half-time" system, and in the year 1910-11 the number of children who took advantage of it was 71,475, 80 per cent. of whom belong to the districts of Lancashire and Yorkshire engaged in textile industries. The total number of pupils in attendance at public elementary schools of England in the year 1910-11 was nearly 5,000,000, so that the "half-timers" form only about 1½ per cent. of the children under instruction, and since the year 1907-8 the number has been continually decreasing.

Little can be said in favour of the "half-time" system from the point of view of the child's physical, mental, and moral development, all of which are sacrificed by it to the interests of some parents and employers. The facts described in the work on "Continuation Schools in England and Elsewhere," edited by Dr. M. E. Sadler, provide an unanswerable indictment of the system by which child-labour is exploited because it is cheap and the educational discipline of school is minimised at a period when it is most needed.

Several attempts have been made to abolish the half-time system, the most recent being the Education (School Attendance) Bill, which was introduced in the House of Commons last year, and was afterwards sacrificed. The Bill provided that no child under the age of thirteen should be allowed to leave a public elementary school, and that a child should only be allowed to leave school before the age of fourteen for the purpose of entering into some beneficial employment. It was left to the local education authority to decide whether the conditions of the proposed employment were suitable to the child, and whether it was likely to lead to permanent employment and to afford useful training.

It may be possible to find arguments in favour of permitting a child to leave school relatively early in order to enter employment which will make him a skilled workman, but no amount of special pleading will prove that a child of twelve is benefited by working six hours in a mill each day and attending school for two and a half hours as well. When the school curriculum is of a more practical character than it is at present—and many education authorities are making it so—it will not be reasonable to urge, as Sir William Anson did last year, that the mechanical drudgery of the mill-room is more valuable for after-life than instruction in educationally-graded courses of manual work and housecraft.

The great majority of children who leave the elementary schools receive no further school training. The following table, based upon the statistics prepared for the Board of Education by the Continuation Schools Committee which was appointed in 1907, gives some indication of the numbers of adolescents receiving no regular education:—

Boys and Girls (England and Wales), 1906-7.

Age	Population	Not at school (either day or evening)	
		No.	Per cent.
12	687,300	14,424	2.10
13	690,300	155,871	22.58
14	691,000	442,950	64.10
15	682,100	523,383	76.73
16	649,200	532,016	81.95
17	664,900	557,632	86.87

It is a common complaint that what is learnt in school is soon forgotten in after-life. This is true of most subjects and of most children; and the loss of the knowledge is usually the result of disuse. The above table shows that a very small proportion of children from elementary schools continue their educa-

tion by attendance at continuation schools, the result being that in most cases they are unable after a couple of years to perform the simplest arithmetical calculation or show evidence of having received instruction in any ordinary subjects other than reading and writing. This is a bad beginning for after-life, and the nation will benefit by any measure which will bring pressure to bear upon parents and employers to ensure attendance at continuation schools. In Germany, twenty-seven States have adopted the compulsory continuation-school system, which imposes the statutory obligation on all employers of labour to give their employees under eighteen years of age such leave of absence from work for the purpose of attending the schools as the local authorities may prescribe. It is time that similar measures were adopted in our own country. The years of youth and adolescence, when supervision, discipline, and guidance are particularly needed, are at present left unguarded by the State. It is true that we have in the three-quarters of a million students who attend evening and similar schools an army of voluntary students of which any nation may be proud, but nearly one-fifth of these students fail to complete the small minimum of attendances (from thirty to sixty hours) required to enable grants to be claimed towards their instruction, and most of the remainder only receive very elementary instruction, comparable perhaps with the work of continuation and trade schools in Germany, but forming no satisfactory substitute for the highly developed system of secondary and technical education in that country.

We do not suggest that the education system of Germany is adapted to the needs of our own country and people, but we do believe that until a national system of our educational institutions has been formulated comparable with that of our chief competitor, it will not be possible to inspire confidence in the expenditure of large sums of public money on education. We go to Germany for our illustrations because there the result of organisation by the State has been to raise education out of the slough of commercialism and make the people appreciate its advantages to the nation and the individual. If comparison with Germany is permissible in the case of armaments, it is much more so in connection with education, in which we ask, not for two schools to one, but an approach to equality.

In true secondary schools, high-grade technical institutions, and advanced university students lie our weaknesses as compared with Germany. There are nearly 1000 recognised by the Board of Education as efficient secondary schools in England and Wales, and they are attended by about 170,000 boys and girls, three-fifths of whom are from public elementary schools. Three-quarters of these pupils are, however, under fifteen years of age, and if pupils under twelve years of age be left out of consideration the average length of the secondary-school life is less than three years. Germany has in its secondary schools more than twice as many pupils as are in our State-aided secondary schools, and all taking courses lasting six or nine years, leading to definite goals and linked up closely to the public life. The leaving certificate obtained after passing through a nine-years' course qualifies for entrance into any German university, and to any of the learned professions. We have no such general certificate for the pupils of our secondary schools, and the standard of the certificate could not be passed successfully by the majority of the students in our universities, while to apply it to the product of our schools at present would be impossible.

With few exceptions, our technical institutions also

will not bear comparison with the technical high schools of Germany, either as regards number of students or nature of the instruction. The total number of day technical students in English polytechnics, technical schools, and colleges, and in universities and university colleges recognised as technical institutions by the Board of Education, is about 4000; and less than one-fifth have passed a university matriculation examination or its equivalent upon entrance. Less than 2000 day students are taking full courses of instruction in technical institutions in England and Wales, though this number includes students of technology in several provincial universities or university colleges. The technical high schools of Germany and Zurich have together more than six times as many day students taking full four-year courses, after having completed a full secondary-school course and obtained the leaving certificate. If the same standard were required for entrance to our technical institutions, most of them would cease to exist.

Our position as regards university students is equally unsatisfactory when compared with that of Germany. In the whole of the universities of England, including Oxford and Cambridge, there are about 17,000 full-time students, whereas Germany has four times as many. The University of Berlin alone has 10,000 matriculated students; Leipzig 5000; Bonn, Breslau, and Halle more than 3000 each, and six other universities more than 2000. We have a long journey to make before we can approach the position occupied by Germany as regards secondary, technical, or university education, and it is the State which must take the lead if we are to make up our leeway. The first requirement is to organise our educational institutions into a truly national system; that is to say, upon a system which has the well-being of the nation as its main object, and in which facilities are offered to every individual to secure the highest instruction if he is qualified to take advantage of it.

The raising of the leaving age of elementary schools, the abolition of the "half-time" system, the establishment of compulsory continuation schools, and the coordination of elementary and secondary schools are reforms for which England ought no longer to wait, but of greater importance from the point of view of national progress is the development of higher technological instruction and research in our technical colleges and universities. The importance of this was emphasised by Mr. H. G. Wells in three articles contributed to *The Daily Mail* on April 7, 8, and 9. Mr. Wells's theme was the nature of our naval and military armaments and the national expenditure upon these preparations for war; and he urged that too much confidence is placed in obsolescent instruments of destruction and far too little encouragement given to organised technical research, military and naval experiment, and other means by which a secure position can be obtained by the aid of science. "I will suggest," he said, "that we have the courage to restrain and even to curtail our monstrous outlay upon war material, and that we begin to spend lavishly upon military and naval education and training, upon laboratories and experiment stations, upon chemical and physical research, and all that makes for knowledge and leading, and that we increase our expenditure upon these things as fast as we can up to ten or twelve millions a year." The arts of peace, no less than those of war, require the production of as many highly educated, inventive, investigating men as the nation can obtain from all classes of the community. The future of every modern State depends upon the work of its men of science and engineers. Let us hope that this will not be forgotten when the Government gives attention to the organisation of education,

and that consideration will be given not only to the acquisition of knowledge by students of various grades, but also to its increase.

R. A. GREGORY.

VARIATIONS IN ATMOSPHERIC CIRCULATION IN TEMPERATE LATITUDES.

DR. A. DEFANT contributes a long paper to the *Sitzungsberichte der K. Akad. der Wiss. in Wien*, March, 1912, in which he discusses the variations in the meteorological elements in temperate latitudes in both hemispheres. In an introductory section he outlines the theoretical conclusions on which he bases his method of investigation. Briefly stated, they are as follows. If a region is a region of rising pressure, a "Steig-gebiet" in the nomenclature of Ekholm, the mean temperature of the atmosphere is below normal, and *vice-versa* if it is a region of falling pressure; but the precipitation is a maximum if the temperature of the atmosphere is above the normal over the region, and a minimum if the temperature is below the normal. Consequently oscillations in the precipitation correspond with oscillations in the variation of pressure, and if the first are periodic, the second will have the same periods.

The argument is ingenious, and would be unquestionably valid if the correlations were complete, but the question naturally suggests itself: "Why not investigate directly the records of pressure, which is less subject to local influences than is the amount of rainfall?" The paper appears to contain no adequate reason against adopting the direct method, but as rainfall is a more important climatic factor than pressure, the results of the investigation have an interest of their own, apart from the theoretical development.

The author has taken the daily weather reports for South America and Australia for the year 1904, added together the published values of rainfall for each day for all stations, and taken the total so obtained to represent the daily rainfall of the region considered. The totals are then written down in series, and the number of maxima during the year is counted and divided into the number of days. In this way an approximate period is obtained. The variation of this period is then eliminated, and the process repeated to give the next period. The method is clearly a rough one, and some discussion of the significance of the periods obtained appears to be necessary. Nevertheless, the results are interesting, and suggest that the application of Schuster's method of analysis to the search for comparatively short periods would repay the labour involved. Defant obtains periods of about seven, twelve, sixteen, and thirty-one days for the southern hemisphere, and by using the values for 1909 finds corresponding periods of about six, thirteen, and twenty-five days in Europe. It may be noted that Turner found evidence of a period of twenty-five days in his analysis of the Greenwich records.

Using some results of Exner's on the effect of the different thermal conditions over land and water, the author finds that a continent is the source of a series of pressure waves which travel from west to east with a velocity independent of the wave-length, and he connects this series of pressure waves with the variation of rainfall. The most important waves are those of which the lengths in degrees of longitude are 360° , 180° , 120° , &c., while next in importance are those of which the length is half the width of a continent or ocean. Their velocity is about 11° of longitude per day in the southern hemisphere, 14.5° per day in the northern. It is clear that if the results of the author's investigations are valid, they will be of great importance in long-distance forecasting.

E. GOLD.