obtained with mixtures of all inflammable gases or vapours with air or oxygen, and very similar phenomena occur with like mixtures of inflammable dust. The rise and fall of pressure is studied by means of sensitive indicator devices, which produce tracings on a rotating drum.

The pressure rise is caused by the formation of flame at the ignition point—in this case an electric spark—and the spread of this flame throughout the vessel increases the temperature of the gaseous contents, and thus increases the pressure, as in a closed vessel the volume remains constant. The rate of pressure rise is thus, broadly, the measure of the rate of the travel of the flame through the mass; and, if it be assumed that maximum pressure is attained when the whole vessel is filled with flame, then it is possible to determine the flame velocity by these measurements.

In these experiments the flame velocity for the weak mixture is about 2 ft. per sec., and for the strong mixture 13 ft. per sec. These velocities are attained in closed-vessel experiments without a moving piston. In actual engine cylinders, where the charge has been introduced at a high speed through an inlet valve, the flame velocity is much higher, and it varies with different types of engine from about 20 to 100 ft. per sec. The cause of this variation for similar mixtures has been the subject of investigation by Clerk and Hopkinson, and it has been definitely proved that the higher flame velocity found in working engine cylinders is due to the residual turbulence of the mixture after compression caused by the high rate of flow into the cylinder through the inlet valve. In some engines the gases forming the charge flow through the inlet valve at a rate as high as 160 ft. per sec. Without this increase of flame velocity in the engine cylinder it would have been impossible to run high-speed engines, such as petrol engines, in an economical manner. At the lower flame velocity of the closed vessel the exhaust valve will be open before the pressure had time to rise. The effect of turbulence within the cylinder is very marked in other respects. The rate of loss of heat from a heated platinum wire to the mass of air in the combustion space of an engine is much greater for any given point of the stroke when the engine is running fast than when it is running slow, and if the charge be trapped, so as to allow several compressions and expansions before measuring the heat loss, the turbulence has so died down that the conductivity diminishes.

Another point of interest in gaseous explosions is found in the fact, predicted by Clerk many years ago, but proved by Hopkinson, that the flame entirely fills the vessel before maximum pressure is attained, that is, the combustion, even in an explosive mixture of gas and air, is relatively slow as the chemical combination approaches completion.

Another point proved by Hopkinson's experiments in a large closed vessel is that at whatever point in the vessel the ignition be started, that point is the point of maximum temperature during the subsequent pressure rise, and at that point the temperature rises about 500° above the temperature of combustion, due to adiabatic compression of the hot gas.

The investigations of Profs. Callendar, Dalby, and Coker by means of platinum resistance thermometers and platinum alloy thermal couples has proved the temperatures attained in ordinary engines to vary from about 1800° C. to 2500° C. The new methods of direct thermometric measurement of the temperature flame have amply proved, however, the general correctness of the older method of deducing mean temperature by pressure change.

The investigations of Callendar, Hopkinson, and David (Prof. Hopkinson's pupil) on radiation are of great importance, and prove that this source of heat loss is only second in magnitude to heat loss by convection and conduction. All the radiation experiments clearly show the existence of an unexpected transparency of flame to its own radiations. The radiation work throws much light upon heat distribution in the rapidly succeeding explosions used in internal-combustion engines.

It was long ago observed by Hirn, Bunsen, and others that the rise of temperature in gaseous explosions could not be calculated from the then assumed specific heat of the constituent gases and the known calorific value of the inflammable gas. The deficit of temperature was found to be about 50 per cent., and many attempts were made to explain this deficit, Hirn advocating the theory of heat loss on the rising line and Bunsen supporting the idea of a limit to temperature due to dissociation. Later, the French observers, Mallard and Le Chatelier, maintained that at least part of the deficit could be accounted for on the assumption of increase of specific heat of the gases. Investigations of the members of the Committee have dealt, not only with the points which have been here discussed, but with all these questions—heat loss on the rising line, specific heat of the constituent gases, heat loss on the falling line, and dissociation of the combining gases.

Specific heat work has been in progress by Clerk, by Callendar and his pupil, Swann, and much of this work has not yet been published. Dissociation has been discussed by Dr. J. A. Harker, Prof. Smithells, and Dr. Bone, and both internal energy and dissociation have been discussed by Hopkinson. Ignition temperatures of gases have been dealt with by Prof. Harold Dixon, and Dr. Watson has studied the nature of the exhaust gases from the petrol engine. Many experiments, too, have been made on the law of cooling and heating of gases under compression in cylinders by Hopkinson, Dalby, Callendar, and Clerk.

As a result of this work, the conclusion has been arrived at that, so far as explosions in internal-combustion engines are concerned, dissociation has but little to do with the limit reached. This limit is partly due to increased specific heat at high temperatures, to heat loss to the walls, and to radiation from the explosion. Varying specific heat and increasing radiation account for most of the deficit. Allowing for all these things, however, it appears now to be established that combustion is not quite complete even at maximum temperature, and Watson's experiments on the spectrum of an explosion flame appear to support this view.

All these matters are still under examination, and it is hoped that in the near future a much more complete knowledge may be gained than at present exists. Much is known in a qualitative way, and some quantitative knowledge has been attained, but much still remains to be done in the way of quantitative determinations of matters at first apparently so simple as specific heat.

CLIMATE AND TREES.

IN an article on "Woods and Trees of Ireland," in the *Co. Louth Archaeological Journal* for 1914, Prof. Augustine Henry states that in Ireland, as in Scandinavia, the climate prevailing in neolithic times was drier and warmer than that of to-day. Many facts are adduced in support of this improvement, which in Scandinavia amounted to an increase of 4° F. in the average annual temperature. The occurrence of this optimum climatic period is confirmed by the fact that two species of elm in England are unable now to produce fertile seed.

The English elm produces good seeds freely in the warm valley of the Tagus at Aranjuez in Spain, but not in Madrid on the cold plateau 500 feet higher. In England it invariably reproduces itself by root-suckers. The Cornish elm produces ripe fruit in Brittany. Certain forms of Alchemilla are unable now to produce good pollen, yet form seed parthenogenetically. In the Faroe Isles thirty-six species of plants scarcely ever ripen their seeds; and five species never flower. The question of what plants in Ireland are now in too northerly or too cold a climate requires study in the field.

Much has been written on the Lusitanian flora of Ireland, involving the question how the Arbutus is confined as a native tree to Kerry and Cork, not being indigenous elsewhere in the British Isles. Its nearest station on the continent is near Paimpol in Brittany, where, on the abrupt and rocky slope of the cliff of Trieux, for about one and a half miles, this species is very abundant in a wood mainly composed of oak and mountain ash. It is interesting to note that the Cornish elm (*Ulmus stricta*), indigenous only in our islands in Cornwall and Devon, is similarly met with in Brittany. The English elm (*Ulmus campestris*) is probably also a Lusitanian species, occurring elsewhere than in southern England only in Spain as a wild tree. It appears to have entered England by the Severn valley, crossing over the Cotswolds into the Thames valley, and southwards as far as the Isle of Wight.

Prof. Henry, in addition to giving much historical matter concerning the ancient forests of Ireland, shows how the primitive woods and their remains can be easily recognised by the occurrence in them of a peculiar fauna and flora, which is absent in plantations and in arable and pasture lands. A list is given of these sylvicole animals and plants.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

GLASGOW.—The following additional examiners have been appointed:—Surgery, Sir Charles B. Ball, Bart.; medicine, Sir Thomas Oliver; physiology, Prof. E. P. Cathcart; geology, Dr. John Horne; zoology, Mr. H. H. Brindley; engineering, Prof. J. B. Henderson; mining, Prof. W. H. McMillan.

Forty-three members of the teaching staff, professors, lecturers, and assistants, are engaged in military service at the present time, and nearly five hundred commissions in the Army and Navy have been granted to students and junior graduates of the University. One, who afterwards died of wounds, received the Victoria Cross.

LONDON.—The Senate has conferred the titles of Professor and Reader in the University upon the following:—*Professors*:—Dr. A. L. Bowley (London School of Economics), statistics; Mr. L. R. Dicksee (London School of Economics), accounting and business organisation; Mr. J. E. S. Frazer (St. Mary's Hospital Medical School), anatomy; Dr. T. M. Lowry (Guy's Hospital Medical School), chemistry; Mr. J. H. Morgan (University College and the London School of Economics), constitutional law; Dr. W. J. R. Simpson (King's College), hygiene and public health; Mr. J. H. Thomas (University College), sculpture; and Mr. G. Wallas (London School of Economics), political science. *Readers*:—Dr. R. W. Chambers (University College), English language and literature; Mr. H. Crompton (Bedford College), chemistry; Dr. J. S. Edkins (Bedford College), physiology; Mr. W. J. Goudie (University College), theory and practice of heat engines; Mr. Major Greenwood (Lister Institute), medical statistics; Dr. R. G. Hebb (Westminster Hospital Medical School), morbid anatomy; Dr. R. T. Leiper (London School of Tropical Medicine), helminthology; Dr. H. R. Le Sueur (St. Thomas's Hospital Medical School), chemistry; Dr. F. S. Locke (King's College), physiology; Miss Sara Melhuish (Bedford College), education; Dr. F. G. Pope (East London College), chemistry; Dr. H. E. Roaf (St. Mary's Hospital Medical School), physiology; Dr. O. Rosenheim (King's College), biochemistry; Mr. J. Henderson Smith (Lister Institute), bacteriology; Dr. J. F. Spencer (Bedford College), physical chemistry; Dr. H. M. Turnbull (London Hospital Medical College), morbid anatomy.

MANCHESTER.—The movement started last year for the establishment of a Radium Institution in Manchester met with a generous response from the public. Thanks to the assistance of public men and the Press, the committee that was appointed to carry out the scheme was able to collect a sum of about 30,000*l*. The radium department was established at the Royal Infirmary, and began work on January 1 in a number of rooms that had been equipped at a cost of 1000*l*., and started with about 800 milligrams of radium metal. The contract for the radium, which cost about 21,000*l*., was fortunately given to an American firm, and its delivery was not therefore interfered with by the outbreak of the war. In order to ensure the maximum efficiency, the Radium Committee, acting on the advice of Sir E. Rutherford, Sir Wm. Milligan, and other experts, took control of the equipment of the laboratories; and the standardisation of the radium was done in the physical laboratories of the University of Manchester. The committee has also drawn up a scheme for the distribution of radium either in the solid form as applicators, or as emanation tubes from the liquid form, to the other hospitals in Manchester and the district. Dr. Arthur Burrows is the radiologist at the infirmary responsible for the administration, Mr. H. Lupton is the physicist in charge, and Sir E. Rutherford acts as consulting physicist to the department.

OXFORD.—The Committee for Rural Economy reports that during the past academic year forty-eight individual students worked in the department. The soil survey of the district round Oxford has been continued, and a new research on the nitrogen in peat has been started. The new buildings, erected at a cost of nearly 6000*l*., were completed and ready for occupation in October last. Several papers have issued from the school during the year, including six by Prof. Somerville (Sibthorpian professor), a joint paper by Prof. Somerville and Mr. Harper, and others by Messrs. Harper, Morison, Doyne, Sothers, and Jones. Prof. Somerville continues to edit the *Quarterly Journal of Forestry*.

The annual report of the Delegates for Forestry shows that the number of the students in the department at the beginning of the year 1914 was thirty-eight. This number by the end of the year, in consequence of the war, had declined to fourteen. A visit was paid, under the personal direction of the professor of forestry, Sir W. Schlich, to the Forêt de Lyons, in northern France, and weekly excursions were undertaken to Bagley Wood, where, by permission of St. John's College, a forest nursery and experimental plantations have been established. Here periodical measurements are taken of many species of forest trees. Advice was sought and given in respect of twelve estates aggregating 9322 acres, and other