

News and Views.

IN an address on "Science and the Civil Service," given in November last to the Professional Institute of the Civil Service in Canada, Prof. J. C. McLennan reminded his audience, which included members of the Canadian Cabinet, of the benefits which scientific workers employed by the State have conferred on the populations in the Dominion. So far from scientific men being mere 'high-brows,' unpractical dreamers, and visionaries whose services are worth a mere pittance, they are more practical than the arm-chair politicians who despise science. It was a member of the Geological Survey of Canada, Dr. Dawson, who discovered the famous gold-bearing belt in the Yukon territory. It was largely owing to Prof. Miller and his colleague, Mr. Thomas Gibson, that a mining policy for the development of the silver, nickel, copper, gold, and other metallic mineral fields in Ontario was inaugurated. Canada's remarkable success in agriculture was based on the work of two public servants, Dr. William Saunders, who created the Experimental Farm System, and his son Dr. Charles Saunders, who discovered the Marquis variety of wheat. To another, Dr. Gordon Hewitt, who developed the Dominion Entomological Service and devised means for the control of grasshopper pests, must be given the credit of saving Canadian farmers millions of dollars yearly. The list of services rendered to the material prosperity of Canada by scientific workers in the public services could be extended indefinitely. For the most part they have worked for wretched salaries and, in some cases, with but the most meagre recognition of their great works. It is time the statesmen of the Dominion realised the immense potentialities of properly endowed scientific services.

PROF. McLENNAN did well to point out to the statesmen and other public men present that if the scientific services are starved in Canada, the best brains of the community will continue to migrate to its great neighbour, where they can expect greater encouragement and more freedom to apply their discoveries. The tendency on the part of the wealthy and financial houses to send money to the neighbouring State for investment is a direct consequence of the apathetic attitude of the Dominion Government towards scientific research. Money now goes for investment and people of ability for employment to places where science is appreciated, where invention and discovery find application in industry. Scientific workers, by the discoveries and advances they are making continually, not only stabilise industries, but also point the way for still greater developments. The best protection for Canada is the adoption of a policy "Science in the Civil Service and Science in Industry." Canada badly needs a National Research Institute in which those scientifically inclined, or those in control of industries, can have their problems investigated. With this view the Hon. Charles Stewart, Minister of the Interior, entirely agreed, and made the useful suggestion that the scientific workers of Canada, led by Prof. McLennan, should

go out into the highways and byways and convert the laymen of Canada, who wield the 'big stick' to urge on or frighten members of Parliament, to the need for and value of scientific research.

AT the risk of appearing tedious, anthropologists continue, and wisely, to urge the importance of their studies for purposes of administration among backward races. The latest pronouncement is by Mr. J. H. Hutton, of Assam, who is well qualified to speak both as an anthropologist and an official. In his presidential address to the Anthropological Section at the Calcutta meeting of the Indian Science Congress last January, he argues ably for the utility, and indeed the essential need, of a knowledge of the principles of the science in dealing with such a people as that with which he is most familiar, namely, the Nagas. He points his argument with many an apt illustration in which knowledge of sentiment and custom, especially in the judicial field, has been an essential condition to secure the right handling of incidents such as crop up daily in the path of the administrator. He deals with the difficult question of missionary activity temperately, even though he is compelled to conclude that their influence is in practice harmful, as it breaks bonds which form part of the tribal complex, but for which Christianity affords no substitute to help the native. Supporters of the missionary, it may be noted in passing, who think that Christianity should be able to afford the necessary influence to replace tribal custom, in arguing from the analogy of a Christian society, overlook the fact that ethics are fundamentally cultural even when they have a theological sanction, and to a great extent cannot be transposed from one system to another. Mr. Hutton's careful analysis of the results which arise from culture contact between east and west to the detriment of the health and numbers of the native population constitutes a warning against the too hasty introduction of civilising influences, which deserves careful pondering by those who are interested in the advance of backward peoples.

A PAPER was read on Mar. 30 by Mr. D. Brownlie, before the Diesel Engine Users' Association, on the subject of liquid fuel from coal. He pointed out how necessary a supply of liquid fuel produced in Great Britain will be if the Diesel engine is to attain an importance commensurate with its thermal efficiency. This supply may be derived from coal by carbonisation at high or low temperatures, by hydrogenation, or by synthetic processes based on carbon monoxide. The author dealt with these methods *seriatim*—in particular with the carbonisation of coal at low temperatures, on which he listed seventy-five different processes, describing thirty of major importance which have been in more or less continuous operation in large-scale plant. Hydrogenation and synthetic fuel production were described in outline. The author deplored the slow advance of the production of liquid fuel from British coal, and indulged in a jeremiad on the absence of scientific development of

our home resources. It is easy to exaggerate here, for there has been no lack of ingenuity applied to the carbonisation of coal by British workers. About a third of the processes scheduled by the author are of British origin or development; undeniably capitalists have not withheld ample financial support, as many of them would ruefully agree. The author himself throws light on the slow progress when he enlarges on the development of mineral oil production. Oil *can* be produced from coal, but *must* be sold in competition with natural petroleum, and present-day economic conditions do not lighten the task of those who seek to manufacture liquid fuel from coal.

"THE Agricultural Depression, its Causes and Possible Cures," was the subject of an address by Mr. W. C. D. Dampier-Whetham at the ordinary general meeting of the Surveyors' Institution, held on April 2. A comparison of the present situation with previous depressions shows that all have occurred during times of falling prices in both agriculture and industry and are ultimately due to monetary instability. After discussing the theory of prices, Mr. Dampier-Whetham showed that the general changes in price level from 1843 to 1914 are explained by the varying relations between the world's supply of and demand for gold. Whereas plentiful gold invariably results in an increase of prices and prosperity for the farmer, depressions arise from a falling average level of prices, whether this be due to shortage of gold as in 1873, or to deliberate deflation as in 1920, when efforts were made to restore the gold standard. Protection or free trade has less effect on prices than changes in the value of money. As regards possible remedies for the existing depression, much may depend on the policy of the Federal Reserve Board and possibly on some future international agreement as to the control of the world's gold supply. A system, other than the gold standard, may ultimately be devised for the management of currency and credit, which will tend to keep the index number of wholesale prices constant, and counteract the effects of a probable world shortage of gold. Although such fundamental changes may be premature, some measure of relief will be obtained if efforts are made by the farmers themselves to reduce costs and charges in every possible way, particularly in the sheltered industries, and the questions of marketing, import control, and agricultural credit are still further explored by the Government. The only radical cure, however, is stabilisation of the general price-level, that is, of the value of money.

THE contrast between the Building Exhibition of to-day and those that were held in former years at the Agricultural Hall is very marked. Those at Islington were well attended, it is true; for architects, builders, and others of such groups went there in order to gain up-to-date knowledge of marketed goods and processes; but it was purely as a duty that the journey was undertaken. Since Mr. Greville Montgomery has organised the show at Olympia, the duty of attendance has become a real pleasure. Environment and

district have not a little influence in the change of sentiment; Kensington against Islington, for north is north, and west is west, "and never the twain shall meet." But the character of the display is a more powerful influence still. One outstanding feature is, that all the exhibitors may be regarded as having some association with building; and, again, there are no extraneous attractions, with the exception of good music. The Government shows its sense of the value of the exhibition by having representative departments there; there is the Empire Marketing Board, the name being self-explanatory; and at this stall are to be seen several interesting tests results upon timber beams carried out by the Forest Products Research Laboratory. The Department of Scientific and Industrial Research supplies information as to the work carried on at the Building Research Station near Watford, to which reference was made lately in our columns. As the majority of people are interested in building in one form or another, the attendances at Olympia are naturally large; the goods are attractively displayed, and inquiries are dealt with intelligently. The work of various arts and crafts training institutes forms a feature, and there is also an admirable loan collection of antique and modern furniture, the latter from the designs of well-known architects and others. Altogether, there are close upon four hundred exhibitors.

THE trans-Atlantic flight from east to west by a heavier-than-air machine has at last been accomplished. Capt. Hermann Köhl, Commandant James Fitzmaurice, and Baron von Hünefeld started from Baldonnel aerodrome, near Dublin, in the *Bremen*, early in the morning of April 12, and landed at Greenly Island in the Strait of Belle Isle on the following day. Capt. Köhl, manager of the night-flying department of the Deutsche Lufthansa, and Baron von Hünefeld, with a mechanic, flew from Berlin to Dublin on Mar. 26, where they had to await favourable weather conditions for their Atlantic flight. The mechanic was replaced by Commandant Fitzmaurice, acting officer in command of the Irish Free State Air Service, who acted as second pilot when the flight began on April 12. The *Bremen* is a Junker metal monoplane fitted with a 200 k.w. Junker engine. A rough analysis gives aeroplane weight as 1.2 tonnes; crew, etc., 0.2 tonne; fuel and oil 1.6 tonnes, giving 40 hours' flight at cruising speed 150 km./hr., that is, a range of 6000 km. in calm air. The actual geographical distance covered was about 3500 k.m., so that changes in course and head winds reduced the effective speed to about 90 k.m./hr. Herein lies the patent secret of previous failures. A small circle of about 3500 km. with Dublin as centre grazes the North American coast at Greenly Island, the landing point, from which we may infer that another disaster was averted by a sound decision, good navigation, and the last litre of fuel. Capt. Köhl and Baron von Hünefeld attempted a trans-Atlantic flight from east to west last August, but, after making their way from Dessau across England and Ireland, they were forced to turn back by bad weather and lack of fuel.

A PRELIMINARY notice of the International Meeting of Geologists to be held in Copenhagen on June 25-28, on the occasion of the fortieth anniversary of the Geological Survey of Denmark, has already appeared (NATURE, Dec. 17, 1927, p. 890). The provisional programme of excursions has now been revised. Excursions before the meeting are as follows: June 17-20, to Bornholm; June 21-24, to South Sjælland and the Island of Møen. After the meeting a longer excursion, June 29-July 9, is being organised to north-west Sjælland, Fyn and the Island of Langeland, and Jutland. Geologists who are returning to England or France from Esbjerg will have an opportunity of seeing the Yoldia clay of the Mindel-Riss interglacial episode. The number of participants in each excursion is to be limited, and notice of intention to attend should be sent as soon as possible, and in any case before May 1. Full details of cost, itineraries, and accommodation will be found in the second invitation circular, which can be obtained from the Secretary, International Geological Meeting, Danmarks Geologiske Undersøgelse, Gammelmoent 14, Copenhagen K, to whom all other relevant inquiries should be addressed.

MARSTON TAYLOR BOGERT, senior professor of organic chemistry at the Columbia University, New York, who celebrated his sixtieth birthday on April 18, spent the past winter in Prague as the first visiting professor for international relations to Czechoslovakia sent by the Carnegie Endowment for International Peace. As the guest of the Charles' University he delivered five highly interesting lectures on his original researches on thiazoles and selenazoles; odour and chemical constitution; science and industry; science, the individual, and the State; science in the interest of peace. He also gave similar lectures at the Universities in Brno, Moravia, and Bratislava, Slovakia. The Charles' University Medal has been awarded to Prof. Bogert for his work for the advancement of science, and the honorary degree of Doctor Rerum Naturalium of the Charles' University has been conferred upon him for his discoveries and researches in organic and applied chemistry.

PROF. YUKICHI OSAKA has recently retired from the chair of physical chemistry which he has held for twenty-three years at the Kyoto Imperial University. An account of his career by S. Horiba, with a photograph, is given in the *Bulletin of the Chemical Society of Japan* for January. Prof. Osaka came to Europe in 1899, having already had some experience of teaching chemistry, and studied under Ostwald and Nernst. Four years later he was appointed to the chair of applied electrochemistry at Kyoto, but very soon became professor of physical chemistry. He is best known for his work upon heterogeneous equilibria, although he has also conducted researches upon the catalytic effect of the hydroxyl ion and upon over-voltage. Prof. Osaka is sixty years of age, and his latest paper also appears in the above journal.

DR. ROY CHAPMAN ANDREWS, after maintaining the headquarters of the Expedition of the American Museum of Natural History to Central Mongolia

immobile at Peking for a period of two years owing to political troubles in China, has now left Kalgan to resume work in the desert. According to the Peking correspondent of the *Times* in a dispatch in the issue of April 17, he hopes to ensure the safety of the expedition by a capital payment to the Chief Officer of the brigands of the area, a monthly subsidy, and a sum equal to the first capital payment if the expedition returns safely. The expedition consists of ten Americans, experts in palaeontology, geology, archaeology, and topography, and a surgeon, a photographer, and two motor experts, with twenty-six Mongols and Chinese. The expedition will continue its search for traces of earliest man, and in addition of the five-toed horse, believed to be the progenitor of the four-toed fossil horse of Europe and America.

As promised, the results of Prof. Trombetti's researches in the Etruscan language, following his investigation of the "Liber Linteus," the linen book, in which the mummy of an Etruscan lady, discovered in Egypt and now at Agram, had been wrapped, were duly laid before the first International Congress of Linguists which opened at The Hague on April 10. Prof. Trombetti gave it as his opinion that Etruscan could not be regarded as an isolated language, but showed close relation to the Indo-European and belonged to the group in which the pre-Hellenic languages of Asia Minor were to be found. Of the twelve chapters of the "Liber Linteus," one was said to bear every indication of being an account of the *lectisternium*, i.e. the meal provided for the images of various gods, while others contained a litany, an enumeration of the *Cepen* or magistrates, and a calendar giving the dates of various festivals.

WE learn from a *Daily Science News Bulletin*, issued by Science Service of Washington, that F. W. Peek has been able to store in a suitable condenser and discharge electricity at a pressure of three million six hundred thousand volts. The experiments were carried out at the Pittsfield laboratory of the General Electric Company. The object of the research was to imitate as closely as possible the phenomena that happen during a lightning discharge from a cloud, so as to help in designing effective lightning conductors and safety devices. Although the spark lasted less than a millionth of a second, yet its growth and decay were accurately measured by a cathode ray oscillograph, which uses a beam of electrons for a pointer. In some cases the flash lasted only the ten-millionth of a second. Remembering that light travels with a velocity of 3×10^{10} cm. per second, the flash will be over by the time the light has travelled a hundred feet from the spark.

THE following appointments have been made by the Secretary of State for the Colonies: Mr. S. Gillett to be assistant agricultural officer, Kenya; Mr. W. H. W. Baird, to be entomologist, Veterinary Department, Tanganyika Territory; Dr. R. R. Le Geyt Worsley, formerly sub-director of the Chemical Section, Egypt, to be chemist, East African Agricultural Research Institute, Tanganyika Territory;

Mr. J. G. Brash and Mr. J. C. Bytheway, to be produce inspectors, Nigeria. Recent transfers and promotions made by the Secretary of State include: Mr. R. A. Altson, formerly assistant botanist and mycologist, British Guiana, to be assistant mycologist, Department of Agriculture, Federated Malay States and Straits Settlements; Mr. J. T. Templer, formerly administrative cadet, Tanganyika Territory, to be assistant conservator of Forests, Uganda. Mr. Baird's appointment is of interest in that it appears to be the first appointment, on a permanent basis, of an entomologist to a veterinary department in the Colonial Services.

FARMERS' and farm workers' associations and clubs, chambers of agriculture and horticulture, students' societies, and other bodies interested in agriculture or market gardening are again being invited to inspect the Rothamsted and Woburn Experimental Plots during the coming summer. Mr. H. V. Garner and Capt. E. H. Gregory will be available to demonstrate the plots at any time. At Rothamsted the soil is heavy. The experiments deal with the manuring of arable crops, especially sugar beet, potatoes, mangolds, barley, oats, wheat; manuring of meadow hay; effect of modern slags and mineral phosphates on grazing land and hay land; inoculation of lucerne; crop diseases and pests; new experiments are in progress on the laying down of land to grass; demonstrations of modern implements, tractors, and good types of tillages. At Woburn the soil is light. The experiments there are concerned more particularly with the manuring of potatoes, sugar beet, wheat, malting barley, and the use of green manures. All communications and requests to visit the Stations should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden.

THE Faraday Medal of the Institution of Electrical Engineers will be presented to Prof. J. A. Fleming at the ordinary meeting of the Institution to be held on Thursday, April 19, at 6 P.M. The presentation will precede the nineteenth Kelvin Lecture, by Sir Oliver Lodge, on "The Revolution in Physics."

A VIOLENT earthquake was recorded at Kew Observatory on April 16 at 9 h. 4 min. 32 sec. G.M.T. The epicentre is estimated to be 1430 miles away, probably near the western coast of the Black Sea. The disturbance at Kew was of about the same intensity as that produced by the destructive earthquake which occurred near Smyrna on Mar. 31.

THE Council of the Institution of Automobile Engineers has awarded the Institution Medal to Major G. S. Wilkinson for the prominent part taken by him in the design of the Napier Lion 875 h.p. engine fitted to the Supermarine-Napier S5 with which Flight-Lieutenant S. N. Webster won the Schneider Trophy Race in September last.

It will be remembered that at an extraordinary meeting of the general committee of the British Association held on Dec. 2, it was resolved to apply

for a Royal Charter for the Association. Mr. A. A. Campbell Swinton very generously offered to bear the cost of obtaining the Charter. It is now announced that His Majesty the King in Council has been pleased to grant the petition of the British Association.

THE recently issued catalogue of Judex Analytical Reagents and Laboratory Chemicals, issued by the General Chemical and Pharmaceutical Co., Ltd., Willesden, includes a wide range of inorganic and organic chemicals. Among them are analytical reagents of guaranteed purity, standard solutions for volumetric analysis, special reagents for use in the analysis of water, gas, milk, sugar, urine, iron and steel, volumetric solutions of the "British Pharmacopoeia," indicators, chemicals for electro-planting, accumulator acid, etc. Besides supplying rare chemicals for research and analysis, the firm undertakes the manufacture of large or small amounts of unusual substances required for special purposes.

THE "Statistical Report of the Health of the Navy for the Year 1925" and the "Report on the Health of the Army for the Year 1926" have recently been issued by the Admiralty and the War Office respectively (London: H.M. Stationery Office). As regards the Navy, the returns for the total force for the year show a decrease in the incidence of disease as compared with the previous four years' average and with 1924. In the Army, the incidence of sickness was a trifle higher than in 1925. The incidence of tonsillitis again increased, and as a cause of admission to hospital took second place; all attempts to elucidate the cause of this high incidence have so far failed. Middle ear disease, as in the previous year, heads the list of causes of invaliding.

HISTORICAL details given in a catalogue issued by Messrs. W. Ottway and Co., Ltd., manufacturers of optical and scientific instruments, Orion Works, Ealing, W.5, show that the foundations of the business were laid about three hundred years ago. In 1640, the shop at the Royal Exchange occupied by Thomas Francis Ottway, a maker of instruments of a scientific nature, was destroyed by the fire which devastated central London. The business was afterwards carried on at various addresses until 1900, when the present works at Ealing were opened. The firm is still owned and managed by descendants of the original founder, and their works are now so well equipped as to enable the company to manufacture all the various parts required for the instruments produced by them. These include equatorial mountings for reflecting and for refracting telescopes; astronomical transits; astronomical clocks and chronographs; coelostats with driving clocks and with mirrors up to 18 inches in diameter; control instruments for controlling electrically the driving clocks of astronomical instruments; and a wide range of astronomical telescopes with object glasses up to 5 inches aperture. The instruments mentioned are fully described and illustrated in the catalogue, which contains also a list of various types of naval, military, and sporting telescopes. Achromatic object

glasses up to 6 inches clear aperture and 90 inches focal length, heliographs, prismatic compasses, and prismatic binoculars are also included.

THE 1928 edition of "British Spas and Climatic Health Resorts" has recently been published (London: J. and A. Churchill. 1s.). It gives much information concerning the choice of waters and climates and on British and Irish marine and inland health resorts. Lists of the residential accommodation available in the principal resorts are furnished.

IN connexion with the tercentenary of the publication of Harvey's "De Motu Cordis," the Cambridge University Press will issue a limited edition of "A Bibliography of the Works of William Harvey," compiled by Mr. Geoffrey Keynes. The work will be illustrated by a number of collotypes and facsimiles in line. The same house also announces "The Theory of Probability," which Prof. W. Burnside had almost completed at the time of his death. The volume has been seen through the press by Dr. A. R. Forsyth, and includes the memoir of the author which Dr. Forsyth wrote for the Royal Society.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant part-time lecturer in the biology department of the Plymouth and Devonport Technical College—The Secretary for Education, Education Office, Cobourg Street, Plymouth (April 28). A district agricultural organiser under the Essex Agricultural Committee (on the Staff of the East Anglian Institute of Agriculture)—The Clerk of the Essex

County Council, Shire Hall, Chelmsford (April 30). Professorships of geography, medieval history, Egyptian and Oriental history prior to Græco-Roman times, classics and Græco-Roman history, in the Egyptian University, Cairo—The Director, Egyptian Educational Office, 39 Victoria Street, S.W.1 (April 30). A professor of botany in the Egyptian University, Cairo—The Dean of the Faculty of Science, Egyptian University, Cairo (April 30). A junior assistant (engineer) at the Building Research Station, Watford—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (April 30). A government analyst and bacteriologist for Cyprus—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (May 7). A lecturer in physics in the University of Western Australia—The Agent-General for Western Australia, Savoy House, 115 Strand, W.C.2 (May 9). Head of the architectural, building and surveying department of the Northern Polytechnic—The Clerk to the Governors, Northern Polytechnic, Holloway, N.7 (May 11). A temporary agricultural entomologist in Fiji and, possibly, afterwards in the British Solomon Islands Protectorate—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (May 21). An assistant professor in the department of mathematics of the Imperial College of Science and Technology—The Secretary, Imperial College of Science and Technology, South Kensington, S.W.7 (May 25). A curator of the Gloucester Museum—Mr. St. Clair Baddeley, Castle Hale, Painswick, Gloucestershire.

Our Astronomical Column.

NOVA PICTORIS.—Another telegram from Mr. Wood at Johannesburg was distributed from the I.A.U. Bureau, Copenhagen, on April 14. It states that the Nova is now surrounded by a ring 3 minutes of arc in diameter, with two smaller rings inside it. These rings are clearly much too large to be produced by the outward motion of matter from the Nova since the outburst in 1925. We may assume that they are similar to the nebulosity photographed round Nova Persei in the autumn of 1901, which was explained by the hypothesis that the nebulosity was previously there in a dark state, and became visible by reflecting the light of the outburst.

Pop. Astron. for April states that the magnitude of the Nova in mid-December last was 6.77. As it is falling at the rate of a magnitude per annum, it is probably a little fainter than mag. 7 at present. Several of the daily papers erroneously gave its present magnitude as about 11.

COMETS.—M. Mineur obtained an observation at Paris on Mar. 28 of the comet detected on Mar. 17 by M. Giacobini; the following are the two positions:

	R.A.	N. Decl.	Mag.
Mar. 17. 9264	5 ^h 50 ^m 0 ^s	14° 35'	11
28. 9585	6 12 26.5	14 57 39	10½

The daily motion on Mar. 28 was given as +3¼ min in R.A., 0' in decl. The position on April 21 may be about 8^h in R.A., 14° in decl.

Dr. C. P. Olivier states in *Pop. Ast.* for April that the comet Pons Winnecke yielded a rich shower of meteors on June 23 last. Meteors were fairly numerous on June 26-29.

APRIL SHOWER OF METEORS.—These meteors may be expected on April 21, and should attain a maximum either in the morning or evening of that date. Moonlight will not interfere with the display should it actively return this year. The shower is no doubt a periodical one, but the exact period, or that of the supposed associated comet 1861 I, is not known. Apparently the earliest exhibition of the meteors occurred in 687 B.C., and later returns possibly occurred in 15 B.C. and A.D. 582, but identity may not be absolutely certain though the dates conform within small limits.

April is one of the spring months when meteors are generally rare, so that, should the Lyrids fail to present themselves, meteoric apparitions are somewhat scarce, and long vigils are not suitably rewarded. But the special Lyrid shower may develop unusual strength at any time and amply repay observation. The sky should be attentively watched every year at the end of the third week in April, for evidence as to the character of the shower's return cannot fail to add to our knowledge.

On April 21, before daylight, the radiant will be very high and favourably placed for the visibility of its meteors, but the evening hours between 10 and 12 are indicated as the most probable time for the earth's passage through the denser part of the stream. At the latter time the radiant is in the north-east and not very high. Observations of the paths of any bright meteors that may appear will be valuable, whether they belong to the system of Lyrids or to one of the minor displays of this epoch.