

"equivalent constant wind"—*i.e.* the constant wind which produces the same effect at the same time. The latter is obtained by means of a set of "weighting factors" which express the relative importance of the wind at different parts of the trajectory.

Considering the wind effect at any given point, the weighting factor for any section of a trajectory is the ratio of the effect at that point of unit wind blowing in that section only to the effect at the same point of unit wind blowing throughout the trajectory. If W is the actual wind in any section, and k is the weighting factor for that section, then the equivalent constant wind is given by the sum of the values of kW for all sections up to the point where the effect of the wind is being considered.

The same arguments apply to variations of atmospheric density from standard. An account of the application of weighting factors has appeared in a recent number of *NATURE*²; we are concerned here with the calculation of them.

The values of the weighting factors for given sections depend on the point at which the effect of a wind (or change of density) is being calculated, and on the precise effect which is being considered. For example, a wind in the plane of the trajectory produces changes in both horizontal and vertical co-ordinates of the point reached in a given time, and if the wind varies along the trajectory the constant wind which will produce the same horizontal displacement will not generally produce the same vertical displacement.

The four equations of motion of the plane trajectory express the relations between the com-

² *NATURE*, June 17, "The Importance of Meteorology in Gunnery," by Dr. E. M. Wedderburn.

ponents of velocity, the co-ordinates, and the time. From them can be obtained, by a process analogous to differentiation, four "equations of variation" expressing the relations between the changes in these quantities, for a given time, for any change in conditions which causes first order variations in the plane of the trajectory. (A cross-wind produces only second order effects in this plane, and its treatment is entirely separate.)

The equations of variation have no formal solution, and step-by-step integration is necessary for numerical work. To find wind weighting factors, the obvious method is to integrate the equations for winds blowing in the sections for which weighting factors are required; but this is not necessary, for if the integration is performed for three suitable changes of conditions, the results may be combined to give weighting factors, not only for wind, but for density changes as well.

The numerical work of the process of combining the three solutions is rather heavy and not altogether simple, and a more direct way of calculating weighting factors has been worked out. The equations of variation form a system of linear differential equations of the first order, and by using a certain property of such a system another set of equations (the "adjoint" system) can be obtained, the solutions of which give directly the effect at a given time of a constant wind (or density changes) which begins at a previous variable time. Weighting factors are obtained at once by dividing by the effect of a constant wind which begins at the origin, and differencing the results.

The equations of variation may be applied to any problem in first order variations. The subject of second order variations has not been developed, as its practical importance appears small.

Obituary.

THE study of earthquakes in New Zealand and Australia has suffered a serious loss through the death of MR. GEORGE HOGBEN on April 20 last. For many years Mr. Hogben acted as secretary of the seismological committee of the Australasian Association for the Advancement of Science, and we are indebted to him for reports of this committee, and for many studies of individual earthquakes published in the Transactions of the New Zealand Institute and other journals. It was owing to his efforts that the Milne seismograph was erected at Wellington, N.Z., and that, shortly before his death, an order was given for the improved Milne-Shaw seismograph. In addition to his contributions to our knowledge of earthquakes, Mr. Hogben was interested in education generally, and was for two years president of the Wellington Philosophical Society. According to a notice issued with the Hector Observatory Bulletin (No. 28, 1920), he also issued a valuable report on proportional representation, and at the time of his death had an improved set of mathematical tables in the press.

THE *Atti dei Lincei* (vol. xxix. (1), parts 9-10) contains an obituary notice by R. Versari on the late PROF. FRANCESCO TODARO. Born at Tripi (Messina) on February 14, 1839, Todaro entered the University of Messina in 1860, but on the entry of Garibaldi he took up arms as a volunteer in the Chasseurs of Etna. On the conclusion of hostilities and of service to the wounded, he returned to the University, and was attracted by the German biologists to anatomical and physiological studies. He went for some time to study at Florence under Schiff and others, and in 1865 published his first paper on the muscular system of the human heart and the Eustachian valve. He returned to Messina as professor of human anatomy, and in 1869 gave an address on the renewal of the human body. Todaro was among the earliest to study the anatomy of the lower marine animals, and to realise, in accordance with the doctrine of evolution, the importance of comparative anatomy as throwing light on the anatomy of man. In 1870 he read a paper on the sense-tubes of Plagiostomata, and the following year was invited by Brioschi to the chair

of human anatomy at Rome. Shortly afterwards he concentrated his attention on the development and anatomy of the Salpidæ, discovering many new organs. His first paper on this group appeared in 1875, and his last is in proof. Todaro also published papers on the fertilisation and segmentation of *Seps chalcides*. Being the first to advocate the introduction of gymnastics in Italian schools, he was elected president of the Italian Gymnastic Federation, in which capacity he delivered several inaugural discourses at meetings and reunions.

AMONG the many skippers and hunters of northern Norway who have taken part in Arctic exploration one of the best known was HANS CHRISTIAN JOHANNESSEN, whose death at Tromsø at the age of seventy-four is announced by the *Times*. During his sealing and walrus-hunting in the Barents Sea Capt. Johannessen many years ago visited the little-known Wiche Islands to the east of Spitsbergen and the coasts of North-east Land. At a later date he hunted off Novaya Zemlya and Franz Josef Land, penetrating westward to White Island and Spitsbergen. But Capt. Johannessen's principal work was in the navigation of the Kara Sea and the opening of a sea route between Europe and Siberia. When Baron Nordenskjöld sailed in the *Vega* in 1878 to do the North-East passage he was accompanied by the small steamer *Lena* under the command of Capt. Johannessen. Without the help of a pilot Johannessen took the *Lena* safely through the difficulties of the *Lena* delta, and ascended the river for more than 1700 miles to Nyuiskaya, eventually return-

ing to Yakutsk. This was the first steamer to reach Siberia by this route. Johannessen returned overland, and the *Lena* is still in service on the river. Capt. Johannessen piloted many other vessels through the Kara Sea to the Yenisei River. In 1883, in the *Nordenskjöld*, he rescued the crew of the Dutch expedition in the *Varna*, crushed in the Kara Sea. In the *Gjoa*, which he afterwards sold to Amundsen for his North-West passage expedition, Johannessen made many successful hunting expeditions to the Far North.

DR. DUCKWORTH gives in the September issue of *Man* an account, with a full catalogue of his writings, of the eminent Italian anthropologist, MAJOR-GEN. RIDOLFO LIVI, whose death on April 12 last was a serious loss to science. Gen. Livi is best known by his great work, "Anthropometria Militare," published in 1896-98, which deals mainly with the question of physical development in relation to fitness for military service. He was also author of a manual of anthropometry of wide scope and originality, and of a treatise on domestic slavery in Italy in medieval times. Gen. Livi died at the age of sixty-three, his degrees in medicine and surgery being taken in 1878, when he entered the Army. He served in the African campaign of 1887-88 as well as in the recent war, holding at the time of his death the rank of major-general, to which he was promoted in 1917.

WE much regret to announce the death on September 27, at fifty-seven years of age, of MR. D. H. NAGEL, Vice-President and Senior Tutor of Trinity College, Oxford.

Notes.

A SPECIAL conference has been called together by the Royal Society to consider the future of the International Catalogue of Scientific Literature. The conference held its first meeting at Burlington House on September 28, Sir Joseph Thomson in the chair. The following is the list of delegates:—Sir David Prain, Sir Arthur Schuster, Mr. J. H. Jeans, Prof. H. E. Armstrong, Dr. F. A. Bather, and Dr. P. C. Mitchell, representing the Royal Society; Prof. M. Knudsen, Denmark; M. A. Lacroix, France; Dr. G. van Rijnberk, Holland; Prof. R. Nasini and Comm.-Ing. E. Mancini, Italy; Dr. H. Nagaoka, Japan; Mr. R. Laache, Norway; Baron Alströmer, Sweden; Dr. H. Escher, Dr. M. Godet, and Dr. H. Field, Switzerland; Dr. R. M. Yerkes, Dr. L. E. Dickson, Mr. L. C. Gunnell, and Dr. S. I. Franz, U.S.A.; Sir Henry Hayden and Dr. S. W. Kemp, India; Sir Thomas Muir, South Africa; Sir Edward Parrott, Queensland; Prof. E. W. Skeats, Victoria; Mr. C. B. Rushton, Western Australia; and Prof. A. Dendy, New Zealand. The delegates were the guests of H.M. Government at a dinner at the Carlton Hotel on September 29.

WE understand that Mr. Reid Moir, during his investigations of the north-east coast of Norfolk, has

made an important discovery in the neighbourhood of Cromer. It appears that a flint-workshop site, apparently of Early Chellian Palæolithic age, occurs at this place at an horizon referable to one of the lower members of the Cromer Forest Bed series. The site, though limited in extent, is very rich in humanly fashioned flints, and Mr. Moir hopes in the near future to exhibit and describe the large number of specimens he has collected.

THE MINISTER OF HEALTH has appointed a Committee to investigate and report on the causes of blindness, including defective vision sufficient to impair economic efficiency, and to suggest measures which might be taken for the prevention of blindness. The members of the Committee are:—Mr. G. H. Roberts, M.P. (chairman), Mr. Stephen Walsh, M.P., Mr. N. Bishop Harman, Dr. J. B. Lawford, Mr. G. F. Mowatt, Mrs. Wilton Phipps, Mr. J. H. Parsons (representing the Royal College of Surgeons), Dr. J. Taylor (representing the Royal College of Physicians), Mr. J. C. Bridge (representing the Home Office), Dr. A. Eicholz (representing the Board of Education), Mr. J. S. Nicholson (representing the Ministry of Labour), Mr. W. M. Stone (representing the Scottish Office), Mr. E. D. Macgregor (representing the Ministry of Health), and a representative of the Medical Research