Electric Switch and Controlling Gear: A Handbook on the Design, Manufacture, and Use of Switchgear and Switchboards in Central Stations, Factories, and Mines. By Dr. C. C. Garrard. Second edition, revised and enlarged. Pp. xxii+654. (London: Benn Brothers, Ltd., 1920.) Price 25*s*. net.

No considerable alterations have been made in this work since the first edition was reviewed in NATURE of March 1, 1917. Slight modifications have been effected, and recent data in connection with high-tension gear, lightning arresters, etc., added. Two new sections, one dealing with the standardisation of switchgear and the other with automatic contactor switches, have also been inserted.

Milk Testing: A Simple Practical Handbook for Dairy Farmers, Estate Agents, Creamery Managers, Milk Distributors, and Consumers. By C. W. Walker-Tisdale. Second revised edition. Pp. 90. (London: J. North, *Dairy World* Office, 1920.) Price 3*s*. 6*d*. net.

THE recognition of the value and importance of "milk recording" is making it increasingly necessary that simple but trustworthy methods of testing milk should be published for the use of practical farmers. This need is well met by the present edition of Mr. Walker-Tisdale's little book, which has been enlarged and revised since the second edition was noticed in NATURE of August 10, 1911.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Energy of Cyclones.

THERE can be no doubt, I suppose, that solar and terrestrial radiation are ultimately responsible for the kinetic energy of the winds. The doubts expressed by Mr. R. M. Deeley in NATURE of November 11 and by Mr. W. H. Dines in the issue of November 18 can refer only to the details of the phenomena consequent on the process of transformation of the energy. The first stage is obviously the storage of energy in the potential form of air charged with heat and moisture at the surface or lower levels and cooled by radiation at high levels, especially in the polar regions, as on the plateau of Greenland or on that of the Antarctic continent, or on the sunless slopes of the Himalaya. Equally without doubt the next step is convection, the greater part of which is indicated here and there by falling rain or snow. Measurements of rainfall assure us that there is no lack of energy available for violent winds if the heat-engine is at all efficient.

The general effect of the process of convection is the development of a vast circulation in the upper regions of the atmosphere from west to east round the poles, which has its counterpart in the normal distribution of pressure at corresponding levels. That is probably most pronounced at a level of 8 km., because at that level density is equal all over the globe at all seasons of the year. Above that level, up to the level of equal pressure at 20 km. of which Mr. Dines writes, there is, on the average, a gradient of density from the equator to the pole, and below the level of 8 km. a gradient of density in the opposite direction. The layer of maximum average velocity is above the layer of maximum pressure-gradient on account of the diminution of density with height.

Below the level of 8 km. the distribution of pressure is affected by the gradient of density in a very irregular manner, because the distribution of land and water is irregular. The net result at the surface is the complicated distribution of average pressure which we find in the maps of normals for sea-level.

The maintenance of the average general circulation from west to east in the higher levels is due to the gradual convergence towards the polar areas from which the cooled air flows. That must obviously be balanced by a corresponding flow towards the equator, and as poleward flowing entails a westerly circulation, so flowing towards the equator entails an easterly one. We must, therefore, find room in the system for a body of air flowing from the east comparable at least with the circulation from the west. We find such a body of air in the great easterly circulation of the intertropical regions, which is naturally stowed away over the equator as far as possible from the centres of the two polar demi-hemispheres of influence of pressure-gradient.

These great circulations, easterly and westerly, form a normal "groundwork" of all atmospheric motion; and when Mr. Deeley and Mr. Dines write of the energy of cyclones, they are not concerned, I think, with the energy of the general circulation of the upper levels which I have described, but with the minor circulations which represent the perturbations of the major circulation.

I think myself that the convection of warm, moist air, combined with the vagaries of temperature in the lower layers, will, in the end, prove to be sufficient to explain the energy of cyclonic air-currents—whether directly or as the secondary effect of current-differences, I cannot say. Probably, in order to get a correct view of the perturbations, we ought to subtract vectorially from the observed winds the local motion of the normal circulation, or else accustom ourselves more than we do to the theoretical combination of local circulation with a general circulation.

There are four other aspects of the problem upon which we are at present almost uninformed. The first is the locality where the cyclone, which is the subject of study, was generated; just as the cyclone itself is a perturbation of the general circulation, so what we see going on over our heads is the perturbation of a cyclone which may have originated in the general circulation thousands of miles away. A cyclone is a more or less stable dynamical system which certainly travels, but changes as it travels. The second aspect is the variation of velocity of the wind with height in the general circulation and in the cyclonic area itself. The third, which is closely connected with the second, is the trajectory of convected air. This could be calculated if we knew the point from which it started and the variation with height of the current which carried it. One often reads of convected air rising *vertically*, but we know that the actual trajectories of a pilot-balloon are of very various shapes, seldom vertical, and the balloon may part company from the air which supported it at the start by a distance measured in tens of kilometres. Air in convection rises very slowly. If we set its vertical velocity at one-hundredth of that of a pilot-balloon, the convected air may be thousands of kilometres from the starting point before its upward journey is finished, and its path may be very com-