## ECONOMIC ENTOMOLOGY

THE Royal Horticultural Society has just offered the following prizes for collections of Economic Entomology:—

1. A prize of 10*l.* for the best collection of British insects injurious to any one plant, as the oak, pine, cabbage, wheat, &c. (the choice of the plant to be left to the competitor). The insects to be shown as much as possible in their various stages of development—eggs, larva, chrysalis, and perfect insect. In judging, a preference will be given to those collections which most successfully illustrate the life history of the insect, and exhibit the mischief done, whether shown by specimens, drawings, models, or other means. Examples of the application of drawings, models, and specimens to this purpose may be seen in the Society's collection in the South Kensington Museum.

2. A second prize of 3*l.* for the second best collection.

3. A prize of 5*l.* for the best miscellaneous collection of any branch of British Economic Entomology, similarly illustrated.

4. A second prize of 2*l.* for the second best collection.

The collections to be sent to Mr. James Richards, Assistant Secretary, Royal Horticultural Society, on or before the 1st of May, 1872, each collection bearing a motto, and a separate sealed envelope, with the motto on the outside, and the name of the competitor inside.

The Society is to be entitled to take from any of the collections sent in, whether successful or not, whatever specimens or illustrations they may choose, at a price to be fixed by the judges.

The judges to have power to refrain from awarding the prizes, should the collections seem not worthy.

## SCIENCE TEACHING IN ORDINARY SCHOOLS

A PLAN for teaching the Natural Sciences in ordinary schools has been submitted to the School Board for London by Mr. J. C. Morris. The following are stated by the *Journal of the Society of Arts* to be the principal points of the proposed system:—Subjects—chemistry, heat, light, sound, electricity, magnetism, telegraphy, mechanics, hydrostatics, steam engine, &c.; geology, metallurgy, botany, zoology, animal physiology, health, &c. A committee should be formed to select, revise, and compile a complete set of suitable text books, which should bear their sanction, and be then published in the cheapest possible form. There should be a depôt to provide apparatus at a cheap rate, a complete set of which, sufficient to illustrate the sciences mentioned, would not cost more than 100*l.*, and should be divided into ten cases of 10*l.* each, a case to be complete for one or two subjects. The teacher should be a visting one. He could attend from two to three schools per day, and give from one to two hours' instruction in each, during two days in the week. The instruction to be given in a separate apartment, if there be one; or, if not, at such a time as would not interfere with ordinary school business. A single school teacher could thus attend from six to nine schools weekly, if sufficiently near each other, and get through at least three or four subjects annually, so that in two or three years he would have completed the full course in each school.

There should be an institution where teachers would have an opportunity of acquiring a practical knowledge of their profession, and affording a means of testing their qualifications. A more economical way, however, would be for each teacher to have an assistant, by which method a nucleus of teachers would soon multiply into a goodly number. In conclusion, Mr. Morris advocates periodical examinations, with a regular system of rewards; and, in reference to funds, he thinks that the teachers and inspectors might be supported either by Government or subscription, the apparatus to be supplied by Government at reduced rates. Schools should fix a small fee for attending the class, which would add to its importance, and help to defray expenses. Examination fees in like manner. Evening classes for adults could be managed under somewhat similar conditions.

## THE INFLUENCE OF AQUEOUS VAPOUR ON METEOROLOGY

THE remarks on Meteorology contained in your summary of the scientific advances during the last year, encourage me to offer a few observations on the subject. Where so little is determined, speculations even by unknown contributors may receive some consideration. I shall begin with the subject of aqueous vapour, to which, I think, too much importance has in some respects been attached as a meteorological agent.

I shall commence by offering a determination of the specific heat of aqueous vapour at constant volume, which has not, to my knowledge, been hitherto given. It is evident that if a given weight of water be evaporated at 0° C., and then raised to 100° C., without change of volume, the total heat absorbed by it is the same as if it had been raised to 100° C. in the condition of water, and then evaporated so as to fill the same volume. Now if this amount be one kilogramme, and $c$ be the specific heat of vapour at constant volume, the total heat absorbed in the first case is (adopting Regnault's formula for latent heat—viz., $L = 606^\circ{\cdot}5 - 0{\cdot}695\,t$)—

$$606^\circ{\cdot}5 + 100\,c.$$

And in the second case the equivalent amount is

$$537^\circ + 100{\cdot}8 = 637{\cdot}8,$$

the total amount of heat required to raise one kilo. of water from 0° to 100° C. being 100·8, according to the best determinations.

From this equation we obtain for the mean value of $c$ between 0° C. and 100° C.

$$c = 0{\cdot}313$$

But the specific heat of aqueous vapour at constant pressure seems to be about 0·475. Hence for each kilo. of aqueous vapour raised through 1° C. at constant pressure, we have 0·313 heat units expended on internal work, and 0·162 on external work. The proportion is 1 : 0·517. In dry air the proportion in question, according to the latest determinations, seems to be 1 : 0·421. If the same amount of heat therefore be applied to produce expansion in vapour and in dry air, it produces a greater expansion in the former case. But the difference is not very material. In round numbers 30 per cent. of the absorbed heat is employed in producing expansion in one case, and 35 per cent. in the other. Apart from the different absorptive powers of air and vapour, this difference would be hardly perceptible. For equal quantities, heat absorbed by vapour has little (if any) greater effect in producing air currents or barometric depressions than heat absorbed by air. If the heat is absorbed in *producing* evaporation, the effect is still less. It is well known that less than one-eighth of the heat so absorbed goes to produce external work—a much smaller proportion than if it had been absorbed by dry air. I may observe that the result here arrived at for aqueous vapour supposes that its co-efficient of expansion between 0° C. and 100° C. is greater than that for air in the proportion of nearly 7 to 6. This would make the mean co-efficient about 0·00427 for 1° C. between these limits.

The next thing to ascertain is the quantity of aqueous vapour suspended in the air at any given time. This, of course, cannot be ascertained exactly, but it seems to me to be wholly erroneous to measure it by the tension of vapour at the earth's surface relatively to the pressure of dry air. It is generally supposed that the upper strata of the atmosphere are relatively drier than the lower; but even if we suppose them to have an equal relative humidity, the actual vapour-tension will become less in proportion to the tension of dry air at every step of the ascent. According to Sir J. Herschel, the law by which the temperature varies with the pressure of the air at any elevation is given (in Fahrenheit degrees) by the law

$$t = -87^\circ + 9{\cdot}0667\,p - 0{\cdot}1333\,p^2$$

Assuming this law, and supposing the relative humidity constant, we can calculate the temperature corresponding to any given pressure, and then find the corresponding vapour-tension by reference to the table. By trying this for each separate inch of pressure from 30 inches down to 0, and calculating the vapour-tension in each inch, I find (on a rough approximation) that the average proportion of the vapour-tension to the dry-air pressure will not exceed one-half of that which we find at the earth's surface. Thus, when the vapour-tension at the earth's surface is half an inch in 30 inches, or $\frac{1}{60}$, the average vapour-tension throughout the aërial column does not exceed $\frac{1}{120}$ of the whole; and when we calculate the weight of the superincumbent vapour, we must further allow for its smaller specific gravity. Making this correction, I believe that when the tension of vapour at sea-level is half an inch, the real weight of the superincumbent vapour-column seldom exceeds that of one-sixth of an inch of mercury. The proportions of course are not fixed. Those which I take from Herschel answer best for a temperature at the earth's surface of about 65° F., or 18° C.

I intend to apply these observations chiefly to the explanation of the annual and diurnal variations of the barometer by the greater or less amount of aqueous vapour in the air. It is supposed, for example, that when the vapour-tension at the earth's surface is an inch, about $\frac{1}{30}$ of the whole air-column consists of vapour. This displaces an equal bulk of air, and thus the column is lighter than a dry-air column of the same height and temperature by the difference in weight of the air and vapour occupying this space, *i.e.* about $\frac{3}{8}$ of an inch, or $\frac{1}{80}$ of the whole. But if my computation is correct, the diminution of weight owing to this cause would only be $\frac{3}{16}$ of an inch, or $\frac{1}{160}$ of the whole. Taking the standard pressure at 30 inches, this would only account for a diminution of 0·187 of an inch when the air from being absolutely dry changed to one inch of vapour-tension. In this country we never experience absolute dryness, and we seldom if ever experience so much as an inch of vapour-tension at the surface. Yet the annual variations of the barometer exceed 0·187 of an inch. Looking, for example, at the table for Greenwich Observatory at the end of Herschel's work, I find the mean monthly pressure varying between 29·923 and 29·602 inches, a difference of 0·321 inches; while the monthly means of vapour-tension vary between 0·466 and 0·195, a difference of 0·271; which, as I have endeavoured to prove, would only account for a change of 0·051 in the mean pressure. The diurnal maxima and minima at the same place exhibit a difference of 0·018, the vapour-tension giving 0·042, which only accounts for about 0·008.

The same thing is more evident in other places. At Madrid for example, the monthly barometric averages vary between 28·003 and 27·701, a difference of 0·302, while the vapour-tension varies between 0·236 and 0·076, a difference of 0·160. At Longwood, St. Helena, the diurnal variation of the barometer gives a mean of 0·067, while that of the vapour-tension is only 0·030. This would only account for a change of 0·006, or less than $\frac{1}{10}$ of the actual change. At Bombay the diurnal variation of the barometer amounts to 0·102 inches, while the corresponding variation of vapour-tension is only 0·004. This would not account for one hundredth part of the change.

The same result is confirmed by taking another view. It is pretty evident that in a country of any considerable extent the diurnal oscillation of the barometer (which is often nearly double the diurnal variation), if produced by changes of vapour-tension, must always be less than the mean diurnal rainfall and dew-fall, since rain often falls at hours when the barometer is on its diurnal descent. Now in this country the mean diurnal rainfall does not exceed $\frac{1}{15}$ of an inch, corresponding in weight to $\frac{1}{200}$ of an inch of mercury. Supposing all this to fall during the hours when the mean barometric pressure is increasing, the subtraction of that amount of aqueous vapour from the column, and the replacing of it by air, would not nearly account for the observed diurnal oscillations.

I therefore conclude that the annual and diurnal variations of the barometer are not due to changes in the amount of vapour present in the aërial column. Indeed it does not seem certain that the vapour displaces air at all. It may simply permeate that column without displacing any of it, and thus add to the weight of it. Again, if it displaced air, condensation or the formation of dense clouds ought always to be attended with a rise in the barometer, since air would rush in to fill up the space which the vapour vacated on condensing. This does not seem to be the case.

W. H. S. MONCK

## THE ROYAL SOCIETY OF VICTORIA

WE owe an apology to our scientific friends at the Antipodes for having allowed the president's address, delivered last July, to have remained so long unnoticed. Mr. Ellery, after noticing the most important papers that had been read during the past two sessions (for no address was delivered in 1870 in consequence of alterations being made in the Society's buildings), including eight on physical science, seven on geology, mineralogy, and palæontology, one on natural history, three on medical science, one on social science, and four on arts and manufactures, expresses his regret that the state of their finances has for a time caused a stoppage in the printing of their Transactions which were commenced in 1868. He then proceeds to notice the present state of the chief scientific establishments in Victoria. "Botanical knowledge," he observes, "is largely indebted to the labours of our member, Dr. Von Müller, the head of the botanical department of Victoria. One of the prominent results of Dr. Müller's investigations is the publication of the *Universal Flora of Australia* (under the editorship of Mr. Bentham), to which Dr. Müller is the principal contributor; the fifth volume has, by this time, passed the press in London. This work, when completed, will be the only one extant that deals universally with the flora of a large division of the earth's surface. It will form a permanent basis of all future research with respect to the adaptability of Australian plants to medicine, the arts, or other useful purposes. You will be glad to learn that Dr. Müller is about to establish a permanent phytological collection in our new industrial museum, which will comprise objects illustrative of our natural resources in the vegetable kingdom, and of materials used in the industries obtained from plants in this country as well as other parts of the globe. Such a collection properly arranged and accessible to the public will undoubtedly prove a valuable and instructive addition to the industrial museum, more especially if at the same time Dr. Müller fulfils a project he has in contemplation of publishing in a popular form a volume on the culture of utilitarian plants in the colony not indigenous to it, as well as of plants likely to add to the resources of countries lying under similar latitudes to our own. The preservation and perpetuation of our more extensive forests has already become a question of serious import. A few years ago we thought our forests inexhaustible; but already the bad effects of the indiscriminate stripping of our mountain ranges are becoming visible. The immense and increasing draft on our forests for fuel and other purposes has already denuded the land in the vicinity of towns and other centres of population of its former covering of timber. This, unless replaced by artificial planting, will eventually leave our hills bare, and in all probability the climate will suffer in proportion. Dr. Müller, in introducing and rearing very large numbers of forest trees that will be useful in themselves for the wood and bark, has exercised a wise forethought, of which the colony will reap the fruit in years to come, when the corks, oaks, hickories, red cedars, and firs, shall have in part replaced our eucalypti, mimosæ, and other far less useful trees."

"Our observatory," he adds, "has been engaged with its usual work in astronomy, meteorology, terrestrial magnetism, and general physics. Considerable progress has been made in the Melbourne portion of the survey of the southern heavens; the sky lying between the 60th and 52nd parallels of declination has been carefully surveyed, and the positions of 38,305 stars established and catalogued, of which 29,633 have been reduced to the epoch agreed upon, namely, 1875, and their positions at that date computed. Our staff of self-registering meteorological instruments may now be considered complete, and consist of three magnetographs (that is for declination, dip, and horizontal intensity), a thermograph, a barograph, electrograph, and anemograph. With these instruments a continuous and unceasing record is obtained by the aid of photography of all the variations in the force and direction of the earth's magnetism, of the temperature of the air, and of evaporation, of the state and variations of the pressure of the air, atmospheric electricity, as well as of the direction, changes, and force of the wind."

The great Melbourne telescope, which, when the address was delivered, had been fairly at work for ten months, is then considered, and Mr. Ellery observes that while the Society is disappointed in not getting, as it was hoped, the best telescope in the world, the members may feel satisfied that they have obtained an instrument that, "if it does not exceed, quite equals every other of its sort that has been yet made."

The progress of the survey is then noticed at considerable length. "The coast line from the boundary of South Australia