It is a minor matter, but it seems a pity that the nomenclature of the species in a standard work like "Darwinism" should not be scrupulously exact. Thus (p. 17), "*Phalæna*" *graminis* should be *Charæas graminis*. "*Helisonia*" (p. 44) should be *Helisoma*, and it is only a section, or subgenus, of *Planorbis*. On p. 235, "*filipendula*" and "*jacobeæ*" should read *filipendulæ* and *jacobææ*. "*Sphinx fuciformis*," of Smith and Abbott (p. 203), is really *Hemaris diffinis*, while on p. 204, "*Sphinx*" *tersa* is a *Chærocampa*, and "*Sphinx pampinatrix*" is *Ampelophaga myron*. T. D. A. COCKERELL.

West Cliff, Custer Co., Colorado, January 22.

A Formula in the "Theory of Least Squares."

SOME time ago, having had occasion to investigate the relation between $\Sigma(x^2)$ and $\Sigma(v^2)$ in the "Theory of Least Squares," I found a simple formula which connects them, and which I have never seen given in any of the text-books on the subject. I inclose it, and hope it is worth publishing in your journal.

University of Toronto, February 1. W. J. LOUDON.

Let a number of observations be made on a quantity whose true value is T. If these observations be represented by M_1, M_2, M_3, . . . M_n, then the most probable value is A, the arithmetic mean, and $A = \frac{\Sigma(M)}{n}$. If, moreover, the true errors be denoted by x_1, x_2, x_3, . . . x_n, and the residuals by v_1, v_2, v_3, . . . v_n, then $\Sigma(v) = 0$ by the definition of the arithmetic mean. It is required to find a relation between $\Sigma(x^2)$ and $\Sigma(v^2)$. We have—

$$\begin{aligned} x_1 &= T - M_1 \quad &\text{and} \quad v_1 &= A - M_1 \\ x_2 &= T - M_2 & v_2 &= A - M_2 \\ x_3 &= T - M_3 & v_3 &= A - M_3 \\ &\text{\&c.,} & &\text{\&c.,} \end{aligned}$$

from which $\Sigma(v) = 0$.

$\therefore$ equating equal values of M_1, M_2, M_3, . . . , &c., we get—

$$\left.\begin{aligned} T - x_1 &= A - v_1 \\ T - x_2 &= A - v_2 \\ T - x_3 &= A - v_3 \\ &\text{\&c.} \end{aligned}\right\} \quad \text{or} \quad \begin{aligned} x_1 &= v_1 + T - A \\ x_2 &= v_2 + T - A \\ x_3 &= v_3 + T - A \\ &\vdots \end{aligned}$$

$$\text{and adding} \quad \Sigma(x) = \Sigma(v) + n(T - A)$$
$$\text{and} \quad \Sigma(v) = 0.$$
$$\therefore \quad \Sigma(x) = n(T - A) \quad . \ . \ (1)$$

Again—

$$\begin{aligned} x_1 &= v_1 + T - A \\ x_2 &= v_2 + T - A \\ &\text{\&c.} \end{aligned}$$

$\therefore$ squaring, we have—

$$\begin{aligned} x_1^2 &= v_1^2 + 2v_1(T - A) + (T - A)^2 \\ x_2^2 &= v_2^2 + 2v_2(T - A) + (T - A)^2 \\ x_3^2 &= v_3^2 + 2v_3(T - A) + (T - A)^2 \\ &\text{\&c.} \end{aligned}$$

$$\therefore \quad \Sigma(x^2) = \Sigma(v^2) + 2\{\Sigma(v)\}\{T - A\} + n(T - A)^2$$

But $\Sigma(v) = 0$; and from (1), $T - A = \frac{\Sigma(x)}{n}$;

$$\therefore \quad \Sigma(x^2) = \Sigma(v^2) + n\left\{\frac{\Sigma(x)}{n}\right\}^2$$

$$\Sigma(x^2) = \Sigma(v^2) + \frac{\{\Sigma(x)\}^2}{n}.$$

This is the exact formula; from which it may be seen that, as positive and negative errors are equally likely, a close approximation will be obtained by taking $\{\Sigma(x)\}^2 = \Sigma(x^2)$, neglecting $2\Sigma(xx^1)$.

And we obtain Gauss's formula—

$$\Sigma(x^2) = \Sigma(v^2) + \frac{\Sigma(x^2)}{n}, \quad \text{or} \quad \frac{\Sigma(x^2)}{n} = \frac{\Sigma(v^2)}{n - 1}.$$

Galls.

ADMITTING, with Prof. Romanes (NATURE, February 20, p. 369), the plausibility of Mr. Cockerell's view that galls may be attributed to natural selection acting on the plants directly, I beg leave to point out a very obvious difficulty—viz. the much greater facility afforded to the indirect action through insects, by the enormously more rapid succession of generations with the latter than with many of their vegetable hosts—oaks, above all.

Freiburg, Badenia, February 22. D. WETTERHAN.

The Cape "Weasel."

IN Prof. Moseley's account of his visit to the Cape of Good Hope ("Notes of a Naturalist on the *Challenger*," p. 153), the following sentence occurs:—"Again, there are tracks of the Ichneumon (*Herpestes*), called by some name sounding like 'moose haunt.'"

In Todd's "Johnson's Dictionary," 1827, we find: "*Mouse-hunt*, a kind of weasel;" two quotations being given:—(1) "You have been a mouse-hunt in your time" ("Romeo and Juliet," iv. 4). (2) "The ferrets and mouse-hunts of an index" (Milton, "Of Ref. in Engl.," B. 1).

Halliwell's "Dictionary of Archaic and Provincial Words" (1847) gives, on p. 564: "*Mouse hound, East.* A weasel." Halliwell denies the identity of this word with Shakespeare's mouse-hunt; and Nares ("Glossary") inclines to a similar view. But in any case it seems clear that Prof. Moseley's "moose-haunt" is a dialectical English form—mouse-hunt or mouse-hound; a general word for "weasel." E. B. TITCHENER.

3 Museum Terrace, Oxford, February 17.

The Chaffinch.

THE chaffinch sings almost throughout the year in this locality. The male bird never leaves us in winter like the female, and can be seen in large flocks daily. A singular circumstance that occurred here in December 1888 with regard to a chaffinch may be of interest. At one o'clock in the morning, during a gale, a chaffinch tapped at my study window. On this being opened, it flew into the room and roosted on a bookshelf; next morning it was liberated. This was repeated on two subsequent gales. Not only did it sing each time on being liberated, but all through the winter and spring it followed me about the garden, singing. E. J. LOWE.

Shirenewton Hall, near Chepstow, February 11.

ON THE NUMBER OF DUST PARTICLES IN THE ATMOSPHERE OF CERTAIN PLACES IN GREAT BRITAIN AND ON THE CONTINENT, WITH REMARKS ON THE RELATION BETWEEN THE AMOUNT OF DUST AND METEOROLOGICAL PHENOMENA.[1]

THE portable dust-counting apparatus, with which the observations given in the paper were taken, was shown to the meeting. The apparatus, which was described in a previous communication to the Society, is small and light. It is carried in a small sling-case measuring 8 × 5 × 3 inches. The stand on which it is supported when in use packs up, and forms, when capped with india-rubber ends, a handy walking stick, 1¼ inch in diameter and 3 feet long. No alterations have been made in the original design, and the silver mirrors which at first gave trouble and required frequent polishings, have been used every day for two or three weeks without requiring to be polished, when working in fairly pure country air.

With the paper is given a table containing the results of more than two hundred tests made with the apparatus. In addition to the number of dust particles there is entered in the table the temperature and humidity of the air, the direction and force of the wind, and the transparency of the air at the time.

The first series of observations were made at Hyères, a small town in the south of France, situated about 2 miles from the Mediterranean. The observations were made on the top of Finouillet, a hill about 1000 feet high. The number of particles on different days varied here from 3550 per c.c. to 25,000 per c.c., the latter number being observed when the wind was blowing direct from Toulon, which is distant about 9 miles.

Cannes was the next station, the observations being

[1] Abstract of Paper read before the Royal Society of Edinburgh on February 3. Communicated by permission of the Council of the Society.

made on the top of La Croix des Gardes. The number here varied from 1550 per cubic centimetre, when the wind was from the mountainous districts, to 150,000 when it came from the town.

At Mentone the number varied from 1200 per cubic centimetre in air from the hills to 7200 in the air coming from the direction of the town.

Tests were made of the air coming towards the shore from the Mediterranean at three different places—at La Plage, Cannes, and Mentone. In no case was the amount of dust small. The lowest was 1800 per cubic centimetre, and the highest 10,000 per cubic centimetre.

Observations were also made at Bellagio and Baveno, on the Italian lakes. At both stations the number was always great—generally from 3000 to 10,000 per cubic centimetre. This high number was owing to the wind, during the time of the observations, being light and southerly—that is, from the populous parts of the country. Smaller numbers were observed at the entrance to the Simplon Pass and at Locarno, at both of which places the wind blew from the mountains when the tests were being made.

A visit of some days was made to the Rigi Kulm. On the first day, which was May 21, the top of the mountain was in cloud, and the number of particles was as low as 210 per cubic centimetre. Next day the number gradually increased to a little over 2000 per cubic centimetre, after which the number gradually decreased till on the 25th the number was a little over 500 per cubic centimetre at 10 a.m. On descending the mountain to Vitznau the same day, the number was found to be about 600 per cubic centimetre at midday, and in the afternoon at a position about a mile up the lake from Lucerne the number was 650 per cubic centimetre.

Most of the observations taken of Swiss air show it to be comparatively free from dust. This is probably owing to the vast mountainous districts extending in many directions. It is thought that much of the clearness and brilliancy of the Swiss air is due to the small amount of dust in it.

Owing to the kindness of M. Eiffel an investigation of the air over Paris was made on the Tower on May 29. The day was cloudy and stormy, with southerly wind. Most of the observations were taken at the top of the Tower, above the upper platform, and just under the lantern for the electric light. The number of particles was found to vary very rapidly at this elevation, showing that the impure city air was very unequally diffused into the upper air, and that it rose in great masses into the purer air above. Between the hours of 10 a.m. and 1 p.m. the extreme numbers observed were 104,000 per cubic centimetre and 226 per cubic centimetre. This latter number was obtained while a rain-cloud was over the Tower, and, as the shower was local, the descending rain seems to have beaten down the city air. The low number continued some time, and was fairly constant during the time required for taking the ten tests of which the above low number is the average.

The air of Paris was tested at the level of the ground on the same day, the observations being made through the kindness of M. Mascart in the garden of the Meteorological Office in the Rue de l'Université. The number on this day varied from 210,000 to 160,000 per cubic centimetre.

Very few tests have been made of the air of London. The air coming from Battersea Park, when a fresh wind was blowing from the south-west, on June 1, was found to vary from 116,000 to 48,000 per cubic centimetre. The numbers observed in cities are of no great value, as so much depends on the immediate surroundings of the position where the tests are made; so that, while no ow number can be observed, a very high one can always be obtained. Those recorded were taken where it was thought the air was purest.

Observations have been made in Scotland for periods of two or three weeks at three stations—namely, at Kingairloch, which is situated on the shore of Loch Linnhe, and about fourteen miles to the north of Oban, at Alford in Aberdeenshire, the observations being made at a distance of two miles to the west of that village, and at a situation six miles north-west of Dumfries.

At Kingairloch the number varied from 205 per cubic centimetre to 4000 per cubic centimetre. At Alford from 530 to 5700 per cubic centimetre, and at Dumfries from 235 to 11,500 per cubic centimetre. These three stations were in fairly pure country air—that is, pure as regards pollution from the immediate surroundings.

Tests were also made of the air on the top of Ben Nevis on August 1, when the number was found to be 335 per cubic centimetre at 1 p.m., and 473 two hours later. On the top of Callievar, in Aberdeenshire, on September 9, the number was at first 262, and rose in two hours to 475 per cubic centimetre.

The pollution of the earth's atmosphere by human agencies is then considered, and it is pointed out that, while on the top of the Rigi and in the wilds of Argyllshire air was tested which had only a little over two hundred particles per cubic centimetre, near villages the number goes up to thousands, and in cities to hundreds of thousands. The increase, though great, is shown not to be in proportion to the sources of pollution, and it is pointed out that part of this is owing to the impure stream of air being deepened as well as made more impure.

About 200 particles per cubic centimetre is the lowest number yet observed, but we have no means of knowing whether this is the lowest possible, or of knowing how much of this is terrestrial and how much cosmic, formed by the millions of meteors which daily fall into our atmosphere. Even in the upper strata there seems to be dust, as clouds form at great elevations.

The effect of dust on the transparency of the atmosphere is then discussed with the aid of the figure in the table. It is shown that the transparency of the atmosphere depends on the amount of dust in it, and that the effect of the dust is modified by the humidity of the air. With much dust there is generally little transparency, but it is pointed out that air with even 5000 particles per c.c. may be clear, if it is so dry as to depress the wet-bulb thermometer 10° or more. By comparing days on which there was the same amount of dust, it is seen that the transparency varied with the humidity on two days with the same amount of dust; but the one with a wet-bulb depression of 13° was very clear, while the other, with a wet-bulb depression of only 2°, was very thick.

To show the effect of the number of particles on the transparency, a number of days are selected on which the humidity was the same, when it is seen that when the wet-bulb was depressed 4°, with 550 particles the air was clear, medium clear with 814, but thick with 1900. From the table a number of cases are taken illustrating the dependence of the transparency of the air on the number of particles in it, and on the humidity, both dust and humidity tending to decrease the transparency. Humidity alone seems to have no influence on the transparency apart from the dust, but it increases the effect of the dust by increasing the size of the particles.

The modifying effect of the humidity is shown to be influenced by the temperature. The same wet-bulb depression which will give with a given number of particles a thick air at a temperature of 60° will give a clearer air if the temperature be lower. This is illustrated by examples taken from the table. The increased thickening effect accompanying the higher temperature will be due to the increased vapour-pressure permitting the dust particles to attach more moisture to themselves. These remarks all refer to what takes place in what is called dry air—that is, air which gives a depression of the wet-bulb thermometer.

The conclusion come to from the consideration of all the observations is that the dust in the atmosphere begins to condense vapour long before the air is cooled to the dew-point. It seems probable that in all states of humidity the dust has some moisture attached to it, and that, as the humidity increases, the load of moisture increases with it.

Another method of testing the condensing power of dust for water-vapour is then described. In working this method the dust is collected on a glass mirror, and its condensing power is determined by placing the mirror over a cell in which water is circulated, in the manner of a Dines hygrometer. The temperature at which condensation takes place on the dust and on a cleaned part of the glass is observed. The difference in the two readings gives the condensing power of the dust. One kind of dust artificially prepared was found to condense vapour just at the dew-point, while another condensed it at a temperature 17° above the saturation-point. The atmospheric dust was collected on the mirrors on the same principle as that used in the thermic filter described by the author in a previous paper, the dust being deposited by difference of temperature, the necessary heat being obtained by fixing the collecting mirrors on a window-pane. Dust was also collected by allowing it to settle on the plates. The atmospheric dust was found to condense vapour at temperatures varying from 1°·8 to 4°·5 above the dew-point. This condensing power of dust explains why glass such as that in windows, picture frames, &c., often looks damp while the air is not saturated; and in part it explains why it is so necessary to keep electrical apparatus free from dust, if we wish to have good insulation.

The constitution of haze is then considered. It is shown that in many cases it is simply dust, on which there seems to be always more or less moisture. But as what is known as haze is generally seen in dry air, the effect is principally due to dust.

Some notes from the Rigi Kulm are given, where "glories" and coloured clouds were seen. The condition of the transparency of the lower air as seen from the top of the mountain is discussed with the aid of the observations made by observers at the lower levels. These observations were kindly supplied by M. Bilwiller, of the Swiss Meteorological Office. The difference observed at the top of the mountain in the transparency of the air in different directions is shown to have been caused by a difference in the humidity of the air in the different directions. The variation in the number of particles on the top of the mountain is considered, and it is shown that the great increase in the number which took place on the second day was probably due to the valley air being driven up the slopes, reasons being given for this supposition. The colouring in clouds, and on scenery at sunrise and sunset, as seen from the tops of mountains and valleys, is remarked upon, and it is shown that there is reason for supposing that when seen from the lower level the colours will generally be the more brilliant and varied.

The relation of the amount of dust to the barometric distribution is then investigated—as to whether cyclonic or anticyclonic areas have most dust in them. It is shown that there is most dust in the anticyclonic areas. The interpretation of this, however, is shown to be that the amount of dust depends on the amount of wind at the time, and as there is generally little wind in anticyclonic areas, there is generally much dust. Diagrams are given showing by means of curves the amount of dust on each day, and also the velocity of the wind. The curves are found to bear a close relation to each other—when the one rises the other falls. The only exceptions to this are when the stations where the observations were made are not equally surrounded in all directions by sources of pollution. In that case, even with little wind, if it blows from an unpolluted direction the amount of dust is not great.

The increase in the dust particles which takes place when the wind falls, seems to point to a probable increase of the infection germs in the atmosphere when the weather is calm. As, however, the conditions are not quite the same, the organic germs being much larger than most of the dust particles, and settling more quickly, it may be as well, while accepting the suggestion, to refrain from drawing any conclusion.

In all the fogs tested, the amount of dust has been found to be great. This is shown to be what might now be expected from a consideration of the conditions under which fogs are formed. One condition necessary for the formation of a fog is that the air be calm. But when the air is calm both dust and moisture tend to accumulate, and the dust, by increasing the radiating power of the air, soon lowers its temperature and causes it to condense vapour on the dust and form a fog. The thickness of a fog seems to depend in part on the amount of dust present, as town fogs, apart from their greater blackness, are also more dense than country ones. The greater amount of dust in city air, by increasing its radiating power, it is thought, may be the cause of the greater frequency of fogs in town than in country air.

At the end of the paper some relations are pointed out between the amount of dust and the temperature at the time the observations were made, showing that when there was a large amount of dust there was also a high temperature; and some speculations are entered into as to the effect of dust on climate. But it is at the same time pointed out that the observations are far too few and imperfect to form a foundation for any important conclusi n on that subject.

In a short appendix is given the result of some tests made between January 23 and 29 of this year at Garelochead. During the gale on Saturday, the 25th, the number was rather under 1000 per cubic centimetre. On Monday, though the wind was still high, the number fell to about 250; and on Tuesday, when the wind had fallen and veered to the north, the number fell lower than had been previously observed. The number varied from a little over 100 to about 90 per cubic centimetre. On this day the air was remarkable for its clearness, the sun was very strong, and the evening set in with a sharp frost.

JOHN AITKEN.

P.S.—The author of the paper also showed at the same meeting of the Society the apparatus which have just been constructed from his designs for the Observatory on Ben Nevis. The apparatus has been constructed by the aid of a Government grant, obtained by the Council of the Scottish Meteorological Society, for the purpose of carrying on the investigation on the dust in the atmosphere at the top of Ben Nevis. Two complete sets of apparatus were shown. The one is the large laboratory form of the dust-counter, and is to be fixed, in the meantime, in the tower of the Observatory; the air being taken in to it by means of a pipe. The other is the small portable form of instrument, to be used when the direction of the wind is such as to bring the smoke of the Observatory towards the tower. This latter instrument has for a short time been in the hands of Mr. Rankin, one of the Ben Nevis observers, who has been practising with it near Edinburgh before beginning regular work at the Observatory.

A UNIFORM SYSTEM OF RUSSIAN TRANSLITERATION.

UP to the present time no one system of transliterating Russian names and titles into English has been generally adopted. Some of those most interested in the cataloguing and recording of Russian scientific literature have therefore arranged the following scheme in order to secure the general use of a system which will enable