Too many Decimal Places.

A COMMUNICATION in NATURE of January 26 (p. 294) ends with the sweeping suggestion "that, as a rule, only experimentalists are capable of judging the limits of accuracy of experiment, and that they may be trusted to save themselves trouble where trouble may be saved without sacrificing accuracy."

On the contrary, is it not true that experimenters, as a class, have shown a marked tendency to give unnecessary trouble, both to themselves and to those who utilize their results, by using too many significant figures in their numerical work? The strictures of mathematicians have done much to check this tendency. But can it yet be claimed that their habits need no critical inspection in this respect? Not being prepared to bring forward statistics, I can only make this remark in the form of a query, which applies to the general statement quoted, rather than to the merits of the special discussion which gave rise to it. In vol. lxi. (1871) of the Journal of the Franklin Institute, Prof. Pickering has shown by graphical methods how greatly Regnault's coefficients may be simplified. J. RAYNER EDMANDS.

Harvard College Observatory.

"The Teaching of Elementary Chemistry."

IN NATURE of February 23 (p. 389), an anonymous correspondent, signing himself "Z.," draws attention to what he calls "a few highly misleading passages in the two books reviewed under the above heading in NATURE of January 19."

In the name of the authors of these books, I challenge "Z." to make good his statement that the passage which he quotes from p. 65 of the "Elementary Chemistry," concerning the reaction between sodium and water, is "highly misleading." We assert that the sentence is not misleading. The second statement quoted by "Z." is not quite correct: chlorine monoxide is prepared by passing dry chlorine over yellow mercuric oxide, which has been previously dried at 300°-400°, at the ordinary temperature, not over heated mercuric oxide, as stated on p. 116 of the "Elementary Chemistry." We thank "Z." for the correction. But, inasmuch as the result of passing chlorine over yellow mercuric oxide dried at about 100° is to evolve oxygen without forming chlorine monoxide, the correction does not affect the argument, and it may still be justly said that in making chlorine monoxide "we carry out a reaction in which oxygen is produced in presence of chlorine." The supposed contradiction found by "Z." between the directions given in the "Practical Chemistry" to the student who is burning a weighed quantity of magnesium—not to remove the lid of the crucible lest some of the magnesia should be "volatilized and lost"—and the statement in the "Elementary Chemistry," that "no compound of magnesium has been gasified," rests upon a verbal quibble. *Volatilized* and *gasified* have not precisely the same connotation. I confidently assert that no student is in danger of being misled by either of the statements which "Z." has quoted.

"Z." states that the results of an experiment on the reaction between potash and iodine, described on p. 63 of the "Practical Chemistry," contradict the sentence on p. 62 of the same book concerning the similarities between the chemical properties of chlorine, bromine, and iodine. I reply that "Z." has here shown himself to be unacquainted with the methods of chemical classification; and also that he has taken the word *similar* to mean the same as *identical*.

If "Z." will bring forward proofs that the statements he has quoted are "highly misleading," and will sign his name to the letter in which he states these proofs, I am ready to argue each point with him in detail. But, if "Z." continues to charge the authors of the books he has deigned to notice with making misleading statements, while he himself remains anonymous, I shall decline to take any notice of his communications.

Cambridge, February 29. M. M. PATTISON MUIR.

The Gale of March 11.

I BEG to inclose the readings of my standard Robinson's cup-anemometer during the gale of March 11:—

11–12 a.m.,	64	miles.
12– 1 p.m.,	67	,,
1– 2 ,,	71	,,
2– 3 ,,	73	,,
3– 4 ,,	63	,,

General direction, S.W.; altitude, 600 feet above mean sea-level. C. E. PEEK.

Rousdon Observatory, Lyme Regis, March 13.

THE DISPERSION OF SEEDS AND PLANTS.

IN a recent number of NATURE (vol. xxxv. p. 151) I mentioned instances which had come under my observation, in which birds had taken an active part in the dispersion of seeds and plants. Since then I have come across further notes bearing upon the subject which is one of considerable interest and importance, as it throws a direct light upon some at least of the agencies whereby plant life has been distributed over the surface of the globe. Although birds, from their greater adaptability to rapid and extensive locomotion, are more concerned than any other animals in the dispersion of plants, they are by no means alone in this work.

It may seem strange, at first sight, to assert that cattle have been the means of distributing the seeds of certain plants from one country to another, but a statement is made by Grisebach[1] respecting *Pithecolobium Saman* (N.O. Leguminosæ), a large tree native of Tropical America, now naturalized in Jamaica, that the "seeds were formerly brought over from the continent [of America] by cattle." This statement has been carefully examined, and it is fully borne out by facts. Formerly, Jamaica, like Trinidad at present, was dependent for cattle on Venezuela. The food of the animals during their voyage consisted amongst other things of the pulpy legumes of *Pithecolobium Saman*. The seeds being very hard were uninjured by the process of mastication and digestion, and they were dejected by the animals in the pastures, where they germinated and grew up into large trees. In this instance the seeds were carried across the sea a distance of about a thousand miles, and there is no doubt that the cattle were directly concerned in their introduction. Indeed, without them the seeds, even if accidentally introduced amongst the fodder, would not have been placed under such circumstances as would have enabled them to give rise to plants. In the first place, by being passed through the animals the seeds were softened and the period of germination hastened. In the second place, being embedded in the droppings of the animals the seeds had a suitable medium to protect and promote germination; and this medium enabled the young plants to withstand the season of drought which is incidental to almost every tropical country. In this instance we have cattle not only the means of introducing the seeds of a valuable tree, but also involuntarily instrumental in establishing the tree in a new country, and providing shelter, shade, and food for their progeny. Those acquainted with the guango or rain-tree, as this *Pithecolobium* is locally called, will fully realize its value as a shade and food-tree for cattle, and they will also appreciate the singular concourse of circumstances by means of which such a tree was introduced to a new country by the very animals which required it most.

It is possible there may be some who will doubt the possibility of seeds retaining the power of germination after undergoing the processes of mastication and digestion, and especially in the special case of ruminating animals. There is, however, very clear evidence on the subject. It is a common occurrence in India to utilize the services of goats to hasten the germination of the seeds of the common *Acacia arabica*, known as the babul. This tree belongs to the same natural order as the *Pithecolobium*, and grows in the poorest and driest soils of India. The babul seeds will not germinate readily in the hot weather, and it is the regular habit, in order to save a season, for a person desirous of a crop of seedlings to make a bargain with a herdsman or a neighbour who possesses a flock of goats to quarter them for some days in a small inclosure in which they are fed on babu leaves and pods. The droppings of the animals contain a certain number of seeds which are uninjured, and these now readily germinate, and give rise to plants the same

[1] "Flora, British West India Islands," p. 225.

season. I am informed by Dr. Watt that in India "several other plants are treated in the same way." The seeds of the several species of cultivated Guava are hard and do not easily germinate. These, however, are said to germinate more freely and readily when they are picked up in night soil.

While on this subject I would mention that when at St. Helena in 1883 I expressed some surprise that no attempt was made to utilize "urban" manure in the neighbourhood of Jamestown, when the land was so impoverished and yielded such poor crops. I was met by the fact that if such manure was largely used the land would become overrun with plants of the prickly pear, *Opuntia Ficus-indica*, the fruit of which is largely consumed by the inhabitants. There is little doubt that the seeds of this plant, like those of the Guava, and I suspect also species of *Passiflora*, which are swallowed whole, are capable of germination after they have passed through the human body. Another instance occurs to me where the use of manure has been the means of distributing an undesirable plant on cultivated lands. In many tropical countries a grass known as Para, Mauritius, or Scotch grass, and sometimes as water grass (*Panicum barbinode*), has been introduced from Brazil, and highly esteemed for its rapid growth and nourishing properties. It grows well in moist situations, on the banks of streams, and even in soils so swampy as to be suitable for nothing else. In such situations it spreads rapidly and yields abundant food for cattle and horses. Nothing, however, could be worse than this grass for cultivated areas, where the land is required to be kept free from weeds, and where crops of sugar-cane, coffee, tea, and cacao are raised. It has been found that where animals are fed on this grass the joints even after passing through the animals have been known to grow. Hence the manure, if freshly used, has been the means of establishing the plant over wide areas.

In a recent work Mr. Ball has drawn attention to numerous introduced plants which are met with in South America. He naturally mentions the cardoon, the wild state of the common artichoke, which is now more common in temperate South America than it is anywhere in its native home in the Mediterranean region. Darwin[1] doubts whether any case exists on record of an invasion on so grand a scale. Several hundred square miles are covered with this introduced plant, which has over-run all members of the aboriginal flora. The introduction of the cardoon appears to have been effected directly by man for the purpose of contributing to the food supply of cattle; but as regards another widely-spread plant the mode of its introduction is not clearly known.

Mr. Ball states:—"As to many of these [introduced South American plants] it appears to me probable that their diffusion is due more to the aid of animals than the direct intervention of man. This is specially true of the little immigrant which has gone farthest in colonizing this part of the earth—the common stork's-bill (*Erodium cicutarium*), which has made itself equally at home in the upper zone of the Peruvian Andes, in the low country of Central Chili, and in the plains of North Patagonia. Its extension seems to keep pace with the spread of domestic animals, and as far as I have been able to ascertain it is nowhere common except in districts now or formerly pastured by horned cattle. It is singular that the same plant should have failed to extend itself in North America, being apparently confined to a few localities. It is now common in the Northern Island of New Zealand, but has not extended to South Africa, where two other European species of the same genus are established."[2]

Erodium as a genus is separated from the true Geraniums amongst other reasons on account of the tails of the carpels being bearded and spirally twisted on the inside. It is possible that these characteristics have enabled the seeds to attach themselves to the legs and bodies of cattle and so effected their distribution over wide areas in such situations as are favourable to their growth.

In the Island of Jamaica we have a remarkable instance of the naturalization and wide distribution of an introduced plant in the case of the Indian mango. In an official Report, published in 1885, I stated that to the mango, possibly more than any tree in the island, is due the reforesting of the denuded areas in the lower hills; and as in consequence of the changes taking place in the climate members of the indigenous flora are unable to maintain their ground, it is fortunate the island possesses in a vigorous and hardy exotic like the mango the means of counteracting the baneful effects of deforestation. It specially affects land thrown out of cultivation, and the sides of roads and streams where its seeds are cast aside by man and animals. It practically re-clothes the hills and lower slopes with forest, and it enables the land to recuperate its powers under its abundant shade-giving foliage.[1] It is strange that in Ceylon, which is so much nearer the home of the species, the mango does not spread by self-sown seedlings. This corroborates Mr. Ball's statement with regard to *Erodium cicutarium*. The latter is widely spread in South America, but only sparingly found in other countries under apparently exactly corresponding conditions. We cannot say why such anomalies exist. They do exist, however, and offer problems which can only be solved by a closer study of the conditions of plant life, and the interdependence of plants and animals acting and reacting one upon the other.

The orange-tree was introduced to Jamaica more than a hundred years ago. It is now found practically wild over the settled parts of the island, and the fruit is exported to the value of nearly £50,000 per annum. Up to quite recently very few trees were planted. Nearly the whole were sown by the agency of frugivorous birds, who carried the seeds from place to place and dropped them in native gardens, coffee plantations, sugar estates, and grass lands. In such localities the orange-trees grew and flourished, and now a demand has arisen for the fruit in the United States an important industry has been established, the active agents in which have been birds. The agency of birds in the distribution of the seeds of plants is too large a subject to be discussed at length here. A valuable contribution of facts in this direction has lately been made by Dr. Guppy in his important work on the Solomon Islands. As the most recent addition to our knowledge of what takes place in oceanic islands at the present time it deserves careful attention. It will suffice only to quote one or two sentences:—"Whilst through the agency of the winds and currents the waves have stocked the islet with its marginal vegetation, the fruit-pigeons have been unconsciously stocking its interior with huge trees, that have sprung from the fruits and seeds they have transported in their crops from the neighbouring coasts and islets. The soft and often fleshy fruits on which the fruit-pigeons subsist belong to numerous species of trees. Some of them are as large even as a hen's egg, as in the case of those of the species of *Canarium* ('Ka-i'), which have a pulpy exterior that is alone digested and retained by the pigeon. Amongst other fruits and seeds on which these pigeons subsist, and which they must transport from one locality to another, are those of a species of *Elæocarpus* ('toa'), a species of laurel (*Litsea*), a nutmeg, (*Myristica*), an *Achras*, one or more species of *Areca* (palm), and probably a species (of another palm) *Kentia*."

D. MORRIS.

[1] "Naturalist's Voyage round the World," by Charles Darwin, new ed. 1870, p. 119.

[2] "Notes of a Naturalist in South America," by John Ball, F.R.S., London, 1887, pp. 164, 165.

[1] Annual Report, Public Gardens and Plantations, Jamaica, for the Year 1884, p. 45.