

first letter, we are at liberty to imagine a time when there was much more land than there is at present, and when all the oceans were comparatively shallow. A. J. JUKES-BROWNE.

Galls.

BEFORE rushing into arguments on this subject, it appears to me that more good might be done by entering into investigations of the physiological and morphological problems involved.

A gall-fly of a particular species inserts an egg in a certain position on a certain plant (oak, for instance). Another gall-fly of a different species inserts its egg almost in the same position on the same plant. But the results are totally dissimilar. An abnormal growth is set up, from irritation, in either case; but the nature of this growth is quite different. The initial irritation is set up by the presence of the egg, and in most gall-insects the egg *grows*—that is to say, it increases vastly in size before the larva is hatched. The irritation is continued by the larva, and the gall is produced, varying in form in accordance with the species of gall-fly that deposited the egg. But I want to know in what consists the difference in the active irritation that causes so great a divergence in the results? I am not aware that this has ever been answered. But I am quite sure it could be answered on purely physiological grounds if carefully studied. The answer would not in the least detract from the importance of the point as regards natural selection; but it might very materially modify speculative theories based on results only, without a precise knowledge of the agencies that produced those results. R. MCLACHLAN.

Lewisham, November 29.

ALTHOUGH I see no need of a better explanation than Prof. Romanes's (NATURE, November 28, p. 80) of the difficulty which galls seem at first sight to present for natural selection, yet I beg leave to say some words of further elucidation.

When it was said by Darwin ("Origin of Species," chap. vi.): "If it could be proved that any part of the structure of any one species had been formed for the exclusive good of another species, it would annihilate my theory, for such could not have been produced through natural selection," he evidently meant only species living without organic connection with each other, viz. his own example of the rattlesnake. The argument does by no means apply to organisms living in a relation of *symbiosis*, as is the case with gall-bearing plants and the larvae inhabiting the galls.¹ Such associations form, as it were, one compound organism. Natural selection evidently may act in favour of each symbiont separately, provided only that the effect will not damage the other symbiont in such a degree as seriously to impair its existence. Some "disinterested" expenditure of energy and of organic substance is not excluded by natural selection, but may be promoted, if of advantage to the other partner. Thus the production of galls will scarcely do any serious injury to an oak, and even if such were sometimes the case, there would be no comparison to the damage worked, for instance, by Trichinæ, on the organism of man and animals, which hosts, nevertheless, in consequence of the stimulus caused by the parasite, afford the substance for capsules protecting the worms, just as plants produce manifold structures beneficial to the gall-insects. If Trichinæ would attack a species of mammals as frequently as, for instance, leaf-cutting ants attack some tropical plants, then those hosts would be forced either to develop, by survival of the fittest, some protection against their invasion, or they would succumb to the enemy and die out.

Analogous examples might be multiplied of both plants and animals, and it is especially to be remembered, as alluded to by Prof. Romanes, that the chemical activities of parasites, including the elaboration of ferments affecting the saps and tissues of the host, are as much under the guidance of natural selection as are their morphological variations. D. WETTERHAN.

Freiburg, Badenia, November 30.

WITH all due deference to your able correspondents Dr. St. George Mivart and Prof. G. J. Romanes, I cannot

¹ Darwin's thorough acquaintance with these important structures is shown by his elaborate discussion in "Animals and Plants under Domestication," chap. xxiii. (2nd ed. vol. ii. p. 272). It is particularly to be noted that Darwin insists on the accordance of galls, for instance, on roses, with structures arising through bud-variation.

for the life of me understand how the theory of natural selection can be seriously assailed by investigations into the formation of galls by insects. Gall-formation has always appeared to me to be a pathological, that is a *perverted physiological* process, and to be due to the action of some animal irritant upon normal vegetable tissues during their period of active growth. These formations are therefore, to my mind, fair'y on a par with the globular nests produced by the larvæ of the Cæstrus, or bot-fly, in the hides of oxen; or to the inflammatory foci in the tissues of the kidneys, due to the translation of Bacilli, in the case of ulcerative endocarditis. Other examples bearing on the subject will doubtless occur to your readers. In all such instances we have certain changes in the cellular or protoplasmic tissue-elements of the host, brought about by the growth and development of a foreigner in their midst; and natural selection, in so far as it operates in such cases, seems to have sided mostly with the stranger, and to be to his advantage alone. That the host under these circumstances performs actions "which, if not self-sacrificing," are at least "disinterested," must be admitted; but it is the self-sacrifice of coercion and disinterestedness under compulsion. W. AINSLIE HOLLIS.

Brighton, December 1.

Luminous Night Clouds.

THE many inquiries and appeals regarding observations of luminous night clouds which have recently appeared in the columns of NATURE, and the growing importance of the subject, will justify me, perhaps, in sending to you, for publication in that journal, the following item, so long after the event it describes took place.

About the middle of November 1887, between eight and nine in the evening, as I was walking homewards from my day's work, I noticed what appeared to me to be the arch of a rainbow very low above the western horizon, and of a snow-white colour. A bank of clouds was rapidly approaching from the west, which, at the time of the first appearance of the arch, covered nearly half the sky, the eastern half being clear. The arch appeared to move eastwards, with and in the midst of the clouds, for it continually rose above the horizon, and, in the course of about half an hour, had approached the zenith.

At this time I called out several people to witness the phenomenon, which certainly presented a most extraordinary appearance. The arch appeared to be uniformly of about 3° or 4° in width, and extended north-north-east and south-south-west across the whole sky. The latter was about wholly overcast with the clouds at this time, except the arch, which presented a glaring brightness, and illuminated the earth with a weird splendour four or five times exceeding that of the brightest moonlight.

While at the zenith, the stars shone through the entire width of the arch with apparently more than ordinary brightness; but as the arch approached towards and receded from that point, the width of the transparency was observed to diminish rapidly with the distance, until at 10° or 15° on either side the stars were invisible through it.

The phenomenon appeared to be a division in the cloud stratum, the opposite walls of which were pretty clearly defined; and there appeared to be absolutely nothing between these opposite cloud walls but the purest air and the white light of the arch. I remember also that the wall or border of cloud on either side of the arch was slowly revolving upon an axis parallel with the arch; just as is often seen in the front bank of clouds of an approaching storm. But I do not remember the direction of the rotation, or whether both borders rotated in the same or in opposite directions.

The arch moved towards the east at about the same pace that it approached from the west, and with apparently the same width and direction of extension. There was no moonlight at the time, and only a gentle breeze was blowing. The weather preceding the phenomenon was fine for several weeks; but a few days afterwards, or on November 19, there was a sudden and extraordinary fall of the temperature, accompanied by some snow and very high wind.

I have thought that possibly this phenomenon might throw some light on the subject of luminous clouds, and that this tolerably accurate description of it may therefore be of interest to the students of that subject. I may add, however, that the luminosity of the arch did not appear to proceed directly from the clouds themselves, but from the clear space between the