which this function has finally attained its minimum, and is thus the unique steady state; it still being borne in mind that this is only a proposition of averages derived from a great variety of instances in which nothing is conserved in encounters except the energy, and that exceptio nal cases may exist, comparatively very few in number, in which the trend is, at any rate temporarily, the other way.

Such an exceptional case is in fact the very striking one, pointed out by Maxwell and Helmholtz, in which the motions of the system are all at some stage precisely reversed, so that it retraces its previous history backwards, and the trend of the reversed system is therefore in the opposite direction to the one which would lead towards the steady state. Now it has been assumed, at first sight plausibly, that there are just as many cases of this reversed motion as there are of the direct motion; and if that were so, it would undoubtedly go hard with the distribution theorem. But a fallacy underlies such an assumption, as indeed the other accepted proofs of simple cases of the distribution theorem would lead us to expect. Consider an arbitrary distribution of velocity and configuration of the system to begin with; and let it settle down for a time towards the final state, whatever that may be. Suppose at the end of that time that its velocities are all reversed; the system will retrace its course up to the initial state, but when it has got there, it will presumably go on settling down towards the final state by another route, because there is no longer any reason for exceptional behaviour. Thus there will be only a temporary aberration in the course of the reversed system; and further, if the original progress towards a steady state was at all rapid, this aberration will be sensible only for a brief time, the remainder of the history of the reversed motion corresponding nearly to the steady state. It is true that if the whole universe were thus reversed, the aberration would be permanent; but then the whole universe is a permanently dissipative system, and there is no question of a steady state being attained by it in measurable time. For a finite system, like a mass of gas imagined as bounded by a rigid envelope, the case would be different.

Thus even if these reversed states amounted to half the possible states, there would still be a preponderating, though not immense, probability in favour of a final settling down. But are these reversed states half the total number? The characteristic of such a state is that it is derived from an entirely fortuitous initial distribution by a process of change which is in the direction of the final steady state, whatever that may be, and much in that direction if the time concerned be considerable. It seems then that the number of configurations which can retrace their history for a sensible time is very much more limited than the total number of possible configurations, and that they are simply the exceptions which do not disprove the rule. For a theorem of average, derived from a very great number of instances, is of course not invalidated by picking out a comparatively small number of instances which depart widely from the average. J. LARMOR.

Cambridge, December 4.

Peculiarities of Psychical Research.

MR. H. G. WELLS disposes very aptly of most of the claims set up by Mr. Podmore and his colleagues to be real scientific investigators. But, I think, he rather disguises the significance of the card-drawing experiments to which he refers. The experiments of M. Richet and those of the S.P.R. belong to two very different categories. In the former case, 789 correct guesses were made in 2927 trials, or a deviation from the most probable result of 57 or 58; this is about 2·4 times the standard deviation, or the odds against a deviation *in excess* of this amount are only about 100 to 1, or odds of only about 50 to 1 of a deviation of this magnitude either way.

On the other hand, in the S.P.R. trials we have a deviation from the most probable of 347, about six times the standard deviation. That is to say, the odds against such a result are in round numbers about 2,000,000,000 to 3! Now, this is of a totally different order to that given by M. Richet's numbers. I have obtained odds as great as 100 to 1 against the results of very carefully conducted lottery experiments. There is in reality nothing significant about such odds. But the odds against the S.P.R. experiments are almost equal to the odds against the Monte Carlo roulette returns! The experiments are significant, very significant—not to my mind, however, of telepathy, but of the want of scientific acumen in the psychical researchers. The interesting point as to whether an abnormal distribution was also in the cards turned up as well as in the percipient, does not appear to have been recorded. Mr. Wells has, however, passed over the difference between the two cases, and given, I fear, the psychical researchers the chance of a little self-glorification on their due appreciation of the significant.

University College, December 8. KARL PEARSON.

Chronometer Trials.

THE Mersey Docks and Harbour Board have, by an Order dated November 29, 1894, modified the regulations under which they are prepared to issue certificates to those who deposit chronometers and other scientific apparatus at their Observatory for test and examination. Under the new regulations, instrument-makers can re-submit their apparatus within a twelvemonth of first deposit, without any additional fee. In the case of chronometer-makers this concession will probably be welcomed for the following reasons. Hitherto, the certificates granted have simply been regarded as a protection to the public, and the makers have had to apply their own tests to ensure accurate performance before submitting them to independent examination. But it will now be possible for makers to spare, in some degree, their own rigorous control, since the certificate granted will show the direction in which correction must be made, and a second certificate will be granted without fee to the improved instrument. If no alteration be needed, the time required for the additional trial is of course saved. Another modification, which will be appreciated by those who seek certificates for watches, is that affecting the condition under which these certificates are granted. The alteration will be best shown by an example. Suppose a watch to have a normal rate in the first position of trial of nine seconds a day, and under the various tests to which it is submitted the rate increase more than a second daily. Such a watch or chronometer, under the old regulations, would be refused an "A" certificate because the daily rate increased to more than ten seconds from mean time. But the watch might evidently be superior to one with a normal rate of two seconds, and which varied some five or six seconds in the various stages of its trial. The alteration in the regulations sanctioned by the Board will now permit the variations to be reckoned from the normal rate, and not from mean times. WILLIAM E. PLUMMER.

Liverpool Observatory, December 10.

Indo-Malayan Spiders.

IN your issue of November 29, Mr. R. I. Pocock, reviewing Mr. and Mrs. Workman's book on "Malaysian Spiders," states: "But the pine-apple is a native of South America, and has only of *late* years been introduced into Singapore; &c." Now, twenty years ago it was as common at Singapore as any other fruit, more so than many indigenous ones. How long before it may have been introduced I am unable to say, but that also should surely be stated "Before such a conclusion, however, can be looked upon as an established fact." I quite grant that in all probability the plant and spider were introduced simultaneously.

New Club, Grafton Street, W. B. A. MUIRHEAD.

Death-feigning in Snakes.

IN NATURE of November 29, p. 107, L. C. Jones asks whether death-feigning is, among snakes, confined to *Heterodon platyrrhinus*.

A writer in the *American Naturalist*, November 1894, pp. 966–8, tells almost precisely the same story of the "Moccasin" snake (*Ancistrodon*) and of "a black or blowing viper."

He also finds "letisimulation" in the toad, and in certain arthropods, worms, and protozoa.

December 1. GERARD W. BUTLER.

The alleged Absoluteness of Motions of Rotation.

PROF. GREENHILL'S remarks on my letter on this subject (NATURE, November 29), admitting that he is unconverted, and throwing out a suggestion that further arguments or explanations are desirable, appear to open a wider question than can