Tralles systems. They give also the corresponding indications of the hydrometers used in Russia, Holland, Spain, and Switzerland.

All the tables are well arranged, well printed, and well spaced, with figures in large type: this all makes for accuracy and convenience in use.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Rule for Determining Direction of Precessional Movement.

THE method of determining the sense of the precession is usually given in the following way:—"If the axis of angular momentum and the torque axis are drawn in the same sense (that is, for the same direction of turning), then the axis of angular momentum sets itself towards the torque axis."

By this method we must imagine the axis of rotation and torque, which cannot be seen directly. By the following method this is not necessary:—

"If you stand at one end of the axle of the gyroscope, it will precess in the same sense to the rotation of the wheel, as seen by yourself." Here, the moment of force due to your own weight determines the tilting couple. According to my experience, this is a very convenient and practical rule for the direction of precession of a gyroscope. W. WATANABE.

34 Waldegrave Park, Twickenham, September 28.

I AM obliged by your courtesy in allowing me to see Prof. Watanabe's communication. He sent me his rule some little time ago, but by an accident which I regret his letter did not receive immediate attention.

I take it that what Prof. Watanabe's very concise statement suggests is the following. Imagine the gyrostat, supported, let us say, at a point on its axis of symmetry, with that axis inclined at an angle θ to the upward vertical, and precessing under a couple produced by a gravity force applied at a point on the axis of symmetry. If that force be due to the weight of an observer standing on the axle and looking towards the spinning flywheel, the axle, with the observer, will be carried round in azimuth in the direction in which he sees the part of the wheel looked at carried by the rotation.

This is quite correct and convenient if it is the upper part of the wheel that is looked at, and if the precession is, as it is almost always taken to be, and usually is, that given by the numerically smaller root of the quadratic equation which determines the steady motion of the gyrostat for a given value of θ. But, except in the case of $\theta=90°$, when the larger root is infinite, it is possible, by properly starting the gyrostat, to realise the precession given by the numerically larger root. This is the "adynamic" precession, so called because to a first rough approximation, this precession, if the gyrostat is rapidly rotating, is independent of the applied couple. In this case, when also θ is greater than 90°, and the roots are therefore opposite in sign, Prof. Watanabe's rule must be reversed. But it is to be noted also that, in these unusual circumstances, neither does the rule hold that the axis of spin follows the couple axis. A. GRAY.

The University, Glasgow, October 7.

The Meaning of "Chincough."

IN the notice (NATURE, October 7, p. 141) of the book, "A Chaplet of Herbs," the expression "chincough" is explained in parenthesis as "(hiccough)." The word is in everyday use in this country, and never in any other sense than the whooping-cough; its etymology being understood as connected with the French *chien*=a dog.

The popularly recognised cure for hiccup in children used to be, and may be still, to "frighten it away" by some sudden and discomposing question. It often proved to be quite efficacious. W. E. HART.

Kilderry, Londonderry, Ireland, October 10.

FELLOWSHIPS FOR INDUSTRIAL RESEARCH.[1]

THE subject of the pamphlet referred to below is one of first-rate importance, especially at the present time of crisis in certain branches of manufacture, the cause of which has been attributed to failure to link science and industry.

The experiment referred to is one devised by the late Prof. Duncan, of the University of Kansas (and later of Pittsburgh). It begins by insisting that technical training should not cut into the full graduate course in pure science. The failure to co-ordinate academic training with industrial methods is attributed to mistakes on both sides. It is urged on the side of industry that current industrial practice is always ahead of text-book presentation, that academic methods are too minute and cumbersome, and that whilst strict scientific accuracy is essential in a pre-graduate course, it must give place to less accurate time-saving processes in the factory.

The university professor is also accused of regarding the utilisation of science for human needs as more or less degrading to science itself, and that in consequence he is careless in selecting a chemist possessing the right qualifications; for as Dr. Duncan asserts, industrial research demands all the qualities which are necessary for success in pure science, together with ability to control workmen.

The case against industry is much more searching. Dr. Duncan considers that the failure on the part of the factory to appreciate the advantage of applied science is due to an incapacity to select chemists, inexperience in dealing with them, and ignorance of the facilities in the way of laboratories and libraries which should be placed at their disposal. He states that he has met with instances of chemists of high training, creative power, and practical character who are overburdened with routine drudgery and subjected to the interference of factory foremen, and are working under an entire misapprehension on the part of the officials of the company as to their possibilities and value. Moreover, it is pointed out that the manufacturer may not know the real nature of the problems which have to be solved, their relative importance, or the kind of knowledge required for their solution. . He has no means of judging the qualifications of the men available for his researches

[1] "An Experiment in Industrial Research." By T. L. Humberstone. Board of Education: Educational Pamphlets, No. 30. (London: Wyman and Sons, Ltd.) Price 4*d*.

or the expenditure on laboratories and equipment which the work would entail. He has had no experience of co-ordinating research work with the operations of the factory or of estimating the progress made. In short, though the pamphlet does not say so in so many words, the manufacturer is accused of ignorance of the scientific side of his industry.

Having thus presented the difficulties on both sides, Mr. Humberstone, the author of the report, proceeds to formulate Dr. Duncan's scheme of industrial research fellowships

"Under this scheme a contract is entered into between the manufacturer and the university in which the object of the research is precisely defined. The contract provides that the fellow selected to conduct the investigation desired shall devote his whole time to the research with the exception of three hours a week, which he may devote to instructional work in the chemical department. The fellow is a member of the university, and pays all the regular fees with the exception of fees for laboratory and supplies, for which the instruction he gives in the university is accepted in lieu, unless in the opinion of the university his demands become excessive, in which case the manufacturer who provides the funds for the fellowship is expected to reimburse the university.

"In some instances the manufacturer makes a specific grant for expenditure on apparatus. The contract further provides that the fellow shall work under the direction of the professor of industrial chemistry, and shall forward to the manufacturer periodically through the professor reports on the progress of the work. The manufacturer agrees to pay to the university an annual sum for the emoluments of the fellow during the tenure of the fellowship, which ordinarily extends to two years."

A clause follows relating to the proprietorship of inventions made by the fellow, providing usually for a payment of ten or some other percentage of the net profits arising from discoveries, to be commuted at the desire of either party for a sum fixed by arbitration, and there are certain other details in regard to the publication and use of the discovery.

The advantages claimed under this scheme are that the university profits by the presence of men engaged in researches, which, though utilitarian in their object, may often throw light on questions of purely scientific interest. The university also secures the services of post-graduate students as instructors, and the influence of such a body of men who are keen on their particular work and enthusiastic as to the value of research, is an asset of considerable value. The manufacturer derives advantage from the resources of the well-equipped laboratories, museums, and libraries, and from the facilities offered to the fellow for consulting the staff of his own and other departments of the university when unforeseen difficulties present themselves, whilst at the same time the manufacturer is free from the responsibility of selecting the specialist (which is done by the university) or of supervising his researches.

The advantages of the scheme to the selected fellow are obvious. He is brought into direct contact with a manufacturer and a specific problem, and carries on his investigation under the advantage of being free from interference by foremen or managers. He has also opportunities of consulting a well-appointed library, of obtaining assistance from colleagues, and occasion to test his process under industrial conditions. Moreover, the researches may be put forward in his candidature for the doctorate of the university. The report concludes with an account of the practical working of the scheme, and the remarkable variety of problems which have been submitted to investigation.

The only point which the writer regards as open to serious criticism is that the industrial research of whatever character, whether connected with organic, inorganic, or physical chemistry or physics, is conducted in a special laboratory under the absolute jurisdiction of the director of the industrial research laboratories, instead of being carried out in that department which is specially concerned with the particular problem. Apart from this, the scheme appears to offer many advantages in the present condition of the scientific industries in this country, as well as in America. Whether it is an ideal scheme is another question. It is true that in Germany there are chemists working out in the university laboratories problems which have an industrial object, but the great bulk of such research is restricted to the splendidly equipped works laboratories. The reason for this is a simple one. The managers are trained men of science (as many are in this country) who know the methods of research and the value of the research chemist. They have no need of a director of industrial research. They are in a position to direct it themselves. J. B. C.

CONSTRUCTIONAL DATA OF SMALL TELESCOPE OBJECTIVES.

THE National Physical Laboratory has recently published through Messrs. Harrison and Sons a pamphlet with the above title. This has been prepared at the request of the Director-General of Munition Supplies, and is primarily intended for the assistance of manufacturers of optical instruments who are engaged in the production of optical munitions. The glasses on which the calculations are based are in all cases taken from the most recent catalogue of optical glasses issued by Messrs. Chance Bros. and Co., of Birmingham (February, 1915). The comprehensive character of the tables may be gauged from the fact that all the dense flints of this catalogue are severally combined with all the crowns, two dense barium crowns of high refractive index alone being excepted.

Although the theoretical conditions which it is desired to satisfy in the case of these small objectives are identical with those which determine the construction of large telescope objectives, other considerations which are of little importance in the one case can by no means be neglected in the other, and it thus happens that the