THURSDAY, JANUARY 1, 1874

THE YORKSHIRE COLLEGE OF SCIENCE

NOW that a scheme for a College of Science at Leeds has been all but completed, under the chairmanship of Lord F. C. Cavendish, M.P., it seems somewhat surprising that such an institution in connection with Yorkshire has not been thought of long ere now. It is the largest county in England, carries on a greater variety of industries all more or less dependent for success on the results of scientific research, and boasts of a larger number of local scientific societies and field-clubs than any other county in the three kingdoms, as we have shown in our articles on that subject. However, "better late than never;" and to judge from the prospectus and subscription lists, a very fair start is likely to be made. The scheme proposed by the committee formed at Leeds in 1869 involved an expenditure of 100,000*l.*, but it is not intended at present to carry out the whole of this scheme, but to commence on a smaller scale in temporary premises and with a limited number of professors. We have no doubt, from the hearty way in which the proposal has so far been met, that the college will be a success, and that ere long it will be possessed of a handsome building of its own, with a full staff of professors.

From what follows, it will be seen that the teaching will have a practical or technical aspect, having regard to the processes connected with the multifarious arts and manufactures which occupy the large population of Yorkshire. In the midst of an eminently practical people, there can be no fear of this consideration being neglected, but we hope that in the long run the claims of pure science will not be overlooked, for it is every day being more and more clearly proved that a preliminary training in pure scientific research is the best introduction to a "technical" education; and very many of the industrial applications of science have been found out by students who took no thought of the practical issues of their investigations. There is more than one institution in America which might, in this respect, be taken as models for a technical college.

The Yorkshire College of Science, the Prospectus tells us, is intended to supply an urgent and recognised want, viz.:—Instruction in those Sciences which are applicable to the Industrial Arts, particularly in their relation to Manufactures, Engineering, Mining, and Agriculture. It is designed for the use of persons who will afterwards be engaged in those callings as foremen, managers, or employers; and also for the training of teachers for ordinary Science Schools and Classes.

To carry out the object of the College, it is proposed to establish Professorships in (1) Chemistry and its application to Metallurgy, Manufactures, and Agriculture; (2) Civil and Mechanical Engineering; (3) Physics and Mathematics; (4) Geology and Mining.

The Provisional Committee seem to have right notions as to how scientific men ought to be treated. To obtain the services of eminent scientific men, they say, the payment to each Professor cannot be less than 300*l.* per annum, in addition to a proportion of the students' fees. A precarious income, if raised by annual subscriptions, would not secure Professors of high scientific qualifications, to whom the permanency of the scheme has to be assured. Besides the stipends of the Professors, sundry annual expenses for working and maintenance will be required, and these will be paid out of the general fund. The Committee therefore appeal for contributions upon a generous scale commensurate with the importance of the proposed scheme. This appeal has been well answered already; but we hope that the Committee will not rest until the whole of the original scheme has been realised.

The Committee refer to the sum raised for the Newcastle College of Science, 22,025*l.*, with an annual contribution of 1,000*l.* from the University of Durham, and say with justice, that, considering that the wealth of the district over which the benefits conferred by the Yorkshire College of Science will extend is at least equal to the Newcastle district, it is to be hoped that the public spirit of Yorkshiremen in behalf of the College will be as freely expressed.

To the Owens College, Manchester, the sum of 13,500*l.* has been contributed by the engineering profession towards the endowment of the chair for Engineering; and the hope is entertained that towards the endowment of the Professorship in that subject in the Yorkshire College of Science, aid may be forthcoming from a similar source. The chair for Chemistry has also peculiar claims for support upon the manufacturers of the county whose business requires the aid of chemical science.

Arrangements will be made for the establishment of scholarships at the College. All donors of 500*l.* and upwards towards the College funds will be entitled to nominate to a free studentship for a term of years.

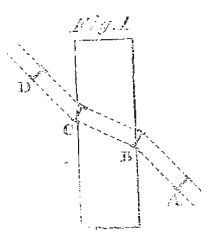
It is proposed to vest the government of the College in a board of governors, consisting of (*a*) all subscribers of 250*l.* and upwards; (*b*) fifty governors elected by the general body of subscribers; (*c*) two professors elected by the professorial staff. The governors shall hold two meetings in the year, shall appoint trustees, shall audit the accounts, shall receive the annual report from the council of the College, and shall constitute a court of appeal in certain cases. The ordinary administration shall be in the hands of a body called the council. This shall consist of fifteen members, including a chairman, to be elected out of and by the governors.

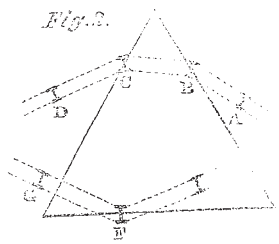
One of our wealthy City Companies, the Clothworkers' Company, we are glad to see, has generously come forward in the interests of the College as well as in the interests of the particular branch of manufacture with which the Company is connected, by endowing a Professorship of Textile Fabrics with 300*l.* a year. The subscription of the coal-owners alone amounts to some thousands of pounds, and we have no doubt, when the time comes to extend the sphere of the College and to give it a permanent building of its own, this wealthy class will see it to be their duty largely to add to this subscription. We hope also that others of our City Companies will see it to be their interest to lend a helping hand to the young institution. There are several such technical institutions on the Continent, and it is on this account that in several respects Continental manufactures are much superior to those of Britain. Let us hope that this may not be much longer the case, but that by the establishment of the Yorkshire

College of Science, and similar institutions in other districts, all who are in any way connected with our arts and manufactures may be trained to work on a method so really scientific that Britain shall in this, as she certainly is in some other respects, be foremost among the nations.

REFRACTION OF LIGHT MECHANICALLY ILLUSTRATED

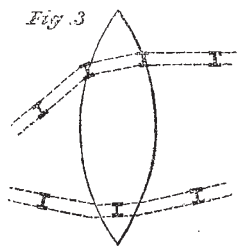
IN preparing an elementary lecture on Light, intended to be given at the Taunton College School, I have had to consider how best to explain the somewhat abstruse principle of optical refraction. It is true that Sir John Herschel, in the sixth of his "Familiar Lectures on Scientific Subjects," giving the explanation of refraction on the undulatory theory, describes it as being "exceedingly simple." The fact is, however, that it involves conceptions of wave-motion, difficult for any but advanced students, and even they feel grateful to the eminent physicist for the help afforded by a familiar illustration with which he follows it. He desires his readers to imagine a line of soldiers marching across a tract of country divided at a straight boundary into two regions, the one level ground suited for marching, the other rough and difficult to walk over. Now if the line of soldiers march with their line of front oblique to the boundary, the men on the side just engaged in the heavy ground

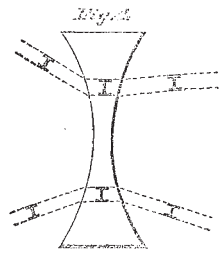




will be retarded as soon as they cross into it, so that if the line be kept unbroken, the consequence must be a change of front, which will leave the whole body of men marching across the heavy ground in a new direction—in a word, their direction of march will have been refracted. Now the light-waves emitted from a radiant point being compared to the circles spreading from a stone thrown into a pond, it is easily understood how a sensibly straight portion of such a light-wave, passing obliquely from one medium to another of different resistance, will be refracted in a new direction. This simple conception of change of front is at once apprehended by the learner, to whom refraction thenceforth ceases to be a molecular mystery, and becomes an intelligible mechanical act dependent on the resistance of the two media and the form of their limiting surface. Probably no point in all Herschel's lectures has fixed itself in the memory of so many intelligent readers.

In following up the train of thought started by Sir John Herschel's comparison, it occurred to me that an instrument made to perform refraction mechanically would be useful in teaching optics, and that such a contrivance would only require a pair of wheels running on a table, into and out of a resisting medium. After a number of trials, made with the help of Mr. R. Knight, a simple arrangement has been completed, which answers satisfactorily in showing the behaviour of a ray of light under the various circumstances of ordinary refraction. Pieces of a thick-piled velvety plush known as "imitation sealskin" are cut out to represent the sections of a thick plate, a prism, a convex and a concave lens, and glued on to smooth boards. The runner consists of a pair of boxwood wheels mounted loosely on a stout iron axle, and is trundled across the board, or still better, the board itself

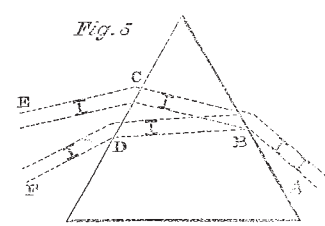




is tilted up, and the runner let go in the proper starting direction. The following figures show the path of the wheels, always from right to left of the page.

In Fig. 1, the runner starting from A, enters the rectangle of velvet at B, where its left wheel being first retarded, it shifts round into the direction BC, till it reaches C, where the left wheel first emerging gains on the right, so as to bring back the runner to the ultimate direction CD. This illustrates the refraction of a ray of light in entering and quitting parallel plane surfaces of a resisting medium, such as a plate of glass. When the runner enters at right angles to the boundary, its direction is of course unchanged, as with the ray of light.

Fig. 2 shows the path ABCD of the runner across a triangle, corresponding with the course of a ray traversing a prism. Also, by causing the runner to enter at about a right angle near E, a direction is given to it which, if the surface of the board and the triangle were similar as to resistance, would make it emerge near F, at a small angle



to the side. But the left wheel passing on to the smooth surface gains so much on the right wheel still in the velvet, that the axle slews round, the left wheel re-enters th velvet, and the runner goes off in the direction FG, thus illustrating the total reflexion which takes place when a ray of light is directed to emerge very obliquely from a more into a less resisting medium, as from a glass prism or a surface of water into air.

The action of the double-convex lens in causing parallel or divergent rays to converge is shown by the path of the runner in Fig. 3, which requires no further explanation, nor does that corresponding to the divergent action of the double-concave lens, Fig. 4. By starting two runners