

The method of treatment adopted by the author is one likely to be very effective in teaching; new principles and processes, as they arise in the natural development of the subject, are illustrated and driven home by the use of models, diagrams, and repeated applications to suitable problems, so that the conscientious student is always fully conversant with the reasons for his geometrical constructions. The very excellent and suggestive questions from the examination papers of the Board of Education for the last five or six years are freely employed, both in the text and as sample test papers, affording a good criterion of progress.

In addition to the ordinary geometrical solids, many familiar objects the forms of which can be dissected into simple geometrical figures are used as examples. After the student has thoroughly mastered the fundamental principles as set forth in part i., he should experience comparatively little difficulty with the three succeeding parts, which extend the subject to lines and planes obliquely situated, to shadows by parallel and divergent rays, and to reflections in horizontal and vertical mirrors. The book will be very acceptable both to teachers and students of this interesting branch of applied geometry.

Strength of Materials. By W. C. Popplewell. Pp. x+180. (Edinburgh and London: Oliver and Boyd, 1907.)

THIS text-book, which is based on the notes of lectures given by the author to day and evening students at the Manchester Municipal School of Technology, deals with the fundamental principles which must be mastered by every student who wishes to have a sound knowledge of machine and structural design. Special attention has been devoted to the effects of unequal distribution of stress, and in chapter vii. the author gives details of his own experimental work in connection with this branch of the subject. The last three chapters give an account of the methods adopted and appliances required in making tests of the various materials used in constructional work, and the important subjects of limit of elasticity and of the influence of previous loading, &c., upon the limit are discussed. In an appendix is given a table of strengths and weights of a large number of different materials, and there is a collection of useful examination questions for each chapter.

LETTERS TO THE EDITOR.

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Lithium in Radio-active Minerals.

THE recent results of Mlle. Gleditsch (*Comptes rendus*, cxlvi., p. 331) corroborating those of Prof. McCoy, viz. that lithium is generally, but not always, a constituent of radio-active minerals containing copper, and that there is no fixed proportionality between the copper and the lithium in these minerals, must not be taken to have the exclusive significance which their authors attribute to them. As explained in our original communication to the Chemical Society, we are inclined to believe that sodium, and perhaps also potassium, are products of the degradation of copper salts when in contact with radium emanation. As both these metals are constituents of ordinary glass, and as the experiments were carried out in glass vessels, the only argument which was used was that the weight of the residue from the treated was greater than that from the untreated copper salt. Lithium was mentioned because it is an unlikely constituent of dust, glass, copper, &c., which were tested specially to prove its absence; it was certainly contained in the treated residue. Inasmuch as

the emanation in contact with water yields neon, on the probable supposition that monatomic gases are produced from the emanation, it would follow that the production of any particular one is dependent on surrounding conditions. It will be remembered that the gases from the action of the emanation on a solution of copper sulphate contained no helium, but probably argon. As sodium and potassium are much more widely distributed than lithium, it is more likely that they are the chief products from copper, and that some modifying circumstance has determined the formation of a trace of lithium. Experiments now in progress in silica vessels will settle this point. Numerous chemical analogies might be adduced in favour of this view. For example, the action of bleaching powder on ammonia solution is to give nitrogen for the most part; if much ammonia be present, and if glue or some other colloid be present, hydrazine is the chief product. One can only be guided by such analogies in determining the lines of future experiments.

W. RAMSAY.

Formation of Ground-ice.

IN Canada we have made an extended study of the formation of ground-ice, or anchor-ice as it is called here, and consequently I was interested to see a letter in NATURE of January 30 from Mr. Hampson asking for information as to its origin.

May I at the outset refer Mr. Hampson to four papers published many years ago which are wonderfully interesting to anyone studying the formation of ground-ice? Two of the papers appeared in the *Edinburgh New Philosophical Journal*, one by M. Arago, vol. xv., p. 123, 1833, and the other by the Rev. Mr. Eisdale, vol. xvii., p. 167, 1834. The two other papers were published in the *Phil. Trans.*, vol. cxxv., p. 329, 1835, and vol. cxxxii., p. 37, 1841, by the Rev. James Farquharson, of Alford.

In reply to the questions raised by Mr. Hampson, I may say that (1) the essential conditions for the formation of ground-ice on the bed of a river are clear weather conditions at night with the water at or near the freezing point, excessively low air temperatures by day, with no sunshine and no surface ice or other cover such as overhanging weeds or a bridge to check the nocturnal radiations. The answer to (2) is covered by the above. (3) A flowing river becomes stirred by eddy currents, and hence the cold surface layers find their way to the bottom. We notice many of our large rivers flow with a rolling motion. (4) The water is such a bad conductor of heat that it is only by the mechanical action that the bed of a river becomes cold enough to form ice on it when aided by radiation, or, as I have shown, by a slight supercooling in the water. (5) Ground-ice will form in water of any degree of agitation provided either or both of the causes mentioned in (4) are operating. In the case Mr. Hampson cites of the mill, I should say the heat generated by the water flowing through the mill would tend to prevent the formation of ice on the lower side.

In Canada we have anchor-ice formed in very large quantities in all the waterways flowing too swiftly for surface-ice to form. In some parts of the St. Lawrence it grows 5 feet or 6 feet in depth, forming very rapidly during the periods of intense cold and clear nights. On bright days the sun's radiant heat brings large quantities of it to the surface with much noise and disturbance. The buoyancy of large masses of the ice is often great enough to raise huge stones and boulders and carry them along in the current, depositing by this means portions of the river bed further down stream in the quieter waters. Boatmen are very careful not to cross the river when anchor-ice is rising, for fear of having a large mass come up under them and carry the boat helpless into the rapids. Under surface-ice, with its covering of opaque snow crystals, anchor-ice does not form, and hence it causes no trouble under these conditions.

Anchor-ice is known and studied in every country in the world where ice is formed, and there is much that might be written about it. In NATURE of January 17, 1907, a careful review of my book on "Ice Formation," with special reference to anchor-ice and frazil, was given, and may help to answer some of the questions in the "long list" mentioned by Mr. Hampson. My paper read