

student requires to know. For how can the action of the steam-engine be properly understood without a knowledge of the principles of fluid and gaseous pressure, and of the relation between heat and work? Yet under the present arrangement the former of these constitutes a neglected part of Subject VI., while the latter comes under Subject VIII., and is associated with matter totally irrelevant.

All these considerations seem to point to the desirability of a change in the official syllabus somewhat as follows:—

(a) To cut out Heat from Subject VIII., making the latter consist of Sound and Light only.

(b) To cut out Hydrostatics and Pneumatics from Subject VI., making the latter consist of Statics and Dynamics only.

(c) To combine Heat, Hydrostatics, and Pneumatics into a new subject having its appropriate number. These three could then be more effectively studied than under the present system, and there would be ample matter therein to form one of the courses from September to May. The syllabus of the new subject would naturally include all the points specified by the Department as necessary preliminaries to the study of Steam (*vide* Steam syllabus, Subject XXII.), and would thus supply a specific want to all engineering students.

On the whole, it is respectfully submitted to the authorities of the Department, and others interested in the education of the people, that the proposed alteration would conduce to a more thorough and systematic study of all the subjects referred to, and be attended with benefit to students both of physics and mechanics. VOLO LEGES MUTARI.

On Last-place Errors in Vlacq.

M. M. F. LEFORT, in his account of the great Cadastre tables, contained in the fourth volume of the *Annales de l'Observatoire Impérial de Paris*, gives a list of errors in Adrian Vlacq's ten-place table of logarithms. As this one by Vlacq, or its copy by Georg Vega, is the only complete table of ten-place logarithms yet in existence, we naturally desire to make it thoroughly accurate, and therefore proceed to correct it by aid of this new information.

M. Lefort tells us that Prony, in his instructions, was expressly enjoined "not only to compute tables which shall leave nothing to be desired as to exactitude, but to make them the most vast and imposing monument of calculation that had ever been made or even conceived," and, adds M. Lefort, "this programme, so widely sketched, has been faithfully carried out." Yet, on the very same page, we are told "that Prony fixed the general limit of precision for his logarithmic tables at 12 decimals"; this although the original work by Henry Briggs had been carried to 14 places.

Thus it seems that the Cadastre tables cannot be trusted to determine the absolute accuracy of those of Vlacq whenever the figures to be rejected are between the limits 4900 and 5100, and that in no case can they serve to check the final figures in Briggs.

Having scrupulously examined, by help of my fifteen-place table, all the corrections given by M. Lefort, I here give the results, in order that the possessors of Briggs, Vlacq, or Vega may make note of them.

Among 282 last-place corrections given, I find seven to be erroneous, the logarithms in Vlacq and in Vega being right. In order to make doubly sure, I have also used my 28-place table, and here give the exact figures from the 8th to the 20th place—

| Number. | Logarithm. |
|-----------|-----------------|
| 26188 ... | 322 49959 00920 |
| 29163 ... | 978 49968 31667 |
| 30499 ... | 999 50010 73882 |
| 31735 ... | 026 49975 27403 |
| 34182 ... | 883 50038 92375 |
| 34358 ... | 753 50011 99957 |
| 60096 ... | 662 49998 09339 |

From this we see that the Cadastre tables are inadequate to the thorough checking of ten-place logarithms; in the case of the last of these miscorrections, even the fifteen-place table is barely sufficient, and needs to be fortified by an extended calculation.

Among the 275 remaining errors, five have been imported from Briggs, and I have therefore examined them to greater length; the logarithms to the 20th place are—

| Number. | Logarithm. |
|-----------|-----------------|
| 7559 ... | 453 41468 90981 |
| 8006 ... | 857 69086 31797 |
| 8009 ... | 936 63054 38960 |
| 10033 ... | 122 46398 29224 |
| 99926 ... | 031 14867 68936 |

Thus there are left 270 errors to be charged against Vlacq; of these no less than 96 are within the limits of inaccuracy allowed by Prony.

Near the end of the list there occurs a group of 21 (from the number 98336 to 98367) which seem to have resulted from some single running error. Now this part of the table was copied from Briggs, and we should expect these errors there; but, on turning to the original work, we find that none of his logarithms differs by more than unit in the 14th place from that of the fifteen-place table, and thus the source of the errors in Vlacq becomes mysterious.

The most feasible explanation is that the errors had been observed and corrected while the sheet was at press, and that thus all the copies of Briggs are not alike. It is probable that the very copy used by Vlacq may be preserved in some one of the libraries in the Netherlands; in such case, an inspection would set the matter at rest. EDWARD SANG.

September 27.

On the Soaring of Birds.

IN answer to Mr. C. O. Bartrum's objections in *NATURE* of September 4 (p. 457), I beg to refer to an article in the *Skand. Archiv. für Physiologie*, ii. 2, in which I have given a detailed account of the weighty reasons which have led me to suppose that soaring birds are able to undertake successive alterations of direction with very little loss of *vis viva*. This loss is of the same kind as that caused by the resistance of the air to the rectilinear translation.

There is, however, one fact which, in the article in the *Skand. Archiv.*, I have thought it superfluous to point out—namely, that the manœuvre of the bird is the same, and the loss of energy thereby equally the same, whether the bird turns in a calm or in a uniform wind. If Mr. Bartrum has been led to another opinion, it may be that he has not quite made out how these turnings are executed. MAGNUS BLIX.

Lund, Sverige, October 10.

Earthquake Tremors.

IF those of your readers who are interested in this subject will turn to p. 84 of the "Report on the East Anglian Earthquake of April 2, 1884," by R. Meldola and W. White (*Essex Field Club special memoirs*, vol. i.), they will see that at Wivenhoe a man who felt the shock of the earth movement found to his own satisfaction, by careful measurement and calculation, that the vertical displacement where he stood amounted to no less than *six feet*. How it was that any building in Wivenhoe remained standing after so tremendous an upheaval the observer did not appear to think worth considering.

ALFRED P. WIRE.

THE PROPERTIES OF LIQUID CHLORINE.

ALTHOUGH chlorine was shown by Faraday so long ago as the year 1823 to be one of the more easily condensable gases, yet, no doubt owing in a large measure to its very disagreeable nature, comparatively little has hitherto been known concerning its properties when in a liquefied state. In view of the fact that chlorine is now stored in the liquid state for the use of manufacturing chemists in a similar manner to carbon dioxide, sulphur dioxide, and ammonia, it is imperative that something more definite should be known as to the relations of liquefied chlorine to temperature and pressure. Consequently, a very complete investigation of the subject has been made by Dr. Knietsch at the request of the directors of the "Badischen Anilin- und Sodafabrik," of Ludwigshafen; and his results, of which the following is a brief account, are published in an interesting communi-