and point, perhaps, to the original food-plant of the San José scale.

T. D. A. COCKERELL.

NOTES ON PHYSICS.

ARCHITECTURAL ACOUSTICS.

ABOUT five years ago Professor W. C. Sabine was directed by the Corporation of Harvard University to propose means for remedying the acoustical defects of the lecture room of the Fogg Art Museum at Cambridge. About two years were spent in experimenting on this room and permanent changes were then made.

The experimental work done in connection with this lecture room has led Professor Sabine to take up seriously the general question of architectural acoustics and we are promised a series of papers on this subject the first of which, on reverberation, is published in a recent number of the *American Architect*.

In an introductory chapter Professor Sabine gives a clear and comprehensive statement as to the different ways in which sound is affected by being confined in an audience room, substantially as follows:

The *loudness* of the sound is as a rule greater at a given distance from the speaker than it is in the open air.

The *character* or *timbre* of a complex sound is more or less altered by re-enforcement of certain of its elementary tones by resonance, or by the re-enforcement or weakening of some of its elementary tones at certain parts of the room by interference. This alteration of the character or timbre of a complex sound Professor Sabine calls *ditortiosn*.

The sound *persists* in a room for a considerable time after the sounding body ceases to vibrate. This is due to the more or less complete reflection and re-reflection of the sound from the walls, floor and ceiling. This persistence of sound in a room Professor Sabine calls *reverberation*. It causes the successive sounds in articulate speech to overlap and become confused. Especially the sonorous vowel sounds persist, and obscure the delicate and fleeting variety of the consonant sounds.

The question of loudness becomes a serious matter only in very large audience rooms.

Sound distortion and reverberation depend very largely upon the same conditions. Thus the extent to which an air column will enforce the tone of a tuning fork depends largely upon the length of time the air column will continue to vibrate when left to itself after having been set vibrating. Sound distortion is not so serious a matter as reverberation and, since the two depend largely upon the same conditions, it seems that reverberation only need be considered in any practical case.

The reverberation of a room, measured by the duration of a sound after the sounding body ceases to vibrate, depends upon the absorbing power of the walls and of other reflecting surfaces and upon the size of the room. Thus heavily draped walls or walls lined with thick felt absorb much and reflect little of the sound which strikes them, and a sound persists but a short time in a room of which a considerable portion of walls are padded or draped. An audience also absorbs a large portion of a sound in a room and greatly reduces reverberation. A larger room has greater reverberation than a small room, walls being of similar material, because the sound has farther to travel between succeeding reflections, and a greater time is therefore required for the absorption of a given portion of the sound.

Professor Sabine found that the note of a particular organ pipe remained distinctly audible in the lecture-room of the Fogg Art Museum for 5.6 seconds after the blowing of the pipe ceased. The method proposed and carried out for the reduction of reverberation was to line a considerable portion of the walls of the room with a thick hair felt.

Professor Sabine has determined, by a very ingenious method, the absorbing power of a variety of wall surfaces, such as brick, plaster on brick, plaster on lath, glass and boards, and he has shown that the reverberation of a room can be pre-determined by calculation in terms of the size of the room and the character of its walls.

W. S. F.

NOTES ON INORGANIC CHEMISTRY.

A VERY considerable amount of work is being done at the present time in filling up the many gaps that exist in descriptive inorganic chem-

istry, especially in connection with the rarer elements. The ultimate aim of this work is to determine more accurately the relation of the elements to each other, and incidentally it is doing much to clear up the Periodic Law. Considering the gaps and discrepancies in the work that has been done upon the element *thallium* since its discovery by Crookes in 1861, it is hardly strange that two workers should have selected this for investigation. In the last *American Chemical Journal* a paper by Professor Cushman, of Bryn Mawr, takes up the first chapters of a study of the halogen compounds of thallium; while the last number of the *Zeitschrift für anorganische Chemie* contains a long article by Professor Richard Jos. Meyer, of Berlin, on trivalent thallium, with especial reference to the halogen compounds and the nitrates. There are some very considerable discrepancies between the observations of these two chemists, which will doubtless be cleared up by further study and by comparison. The most important result of Cushman's is the preparation of two isomeric compounds of the formula $Tl_4Cl_3Br_3$, or as they may be written, $TlCl_3 3TlBr$ and $TlBr_3 3TlCl$. Isomerism of this character, while common in organic chemistry, is very rare in inorganic chemistry, and many have asserted that it does not exist. Meyer has added to our knowledge a large series of new thallium salts, and brings out very beautifully the analogies which exist between thallium and gold. As both these authors are continuing their researches, there may be expected decidedly interesting and valuable contributions to our knowledge of thallium in the near future, as each profits by the work of the other.

A NEW and important addition to our knowledge of the chemistry of radium appears in the *Comptes Rendus*, from the pen of Madame Curie. By carefully fractioning many samples of radiferous barium, she has gradually accumulated small quantities of nearly pure radium; indeed, one specimen of a few centigrams was pronounced practically pure and was used for spectroscopic observations. With a specimen of 0.4 gramme concentrated radium, which, however, contained more or less barium, an atomic weight determination was made. This gave an atomic weight of about 174, while the atomic weight of barium is 137.5. This figure of 174 is a minimum, and M. Demarçay considers from spectroscopic observation of the specimen that there was rather more radium in it than barium. In any case it would follow that the atomic weight of radium must be decidedly higher than 174. This would seem to be very strong evidence that radium is an individual element and not a peculiar form of barium.

J. L. H.

ACADEMEI DEI LINCEI OF ROME.

AT the anniversary meeting of the Academei dei Lincei of Rome, Professor Cremona read a biographical notice of Professor Beltrami, who was president of the Academy at the time of his death. The prizes of the Academy announced in the *Atti* are summarized in *Nature* as follows: For the Royal prize of 1000 francs for normal and pathological physiology six candidates entered, and a large number of essays of considerable merit were submitted by them. The prize has been adjudged to Professor Giulio Fano, of Florence, for sixteen papers, dealing, amongst other subjects, with the physiology of the embryonic heart, the doctrine of experimental psychology, the organ of hearing, the graphic registration of respiratory chimism and reflex movements, the latter being a continuation of previous researches on the organs of *Emys Europea*. Of the six candidates for the Royal prize for geology and mineralogy, two were considered worthy of the award, which was therefore divided equally between them. One of the successful candidates, Professor De Lorenzo, chose geological subjects, and sent in about twenty essays, the most important of which dealt with the Trias of the environs of Lagonegro, the Mesozoic mountains of Lagonegro, geological observations on the Apennines of the southern Basilicate and geological studies of the southern Apennines. Professor Giorgio Spezia's work, on the other hand, was entirely mineralogical, dealing with the influences of temperature and pressure, respectively, on the chemical metamorphism of rocks and minerals. From a long and laborious series of experi-