material with more precautions. Others, again, and among them Sir Joshua Reynolds, have in their different works followed various practices, and consequently had varied results. Thus, some of Sir Joshua's pictures have kept perfectly sound. Others are cracked in the characteristic way just mentioned. Others, again, are cracked in an absolutely irregular way. We can easily form an idea of it if we read in his "Diary Notes," for instance, the way in which he painted the portrait of Miss Kirkman, which he began with whiting and gum tragacanth, then covered it successively with wax, then white of eggs, and then varnished it.

The study of the alterations already fully developed in pictures painted within the last hundred years only, and their comparison with the works of the old masters, would suggest the following rules for the process of painting :—

1. The oil should in all colours be reduced to a minimum, and under no form should more of it than absolutely necessary be introduced into a picture.

2. All transparent colours which dry very slowly should be ground, not with oil at all, but with a resinous vehicle.

3. No colour should be put on any part of a picture which is not yet perfectly dry; and, above all, never a quick-drying colour upon a slow-drying one, which is not yet perfectly dry.

4. White and other quick-drying opaque colours may be put on thickly. On the contrary, transparent and slow-drying colours should always be put on in thin layers.

If the effect of a thick layer of these latter is required, it must be produced by laying one thin layer over another, taking care to have one completely dry before the next is laid on. If transparent colours are mixed with sufficient quantity of white-lead, they may be treated like opaque ones.

We come now to the last layer of the picture, to that one which is spread over its surface in order to equalise optical irregularities, and to protect it at the same time from the air. I mean the varnish.

The varnish may crack or get dim; then it should be treated with Pettenkofer's method; but it may become dark yellow, brown and dirty, and so hide the picture that it becomes necessary to take it off and to replace it by a thin layer of new varnish. It is here that picture-restorers, or we may say picture-cleaners, display their beneficial skill, and also their very destructive activity.

If a picture is throughout painted in oil, if its substance has remained sound and even, and varnished with an easily soluble mastich or dammar varnish, then there will be neither difficulty nor danger in removing the varnish. This can, in such a case, be done either by a dry process, that is, by rubbing the surface with the tips of the fingers, and thus reducing the varnish by degrees to a fine dust, or by dissolving the varnish by application of liquids, which, when brought only for a short time into contact with the oil painting, will not endanger it. We have, however, seen that the works of the old masters are not painted with oil colours like those used by modern painters, but, on the contrary, that certain pigments, and especially the transparent colours used for glazing, were ground only with resinous substances. These latter have, in the course of time, been so thoroughly united with the layer of varnish spread over the surface of the picture, that there no longer exists any decided limit between the picture and the varnish. It is in such pictures that a great amount of experience, and knowledge of the process used for the picture, as well as precaution, are required in order to take away from the varnish as much only as is indispensable, and without interfering with the picture itself. Numberless works of art have been irreparably injured by restorers, who, in their eagerness to remove dirt and varnish, attacked the painting itself. They then destroyed just that last finishing touch of the painting, without which it is no longer a masterpiece.

The difficulty and danger are much greater in cleaning those pictures which have not been varnished with the ordinary easily-dissolved mastich or dammar varnish, but have been painted over with oil, oil-varnish, or oleo-resinous varnish. It seems incredible that these substances should ever be used for such purposes; it is, however, a fact that there are still people who fancy that it will contribute to the good preservation of their pictures to brush from time to time a little of those liquids over their surface. They recognise too late that the varnish becomes more and more dark, of a brownish colour, and opaque. If such varnish has afterwards to be removed, then we meet with the great difficulty, that this can be done only with substances which would just as easily dissolve the whole picture as the hardened layers spread over it.

This shows what can be the value of those universal remedies which from time to time appear, and are praised for the innocuous way in which pictures by their means may be cleaned.

There is at this moment a great discussion going on in Italy about Luporini's method. Luporini is a painter and picture-restorer in Pisa, who believes himself to have invented a new means of cleaning pictures without any danger. Some months ago, in Florence, I examined a large number of pictures cleaned by him. Those of the Gallery of St. Donato, belonging to Prince Demidoff, mostly Flemish and Dutch landscapes, are cleaned very well and without any injury to the painting. On the contrary, the St. John, by Andrea del Sarto, one of the finest pictures of the Palazzo Pitti, I found very much altered by the restoration of Luporini. I had studied that picture very closely the year before, and should now sooner believe it to be a modern copy than the cleaned original. It has lost all softness of outline and the characteristic expression of the face. The change in the flesh tints can scarcely be explained otherwise but by an entire removal of the glazing.

I think it is taking a heavy responsibility to allow a new experiment to be tried upon such an invaluable work of art. Even private persons, who are fortunate enough to be in possession of such treasures, ought to feel responsible for the good preservation of masterpieces, which are, it is true, their material property, but which intellectually belong to the whole civilised world of the present and of the future.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—Messrs. Mackren, Robbs, and Hichens, have been appointed to Scholarships in Natural Science at Gonville and Caius College.

EDINBURGH.—At the Graduation Ceremonial on Tuesday the degree of Doctor of Science in the Department of Mental Science, was conferred on Jacob Gould Schurman, B.A.; in the Department of Mathematics on Alexander Macfarlane, M.A., B.Sc.; in the Department of Chemistry on William Inglis Clark, B.Sc. The degree of Bachelor of Science was conferred on William Thomson in the Department of the Mathematical Sciences; on John Adrian Blaikie and James Johnstone Dobbie in the Department of the Physical Experimental Sciences; on William A. Haswell in the Department of the Natural Sciences; on James Alfred Ewing and John Gray in the Department of Engineering; and on John Brown, M.D., John Berry Haycraft, M.B., C.M., and John Trehame, M.B., C.M., in the Department of Public Health. The Hope Prize Scholarship in Chemistry was awarded to Mr. Lewis Johnstone, and the Falconer Memorial Fellowship for the encouragement of the study of Palæontology and Geology, of the annual value of 100*l.*, tenable for two years, and conditionally for four years, was awarded to R. A. Lundie, M.A., B.Sc.

BALTIMORE.—We recently referred to the system of fellowships at the Johns Hopkins University, Baltimore. From a statement on the subject which has come to hand, we learn that twenty fellowships, each yielding 500 dols. a year, are annually open in the University. They are awarded by the trustees on the nomination of the Faculty, as nearly on the first of June as may be found practicable. Candidates are invited from any part of the country. The object of this foundation is to give to a few scholars of promise the opportunity to prosecute further studies, under favourable circumstances, and likewise to open a career for those who propose to follow scientific and literary callings. The University expects to be benefited by the presence and influence of the Fellows, and by their occasional services; from among the number it hopes to secure from time to time some of its teachers. Three of the twenty fellowships are allotted this year to each of the five departments, Greek, mathematics, chemistry, physics, and biology; and the remaining five will be allotted either in these departments or in others, at the discretion of the Faculty. Appointments are made by a careful consideration of all the evidence submitted to the Faculty. Every candidate in presenting his name is expected to address a letter to the president indicating the course of his previous reading and study, and his general purposes with reference to future work. It is desirable for him to present in printing or manuscript an essay or thesis which may have been written either

for this occasion or for any other purpose. If he has been engaged in any scientific or literary research he should indicate its character, and generally give evidence as to his previous career and *bonâ fides*. The holders of the fellowships are required to reside in Baltimore during the entire academic session, and they are not permitted to engage in teaching, out of the walls of the University, unless for exceptional reasons in other colleges which may ask for some temporary service. They are expected to devote all their time to study under the guidance of one of the professors, or if there be no professor in the chosen department, under the general approbation of the Faculty. Toward the close of the Academic year a report of his work is expected from each Fellow. As opportunities offer, the Fellows are encouraged to prepare and read lectures or essays on subjects to which they have given special attention. They are also required to render occasional services as examiners or as assistants in the laboratories; but those services are not burdensome, unless they are compensated by additional stipends. Those who become distinguished by their attainments may be assured of the constant encouragement of the Faculty. With all these precautions there seems little chance of the Johns Hopkins University being eaten up by idle Fellows.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 11.—"The Acceleration of Oxidation caused by the Least Refrangible End of the Spectrum," by Capt. Abney, R.E., F.R.S.

In a paper contributed to the *Philosophical Magazine* in January last, the author expressed an opinion that Chastaing's idea regarding an acceleration of oxidation being caused by red light might prove true in regard to the oxidation of the photographic image, and elsewhere[1] that Becquerel's coloured spectra might be explained on the same principles, and this he finds to be true as regards oxidation of the photographic image.

A silver bromide film was exposed to diffused light. It was then submitted to the action of the solar spectrum, whilst immersed in a solution of potassium permanganate, hydroxyl, potassium bichromate, or nitric acid, or in ozone. When the strength of these was correct, a reversed image of the least refrangible end of the spectrum was obtained, an increase in oxidation taking place where the red rays acted, the reversal commencing somewhere near D, and extending into the ultra-red.

The accelerating effect of the red rays is most marked when the solutions are weak; but there is a limit to the dilution caused by the fact that in the films employed the silver salt is sensitive as far as the wave length 10,000, and there must be sufficient strength to oxidise the invisible image as it is formed, besides gradually destroying the effect of the preliminary exposure. With silver iodide, as there is no reduction by the red rays, the reversed action is much more readily obtained.

A reversed image of the least refrangible end of the spectrum can thus be produced by using solutions of a certain strength, whilst if made more dilute an unreversed image is obtained. This throws a light on Draper's photographs of this region of the spectrum.

Geological Society, March 6.—Henry Clifton Sorby, F.R.S., president, in the chair.—Henry Edward Richard Bright, George James Cotton Broom, William James Farrer, George Scamell, and Joseph Fletcher White were elected Fellows of the Society.—The following communications were read:—On the geology of Gibraltar, by Prof. A. C. Ramsay, F.R.S., and James Geikie, F.R.S. In this paper the authors, after giving some account of the physical features of Gibraltar, described in detail the various rock-masses of which the peninsula is composed. The chief rock is a pale grey, bedded limestone, overlain by shales containing beds and bands of grit, mudstone, and limestone. Fossils are very rarely met with in the limestone, and have never as yet been found in the shales. The only recognisable fossil they obtained from the limestone was a *Rhynchonella*, which Messrs. Etheridge and Davidson think is most likely *Rh. concinna*. This would make the beds of Jurassic age. The limestone forms the great eastern escarpment, and dips west under the shales, which form the lower slopes upon which the town is built. The dips vary from 12° or 20° up to vertical. The connection of these strata with the rocks of the adjoining districts in Spain and the opposite coast of Africa was traced, and it was shown that the Gibraltar limestone reappears in Ape's Hill in Barbary, while the overlying shales and the sandstones of Queen of Spain's Chair form all the ground to the west of Ape's Hill up to Cape Spartel. The Jurassic strata of Gibraltar are overlain by various superficial accumulations, the oldest of which is a great mass of limestone agglomerate, which is unfossiliferous, and shows as a rule no trace of stratification. It is made up of angular blocks of limestone of all shapes and sizes, and rests upon an uneven surface of limestone: it also covers wide areas underneath which only shales are present. It is excessively denuded, being worn into ravines and gullies, and presents generally a highly honeycombed surface. Terraces of marine erosion have also been excavated in it. It is not now accreting, and could not have been formed under present conditions of climate and surface. The authors gave at length their reasons for believing it to have been the result of a severe climate. The blocks were wedged out by the action of frost, and the heaps of angular *débris* thus formed were saturated by water derived from melting snows, and so were caused to flow *en masse* down the mountain slopes and over the gently inclined ground at their base. The caves and fissures of Gibraltar were then described. It was shown that the true bone-breccias were confined to these. Many of these fossiliferous breccias are of later date than the great agglomerate, since they are met with in fissures and caves that intersect the limestone and limestone agglomerate alike. When the mammalia tenanted Gibraltar, Africa and Europe were united, and the climate was genial. All round the rock occur platforms, ledges, and plateaus, which are evidently the work of the sea. These erosion-terraces are covered in many places with calcareous sandstones containing recent species of Mediterranean shells. Such marine deposits occur up to a height of 700 feet. The movement of depression was interrupted by pauses of longer or shorter duration, and the climatic conditions were probably much the same as at present. After the rock had been re-elevated, the subaërial forces modified the surface of the marine sands that covered the limestone platforms, so that they came to form long sand slopes. The land at this period was of greater extent than it is now, and some grounds exist for believing Europe to have been again united to Africa, for mammalian remains occur here and there in the deposits that overlie the limestone platforms. These relics, however, it is just possible may be derivative. The climate was probably still genial like the present. Overlying the marine and subaërial deposits just referred to occurs an upper and younger accumulation of massive unfossiliferous limestone agglomerate. This deposit the authors believe to owe its origin to severe climatic conditions. After the marine deposits that cloak so much of the eastern side of the rock had been weathered into subaërial sand-slopes, large blocks were detached from the cliffs and steep slopes, and these dropped down upon the sand and were soon drifted over. By and by the blocks fell in such quantities that the sand-slopes in many places were completely buried under a talus of limestone *débris*. This was subsequently consolidated by infiltration into a solid agglomerate, in the same way as the underlying sands were hardened into sandstone. These sandstones contain a few blocks of limestone only in their upper portions. In their horizontally-bedded and lower-lying portions no limestone blocks occur. This later agglomerate bears every stamp of great antiquity, and could not have been formed under present geographical and climatic conditions. The surface is honeycombed and worn, just like that of the solid limestone and the older limestone agglomerate. Since its accumulation the climate has greatly changed, the present being characterised by the absence of frost. In concluding, the authors discussed at length the cause of the cold conditions that gave rise to the great limestone agglomerates, and argued that this cause could not have been *elevation of the land*. They also pointed out that a *submergence of the Sahara* would be equally incompetent to bring about the desiderated climatic conditions, and that even a former much greater elevation of the land, combined with the appearance of a Sahara sea, would fail to supply us with the severe winter climate that was necessary to produce the great agglomerates. They thought that the most probable explanation of the phenomena described is that the cold conditions referred to were contemporaneous with that general refrigeration of climate which took place over so vast an area in our hemisphere during pleistocene times. The limestone agglomerates they look upon as the equivalents of those glacial deposits that occur so plentifully in our own and other countries, and the bone breccias, which are intermediate in date between the lower and upper limestone agglomerates, are paralleled by the interglacial beds of the British Islands, Sweden, Switzerland,

[1] "Treatise on Photography," p. 225. Longmans.