

those of type III.; if this colour was visible in stars of the other two types, they were always near the horizon. Yellow was rarely absent; yellow of greater or lesser brightness predominated completely in a large number of stars when they were high above the horizon and had ceased to scintillate. Orange is very frequent amongst the colours of the stars of the third type, while they scintillate.

If we reflect upon this short sketch of the changes of colour of scintillating stars, we see at once how complicated this phenomenon is, and that, in order to obtain data of tolerable certainty, at least two series of observations must be made, one in dry and the other in rainy weather; and further, that the influence of the star's altitude must be determined, which can be done by dividing the observations into separate zones of five degrees each.

With regard to the colours of scintillating stars Arago has expressed the opinion that the colour observed at any special moment is the complementary colour to those rays of the light peculiar to the scintillating star which at that moment are absent in the eye or in the telescope. M. Montigny agrees with this view and confirms it by an observation which he made when, on some evening specially favourable for observation, he inserted a prism just when the circle produced in the scintillometer by the light of the star Capella was very sharp and showed bright colours; he then found the two arcs of the circle divided into different colours, and this could not have been the case if the colours seen without the prism had actually been present. M. Montigny, however, intends further to examine this question by means of the spectroscope.

Arago also raised the well-known question whether the scintillation of stars is the same for two observers stationed at different places. M. Montigny replies to this question in the negative, and this was Arago's opinion also; he found the colours of a star to be different for those rays which are differently refracted by the two halves of the object-glass. In the same sense M. Donders has noticed that the scintillation does not always show the same peculiarities for each eye of the same observer. Another circumstance may be cited here as another proof, viz., that a double star, both components of which are of the same colour, such as Castor and its companion, which are both white, does not always show the same colours in the scintillometer at the same angles of position. Although the angle separating these two stars amounts to but five seconds of arc, it yet suffices to produce different colours. This shows how greatly the appearance of stars in the scintillometer is affected by the smallest differences in the conditions under which they are observed, since two separate pencils of rays of the same colour travelling side by side and at the same moment may yet be changed to different colours on their passage through the atmosphere.

### UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE subject of the use and abuse of examinations is beginning to be agitated in Austria. Within a few weeks past, two students, one at Pest and the second at Graz, have committed suicide after failing to pass examinations for the doctor's degree. The latter of the two had completed a lengthy course of study, and was an assistant of recognised ability in the university.

DURING the past few years the educational institutions of Rome have been entirely reorganised. The university, as constituted at present, is without a theological faculty. It numbers sixty-four professors, twelve in the legal faculty, twenty-four in the medical, sixteen in the scientific, and twelve in the philosophical-philosophical. Nearly all the conveniences of a well-appointed university are now enjoyed by the students: a botanical garden, laboratories for physics, chemistry, and physiology; the new observatory on the Capitoline, with special institutes for geology, mineralogy, mathematical physics, pharmacy, comparative zoology and anatomy, pathological anatomy, and six clinics. During the past month the Minister of Education has issued a decree for the foundation of a school of archaeology, which shall be amply equipped, and meet a want long felt in this centre of archaeological investigation.

### SOCIETIES AND ACADEMIES LONDON

Royal Society, May 23.—“Experimental Results relating to the Rhythmical and Excitatory Motions of the Ventricle of the Heart of the Frog, and of the Electrical Phenomena which

accompany them,” by J. Burdon Sanderson, M.D., F.R.S., and F. J. M. Page, B.Sc., F.C.S.

This paper, although of some length, is a condensed statement of experimental results, so that it scarcely admits of being abstracted. These relate, as stated in the first paragraph, to (1) the order and duration of the rhythmical and excitatory motions of the heart of the frog, (2) the normal electrical condition of the surface of the heart and the influence thereon of mechanical, chemical and thermal injuries, and (3) the characters of the normal and of the excitatory electrical variations, and the modifications of those characters which are induced by injuries of the surface, and under the temporary influence of radiant heat. As we have not space to reproduce the whole, we will confine ourselves chiefly to the very interesting experiments contained in the two last sections.

The authors begin this part of the subject with the statement that they have confirmed, by repeated experiment, the observations made by Engelmann in 1873, that all parts of the surface of the “resting” heart are equipotential, and that the electrical inequalities which are usually found whenever the surface of the organ is investigated, when in this condition, owe their existence to slight injuries; they then proceed to discuss the conditions which lead to the existence of electrical differences. These are (1) permanent injury of the surface, however superficial and slight in extent, and (2) the temporary influence of radiant heat. As regards permanent injury, their observations are substantially in accordance with the conclusions of Hermann as regards other excitable and contractile tissues, viz., that the death of a part renders it *negative* to all living parts of the same organ. Substituting for the word death (which, in order to express the whole truth, must be understood to include every degree of local lesion, however limited in extent or slight in degree) the expression “permanent injury,” this proposition becomes adequate for its purpose.

The authors further find that the influence of radiant heat produces a modification of the electrical condition of a part, of which the sign is opposed to that of the electrical change produced by injury. They were led to this result by the consideration that if arrest of the chemical changes which constitute the life of a part renders it negative, it is probable that a momentary intensification of these changes will render it positive.

The fundamental experiment by which both facts are established is as follows:—Two points on the surface of the heart, which may be as near to each other as two millims., are connected with a galvanoscopic circuit, and found to be equipotential. A loop of platinum wire, heated by a current, is brought into the neighbourhood of one of them for one second. After an interval of about a second the warmed surface becomes positive: in a few moments this effect subsides. If, then, the hot wire is brought nearer so as to scorch the surface, however slightly, and then removed, the opposite effect—that of permanent injury—manifests itself. The same spot, which was before positive, now becomes negative in a very much greater degree; for whereas the temporary “positivity” scarcely exceeds 1-2,000th Daniell, the “difference” of potential produced by injury may amount to 3-100ths Daniell. On the physiological meaning of these effects the authors do not enter. An indication of their bearing is, however, given by the observation in the next section, which relates to the so-called variation of the heart. By variation is meant the electrical disturbance which accompanies, or rather precedes, each contraction of the ventricle. The fact that such a disturbance exists has been known for several years. It has also been recognised that it precedes the visible change of form by which the systole discloses itself. The authors now show that the disturbance consists of two phases having opposite signs—that in the first phase, which is of short duration, parts near the apex become positive to parts further from it; that in the second phase the opposite condition is observed; further, that the first phase is entirely over before the ventricle begins its contraction, whereas the second phase corresponds in duration with the period during which the ventricle is doing the greatest amount of mechanical work, and ceases at the moment of decline of the muscular contraction of the ventricle. These time relations of the two phases suggest the inference that in all probability the first phase corresponds with that of the negative variation of ordinary muscle, with which it agrees in sign, and that the second phase is more immediately associated with the muscular contraction. That this is so appears to be shown by the observation that if any two points of the rhythmically pulsating heart *a* and *b*, of which *a* is nearest to the apex, are investigated by