THE SONG OF BIRDS.

In view of the interest attached to the experiments made by Professor W. E. D. Scott with a view to ascertaining whether the song of birds is instinctive or imitative it may be well to recall that very similar experiments were made over a century ago. Wallace notes in his essays on 'Natural Selection, etc.,' that "The Hon. Daines Barrington was of the opinion that 'notes in birds are no more innate than language is in man, and depend entirely on the master under which they are bred, *as far as their organs will enable them to imitate* the sounds which they have frequent opportunities of hearing." An account of his experiments is given in the *Philosophical Transactions* for 1773, Vol. LXII., and his results were practically the same as those obtained by Professor Scott, the young birds acquiring the song of their foster parents and not the notes of their own species. Barrington notes that the birds must be taken from the nest when very young, as they are apt pupils and learn the call notes of their parents at an early age.

F. A. L.

Museum of the Brooklyn Institute,
August 28, 1904.

DOCTORATES AND FELLOWSHIPS.

To the Editor of Science: In Science for August 19 is the remark: 'It is somewhat surprising that California and Stanford have together conferred the degree (of Ph.D.) but twenty-five times in seven years.' Among the reasons for this are two: the authorities of this institution advise their advanced students, for the sake of breadth of experience, to take a part of their work in the east or in Europe. This is generally the concluding part. On the other hand, the California institutions grant few artificial aids to students as such. At Stanford this is regarded as a matter of principle, tuition being free to graduate students. By the wider introduction of the 'trading stamp system' in higher education, the number of degrees could be greatly increased, but with no gain to science or art.

David Starr Jordan.

SPECIAL ARTICLES.

LIMITATIONS OF THE KLINOSTAT AS AN INSTRUMENT FOR SCIENTIFIC RESEARCH.

The klinostat is an instrument used mostly in plant and animal physiology, revolving about either a vertical or a horizontal axis, for the purpose of neutralizing the tropic (curving) effects of light and gravitation. It was first made practical and introduced into laboratory work by Sachs in 1872, and fully described with additional improvements in several papers in that memorable series of pioneer research entitled 'Arbeiten des botanischen Instituts in Würzburg.'

The instrument as commonly manufactured is actuated by springs, and may be given several speeds, usually one revolution in ten, fifteen, twenty or thirty minutes. In the use of the instrument for demonstration and research during the past thirty years, it has generally been thought immaterial to consider the angles at which plants are secured to the horizontal klinostat for the purpose of neutralizing the tropic effect of gravitation, or to consider the distribution of light when plants are revolved on the vertical klinostat for the purpose of neutralizing the tropic effect of light. In addition to the foregoing relations of the instrument to gravitation and light, the present tendency to substitute electric and water motors for springs to drive the machines introduces relations of speed. The research of the past ten years has indicated very important limitations to the use of the klinostat, and the most general of these are pointed out in the following lines, and should be recognized by every one using this instrument.

Evenness of Speed.—The first requisite for securing evenness of revolution is the centering of the load. An excentric load will give a slower speed periodically, and this will bring curves. It has been shown in my own laboratory that, in a speed of one revolution in ten minutes, a periodic retardation of but a second or two, due to excentricity of load, will cause, after a long interval, a geotropic curve by the summation of stimuli.

Avoidance of Centrifugal Effect.—It is well known that in rapid revolution, plants simulate toward the so-called centrifugal force