chamber, which could be evacuated and dried. The observations were made by tilting a large plate of the material with a perfectly smooth surface until a small piece of the same substance, provided with three spherical feet, would slide down the surface. Sliding begins at a very small angle, 1·5° for glass, and the speed has a fixed terminal value for each angle of tilt up to a little more than 5°, when the motion becomes an accelerated one. Up to this point there is a definite relation between the speed and the friction, and this relation must be substituted for the discontinuous law of Coulomb, according to which friction prevents motion until an angle of tilt of the order of 10° or 20° is attained.

AN interesting article on critical speeds for torsional and longitudinal vibrations, by Prof. Arthur Morley, of University College, Nottingham, appears in *Engineering* for December 9. The driving effort of a reciprocating engine, or the resistances to be overcome, may be periodically fluctuating in magnitude, and if the period of such a variation should approach to the period of a free torsional vibration, or to an integral multiple of it, torsional oscillations of some considerable magnitude may be set up, with accompanying high stresses in the material of the shaft. Cases of approach to dangerous resonance with longitudinal vibrations are perhaps much less common in machinery. The author gives a complete mathematical analysis in the article, and concludes with an interesting application to the case of a pit cage and contents weighing ten tons, and being raised by an engine running at 100 revolutions per minute. Taking the net section of the rope at 2·5 square inches and E as 13,000 tons per square inch, the depth at which the natural frequency of vibration of the loaded rope is equal to the speed of the engine is 955 feet, neglecting the weight of the rope. Taking a rope weighing 8·4 lb. per foot, and making allowance for its weight, the depth at which resonance will occur works out to about 862 feet.

OUR ASTRONOMICAL COLUMN.

NOVA ARÆ, 98.1910.—A telegram from Dr. Ristenpart to the *Astronomische Nachrichten* (No. 4457) states that the magnitude of Nova Aræ, recently discovered by Mrs. Fleming, was 9·6 on November 19.

The nova is invisible on forty-four plates of the region taken at Arequipa during the period August, 1889, to March 19, 1910, but appears on twenty-one photographs secured between April 4 and August 3 of this year; on these plates its magnitude apparently ranges from 6·0 to 10·0, and thus it would appear that between March 19 and April 4 the magnitude increased from 12·0, the limiting magnitude of the Arequipa plates, to 6·0. Like most of its class, this nova lies well in the Milky Way, its position (1875·0) being $\alpha = 16h.\ 31m.\ 4s.$, $\delta = -52° 10·4'$.

SATURN'S RINGS.—Herr K. Schiller, writing to the *Astronomische Nachrichten* (No. 4458), states that he observed Saturn's ring system on November 26 at Bothkamp, and could detect no extraordinary feature such as was described by M. Jonckheere in an earlier communication; the atmospheric conditions were excellent, and Herr Schiller employed powers of 200, 600, and 800.

PUBLICATIONS OF THE ALLEGHENY OBSERVATORY.—We have received the first four numbers of vol. ii. of the Publications of the Allegheny Observatory of the University of Pittsburgh, and give brief abstracts of them below. In No. 1 Prof. Schlesinger describes the Mellon spectrograph with which he and the other observers prosecute their radial-velocity researches. This instrument was provided, by the generosity of Mr. Andrew Mellon, for line-of-sight work when the Keeler memorial telescope was completed in 1906. The grave disadvantages arising from the location of an astronomical observatory near a large town, where the sky is never clear and ever illuminated by artificial illuminants, had to be considered when the form of instrument was under contemplation. Consequently, the work which is possible had to be materially restricted, because of the necessity of keeping the possible exposures within reasonable limits, and a one-prism spectrograph was designed. The sacrifice was considerable, but peculiar circumstances rendered it necessary. However, it appeared that useful work might be done if the investigations were confined to such stars as have broad, hazy lines, and this decision has been justified by the results already published. Dr. Schlesinger describes and illustrates the details of the instrument, showing how rigidity has been attained with moderate weight. A region of the spectrum from λ 3930 to λ 4750 can be brought into sharp focus, and under exceptionally good conditions a strong spectrum of a fifth-magnitude star can be obtained in about twenty minutes. Owing to the impurity of the town atmosphere, the large mirror of the Cassegrain reflector has to be resilvered once a month, and the small one every other week; even then, at times, they only reflect about half as much light as when newly silvered, and some 40 per cent. of the deterioration takes place within three or four days of resilvering. The arrangements for maintaining the temperature range of the prism box within 0·1° C., for eliminating flexure, and for adjusting the focus are minutely described and very ingenious.

In No. 2 Dr. Schlesinger and Mr. D. Alter discuss the relative motions of 61 Cygni and similar stars. This discussion indicates that the motion of the companion star is orbital rather than in a straight line—that the two stars are physically connected; thus the designation "of the 61 Cygni type," as indicating pairs not physically connected, should be abandoned.

No. 3 contains a discussion of the orbits of the spectroscopic components of ε Herculis, by Dr. R. H. Baker, determined from seventy-two plates taken with the Mellon spectrograph during 1907–8. The period is found to be 4·0235 days, and the orbit nearly circular; there is no substantial evidence for the presence of a third body. In No. 4 Dr. Baker discusses the orbit of 1 H. Cassiopeiæ, from fifty-seven plates secured during 1908–9, and finds the period to be 6·067 days.

THE ORBIT OF THE PERSEIDS.—Meteoric astronomy is being, and is likely to be, considerably advanced by the energetic and organised observations of the Antwerp Société d'Astronomie. Since 1896 the Perseid and other showers have been independently observed at many stations, and the results collated and discussed. During 1909 and 1910, 485 and 303 Perseid trails were recorded, and indicate the existence of seven radiants. For five of the best marked of these M. Henri Dierckx has calculated elliptic elements, which he compares with Hayn's elements for Tuttle's comet, 1862 III., in an article appearing in Nos. 11–12 of tho *Gazette astronomique*. The agreement is well marked, although, as the author remarks, the probably large area covered by the swarm of meteoritic particles precludes the expectation that the Perseid elements would rigidly agree *inter se*.

DEFINITIVE ELEMENTS FOR THE ORBIT OF COMET 1904 II. (1904*d*).—This comet was discovered by M. Giacobini at Nice on November 17, 1904, and was observed until May 2, 1905. Herr J. Sedláček has now discussed 118 observations, referred to eighty-four comparison stars, and publishes the resulting orbital elements in No. 4453 of the *Astronomische Nachrichten*. The orbit appears to be hyperbolic, but the departure from a parabola is so slight as to be practically negligible.

DESIGNATIONS OF NEWLY DISCOVERED VARIABLE STARS.—In No. 4457 of the *Astronomische Nachrichten* the commission of the AG Catalogue of Variable Stars gives the permanent designations to 126 recently discovered variable stars. Many of the objects have been discovered to be variable during the present year, whilst the variability of others was detected during preceding years. In addition to the designations, the commission gives the provisional numbers, the positions for 1900, the range of magnitude, and remarks concerning the discovery, the period, the type, and the spectrum of each object.