fully, and is indeed more difficult to make without error than the screw itself. The principle which should be adopted is that no workmanship is perfect; the design must make up for its imper­fections. Thus the screw can never be made to run true on its bearings, and hence the device of resting one end of the carriage on the nut must be rejected. Also all rigid connexion between the nut and the carriage must be avoided, as the screw can never be adjusted parallel to the ways on which the carriage rests. For many purposes, such as ruling optical gratings, the carriage must move accurately forward in a straight line as far as the horizontal plane is concerned, while a little curvature in the vertical plane produces very little effect. These conditions can be satisfied by making the ways V-shaped and grinding with a grinder somewhat shorter than the ways. By constant reversals, and by lengthening or shortening the stroke, they will finally become nearly perfect. The vertical curvature can be sufficiently tested by a short carriage carrying a delicate spirit-level. Another and very efficient form of ways is V-shaped with a flat top and nearly vertical sides. The carriage rests on the flat top and is held by springs against one of the nearly vertical sides. To determine with accuracy whether the ways are straight, fix a flat piece of glass on the carriage and rule a line on it by moving it under a diamond; reverse and rule another line near the first, and measure the distance apart at the centre and at the two ends by a micrometer. If the centre measurement is equal to the mean of the two end ones, the line is straight. This is better than the method with a mirror mounted on the carriage and a telescope. The screw itself must rest in bearings, and the end motion be prevented by a point bearing against its flat end, which is protected by hardened steel or a flat diamond. Collar bearings intro­duce periodic errors. The secret of success is so to design the nut and its connexions as to eliminate all adjustments of the screw and indeed all imperfect workmanship. The connexion must also be such as to give means of correcting any residual periodic errors or errors of run which may be introduced in the mountings or by the wear of the machine.

The nut is shown in fig. 10. It is made in two halves, of wrought iron filled with boxwood or lignum vitae plugs, on which the screw is cut. To each half a long piece of sheet steel is fixed which bears against a guiding edge, to be described presently. The two halves are held to the screw by springs, so that each moves for­ward almost inde­pendently of the other.

To join the nut to the carriage, a ring is attached to the latter, whose plane is vertical and which can turn round a vertical axis. The bars fixed midway on the two halves of the nut bear against this ring at points 90° distant from its axis. Hence each half does its share in­dependently of the other in moving the carriage forward. Any want of parallelism between the screw and the ways or eccentricity in the screw mountings thus scarcely affects the forward motion of the carriage. The guide against which the steel pieces of the nut rest can be made of such form as to correct any small error of run due to wear of the screw. Also, by causing it to move backwards and forwards periodically, the periodic error of the head and mountings can be corrected. In making gratings for optical purposes the periodic error must be very perfectly eliminated, since the periodic displacement of the lines only one-millionth of an inch from their mean position will produce “ghosts” in the spectrum. (See Diffraction.) Indeed this is the most sensi­tive method of detecting the existence of this error, and it is practically impossible to mount the most perfect of screws without introducing it. A very practical method of determining this error is to rule a short grating with very long lines on a piece of common thin plate glass; cut it in two with a diamond and superimpose the two halves with the rulings together and displaced sideways over each other one-half the pitch of the screw. On now looking at the plates in a proper light βo as to have the spectral colours show through it, dark lines will appear, which are wavy if there is a periodic error and straight if there is none. By measuring the comparative amplitude of the waves and the distance apart of two lines, the amount of the periodic error can be determined. The phase of the periodic error is best found by a series of trials after setting the corrector at the proper amplitude as determined above.

A machine properly made as above and kept at a constant tempera- ture should be able to make a scale of 6 in. in length, with errors at no point exceeding 1/100,000 of an inch. When, however, a grating of that length is attempted at the rate of 14,000 lines to the inch, four days and nights are required and the result is seldom perfect, possibly on account of the wear of the machine or changes of temperature. Gratings, however, less than 3 in. long are easy to make. (H. A. R.)

SCREW-PINE, the popular name for plants of the genus *Pandanus,* which are shrubs or trees of peculiar habit, having

a main stem and a few branches at the ends of which is a tuft of long, stiff, narrow leaves closely arranged in three strongly twisted lines. The stem forms stout roots, which grow obliquely downwards to the soil, and owing to the decay of the lower part of the stem the plant is often supported merely by these strong prop-like roots. The ripe fruits are borne in often very large spherical or cylindrical heads, which are often extremely hard. The genus is the principal one of the family Pandanaceae, a small order of Monocotyledons, which is widely distributed through the tropics of the Old World, especially in the islands of the Malay Archipelago and of the Indian and Pacific Oceans.

SCRIBE, AUGUSTIN EUGÈNE (1791-1861), French dramatist, was born in Paris on the 24th of December 1791. His father was a silk merchant, and he was well educated, being destined for the bar. But, having a real gift for the theatre, a gift which unfortunately was not allied with a corresponding literary power, he very soon began to write for the stage. His first piece, *Le Prétendu sans le savoir,* was produced without his name at the Variétés in 1810, and was a failure. Numerous other plays, written in collaboration with various authors, followed; but Scribe achieved no distinct success till 1815, when *Une Nuit de la garde nationale*, written in collaboration with Delestre-Poirson, made him famous. Thenceforward his fertility was unceasing and its results prodigious. He wrote every kind of drama— vaudevilles, comedies, tragedies, opera-libretti. To the Gymnase theatre alone he is said to have furnished a hundred and fifty pieces before 1830. This extraordinary fecundity is explained by the systematic methods of collaboration which he established. He had a number of co-workers, one of whom supplied the story, another the dialogue, a third the jokes and so on. He is said in some cases to have sent sums of money for “ copyright in ideas ” to men who were unaware that he had taken suggestions from their work. Among his collaborators were Jean Henri Dupin (1787-1887), Germain Delavigne, Delestre-Poirson, Mélesville (A. H. J. Duveyrier), Marc-Antoine Desaugiers, Xavier Saintine and Gabriel Legouvé. His début in serious comedy was made at the Théâtre Français in 1822 with *Valérie,* the first of many successful pieces of the same kind. His industry was untiring and his knowledge both of the mechanism of the stage and of the tastes of the audience was wonderful. For purely theatrical ability he is unrivalled, and his plays are still regarded as models of dramatic construction. Moreover he was for fifty years the best exponent of the ideas of the French middle classes, so that he deserves respectful attention, even though his style be vulgar and his characters commonplace. He wrote a few novels, but none of any mark. The best-known of Scribe’s pieces after his first successful one are *Une Chaîne* (1842); *Le Verre d'eau* (1842); *Adrienne* *Lecouvreur* (1849), in conjunction with Legouvé; *Bertrand et Raton, ou l'art de conspirer;* and the libretti of many of the most famous operas of the middle of the century, especially those of Auber and Meyerbeer. The books of *La Muette de Portici, Fra Diaυolo, Robert le Diable,* and of *Les Huguenots* are wholly or in part by him. Scribe died in Paris on the 20th of February 1861.

His *Œuvres complètes* appeared in seventy-six volumes in 1874- 1885. See Legouvé, *Eugène Scribe* (1874).

SCRIBES. The word “ scribe ” (from Lat. *scribere,* to write) means generally a writer; but it has a more special application as the English term for the Jewish class called in Hebrew *Sopherim* (Gr. γpαμματets). Both the Hebrew and the Greek word are used to denote something equivalent to secretary of state or town-clerk in general; and through the influence of the law, revealed through Moses, upon the Jewish nation conceived as a theocracy, both words denote in particular one learned in Scripture. Jeremiah (for example) knew of Scribes who made the law of the Lord falsehood (viii. 8), just as he knew of false prophets and profane priests (xxiii.). The function of writing belongs rather to the scribe or secretary in general than to the specifically Jewish scribe, whose primary business was to read and interpret the existing revelation of God’s will, just as the town-clerk at Athens read public documents to the assembly (Thuc. vii. 10). So Ezra, the most famous of the early