A New Explosive.—A French chemist named M. Eugène Turpin has, it is stated, discovered an explosive of tremendous power which he terms "Panclastite," and for which he claims a maximum of force with a minimum of risk, the two materials of which it is composed being innocuous until mixed. M. Turpin recently made experiments at Chatham before the military authorities, and they pronounced the explosive to be very satisfactory.

Railways in the Caspian region — General Chernaieff, the governor of Turkestan, has recently gone over the route from Kungrad to the Caspian in person, and finds it well suited for vehicles. Even a railway between the delta of the Oxus and the Gulf Mertvi-kuttuk has been talked of. The connection of Tiflis and Baku by rail is completed, and the journey can now be made between the Black and Caspian seas in thirty hours without change.

Limit of Hearing.—This subject has recently been studied by M. E. Panchon, and his results have been communicated to the French Academy of Sciences. The notes were produced by a powerful siren of the kind invented by Cagniard-Latour, and actuated by steam. The highest audible notes produced in this way had 72,000 vibrations per minute. M. Panchon has also vibrated metal stems fixed at one end, and rubbed with cloth powdered with colophane. In diminishing the length of the stem the sharpness of the note is increased. Curiously enough he finds that the length of stem giving the limiting sound is independent of its diameter; and for steel, copper, and silver the lengths are in ratio to the respective velocities of sound in these metals—that is to say, as 1,000 for copper, 1,002 for steel, and 0.995 for silver. Colophane appears to be the best rubbing substance. When the acute sound ceases to be heard, the sensitive flame of a gas jet is still affected by it.

While upon the subject, we may mention that Mr. Francis Galton has recently invented a "hydrogen whistle," which enables him to obtain notes far above the upper limit of human hearing, its object being to test the hearing powers of insects, which, as is now known, have very very acute ears. The number of vibrations produced by a gas in a whistle is universally proportional to the density of the gas, and as hydrogen is thirteen times lighter than air the sounds produced by it in a given whistle are thirteen times shriller—that is to say, the pitch is thirteen times higher. Mr. Galton has made a whistle 0·14 inch long and 0·04 inch in diameter, which with hydrogen gas gives a sound of 312,000 vibrations per second. The whistle is fitted with a piston at its base to regulate its length, and it is probable that still higher notes can be obtained with a shorter length.

Casting Electrotype Plates.—There are several ways of making wooden blocks and mounting electrotype plates upon them, but none of the methods prevent them from swelling or warping when the "forms" are washed, thereby injuring or rendering them altogether useless. An invention by which all danger of such damage is prevented has been devised by C. Baecler, of Portland, Ore, U.S.A. When an electrotype is to be made, the matrix is put in the casting-box in the ordinary manner, and the core of wood is set in place by supports, two of which are in the lower end of the box and one at the upper end. When an electrotype plate is already cast and is ready to be mounted on a block, another mode of working is followed. The electrotype is "backed" in the usual manner and straightened or planed. Then, laying the face against the bottom of the casting-box, the core is placed on the back and strips of tin foil put around the edges, and the strips are fused when the metal is poured. Then some pieces of fusible metal, just thick enough to fill the space between the core and the lid of the casting-box, are placed on the back of the core, and the enclosing side and end bars are set as in the first case, when it is ready to receive the molten metal. If the electrotype plates are old or long cast or corroded in any way, the edges around the outside of the core where they are to fuse with the new flow of metal are usually scraped bright and the tin foil placed in the joint as before. If the metals to be joined are similar in alloy, it is not always necessary to use tin foil; but any of the common acid fluxes may be employed, and the result is the same—a good joint. A block made in this way is waterproof, is not affected by the air in any manner, and has other valuable features. They also require less metal than those of partially enclosed cores with ends or sides open to dampness; and in the case of electrotype plates previously made ready for mounting, the inclosing metal may be of a commoner and cheaper sort, and barely thick enough to flow and cover the cores, greatly reducing the expense. By this method even the largest plates can be mounted and used with safety and durability, a feature not obtained by any other method.

SIR WILLIAM THOMSON'S QUADRANT ELECTROMETER.—(*Engineering.*)

The quadrant electrometer is one of Sir William Thomson's many and beautiful contributions to electrical science. This instrument illustrated under, is invaluable to the electrician, enabling him, as it does, to measure, with great precision, resistances and differences of potential, the insulation of condensers, and the capacity of submarine cables.

It derives its name from the four brass quadrants, which are so arranged around a common centre as to enclose a small cylindrical box-like space. The opposite quadrants are joined together by a fine wire, and the two pairs thus formed are separately connected with the electrodes of the instrument, Fig. 1. page 32. It is essential that the quadrants be placed symmetrically with respect to the needle. Three of them are movable along radial slots and adjustable by hand, whilst the fourth is susceptible of very fine adjustment by a micrometer screw, fixed on the main cover, Fig. 1.

The "needle," which is somewhat paddle shaped. is of thin sheet aluminium. It is freely movable about a vertical axis consisting of a stiff platinum wire. The upper part of this wire carries a short horizontal cross-piece to which are attached the two threads (unspun silk) of the bifilar suspension.

The needle is charged and kept at a high potential by being in permanent connexion with the inner coating of a large Leyden jar. This coating consists of strong sulphuric acid which, besides being an excellent conductor of electricity, has a remarkable affinity for water, so that the inner working parts of the electrometer are kept dry and well insulated. The outside coating of the jar is formed of strips of tinfoil, sparsely arranged in order that tne interior of the instrument may be seen.

The dielectric is the glass of the jar, which is of white flint, and carefully chosen as to quality and insulation.

A charge is given from (say) a small electrophorus to the acid by means of the charging rod which is seen in Fig. 2 projecting from the upper semi-cylindrical part of the electrometer, technically known as the "lantern." A stiff platinum wire is rigidly connected to the needle, and carries, at its lower extremity, a small weight of the same metal which dips into the sulphuric acid. In this way, the needle is always at the same potential as the inner coating of the jar; its oscillations are, moreover, partly checked by the resistance which the acid offers to the rotation of the terminal weight. The wire is protected against surrounding influences by a narrow metallic cylinder, called the "guard tube."

As the needle is completely enclosed by the quadrants, it is thereby screened against extraneous electrification and is, besides, kept in a constant field of electrical force. Hence the angular deflection of the needle will be constantly proportional to the difference of the potentials of the quadrants.

This deflection is measured by the displacement over a finely divided scale of the image af a narrow slit, through which rays from a lamp are admitted that are afterwards reflected from a mirror in rigid connexion with the needle. This mirror is a light disc of fine microscope glass, silvered and slightly concave. It is surrounded by a sort of brass hood to protect it against the influence of neighbouring electrified bodies.

It is easily seen that the sensitiveness of the electrometer varies with the potential of the needle. Hence measurements are comparable *inter se* only inasmuch as the potential is maintained constant. This condition is attained by means of the *replenisher*, which accessory is merely a small but ingeniously contrived induction machine. By twirling a milled head, Fig. 1, the potential of the jar may be raised or lowered according to the direction of rotation; and, as the increments or decrements are very small, a definite charge map be accurately reproduced. This is indicated by the *idiostatic gauge.*

This gauge is itself an attracted disc electrometer. It is known that the jar has reached its normal charge when the sighting hair lies evenly between two black dots, Fig. 2, which are made on a small white porcelain plate. Errors of parallax are avoided by viewing the air through a plano-convex lens, taking care to keep the line of sight perpendicular to the centre of the lens.