By means of an electromagnet with a laminated core the magnetite crystal was magnetically saturated, and then demagnetized with an alternating current. The effect of magnetization perpendicular to the plane of the crystal face was investigated for the first four orders. On account of mechanical difficulties the test was made only in the third order when the crystal was magnetized parallel to the reflecting surface. In no case was any change observed in the intensity of the reflected beam when the crystal was magnetized or demagnetized, though the method was sufficiently sensitive to detect a variation in the intensity of less than 1 per cent.

A direct calculation shows that a displacement of the atoms of 0.004 of the distance between the successive atomic layers is sufficient to cause 1 per cent. change in the intensity of the fourth order spectrum. If there is any displacement of the atoms when a crystal is magnetized, it is therefore very small. This confirms the observation of K. T. Compton and E. A. Trousdale[2] that magnetization does not shift the atoms in a crystal sufficiently to change the general form of the space lattice in which they are arranged, and verifies their conclusion that the ultimate magnetic particle is not a group of atoms, such as the chemical molecule, but is the individual atom or something within the atom.

It can be shown further that if all the electrons in an atom are in the same plane, the effect on the intensity of the reflected X-ray beam of turning the atom will be greater than one per cent. unless the effective radius of the atom is less than 10^{-10} cm. Other considerations, however, prove that the radius of the atom must be much greater than this.

There is a relatively small number (26) of electrons in the iron atom, and it appears probable that 8 of these, as valence electrons, are at a considerably greater distance than the others from the center of the atom. It is therefore difficult, though perhaps not impossible, to imagine an arrangement of the electrons so isotropic that a rotation of the atom will not produce an appreciable change in the intensity of the reflected X-ray beam.

[2] K. T. Compton and E. A. Trousdale, *Phys. Rev.*, 5, 315 (1915).

The most obvious explanation of our negative result is that it is not the atom which is the elementary magnet, but that it is either the positive nucleus, as suggested by Merritt, or the electron, as suggested by Parson.

If the ultimate magnetic particle is not rotated to any great extent by the magnetic field, no conclusions can be drawn from our experiments. It appears much more probable however, that the molecular magnet is capable of being turned through a large angle, and on this basis we may conclude that:

1. The ultimate magnetic particle is either the atom or something within the atom.
2. If the atom is the ultimate magnet, its electrons are not all distributed in the same plane, as assumed by Bohr, but are arranged very nearly isotropically.
3. Our experiments are in accordance with the hypotheses that the atomic nuclei or the electrons themselves are the ultimate magnetic particles.

In a subsequent paper we shall describe our experiment in greater detail, and shall discuss more fully the significance of our negative result.

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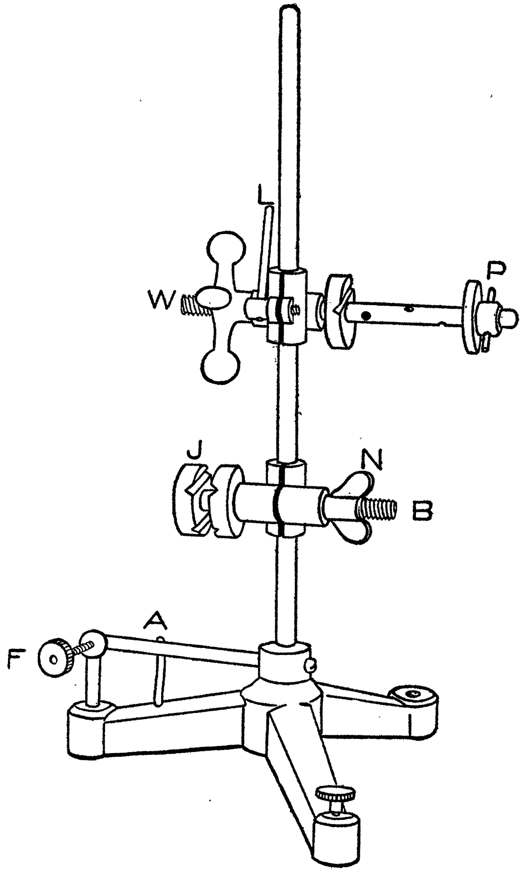
APPARATUS FOR PHYSIOLOGICAL AND PHYSICAL LABORATORIES

An Adjustable Stand for Graphic Experiments.—The stand illustrated in the figure was designed by me, twenty-three years ago, for use with the piston-recorder for air transmission. It has served its purpose so admirably, and is so well adapted for all graphic work where a very delicate adjustment of the writing point is required, that it has seemed to merit a description in print.

The features that have commended it especially are its simplicity, its great delicacy of movement and absence of backlash, and the ability to use it at all times for any of the purposes for which a small stand is necessary.

Its construction is not difficult, but requires accurate workmanship.



The central part of the tripod base is bored and faced on the lathe, and the hole is reamed to a standard size. The base is then placed on an arbor and the lower surface of the hub is turned to correspond with the front. The lower end of the vertical rod is ground into the hole. A collar is securely fastened to this part of the rod, and its lower surface turned to an accurate bearing. A long rod is screwed into the collar, and is firmly pressed against the adjusting screw *F* by the steel rod *A*, which acts as a very strong spring. The vertical rod is fastened to the base by a screw in its lower end, and a spring washer which bears against the turned surface. As the horizontal rod has a considerable length, and the adjusting screw a fine thread, the rotation of the rod when the screw is turned is very slow, and is under perfect control. The elasticity of the spring rod is sufficient to allow the necessary movement in graphic experiments, and is rigid enough to prevent rotation when the stand is used for ordinary purposes.

The vertical rod of the stand just described has a diameter of 10 mm. A much larger stand of slightly modified construction, with a heavy base, and a rod 25 mm. in diameter, is a most useful addition to the equipment of the laboratory, and forms a very satisfactory support for a reading telescope. The lower end of the rod is turned to a shoulder, and is fitted to the base with a screw and a washer, as in the previously described instrument. The collar into which the horizontal arm is inserted is not permanently fastened to the central rod, but is clamped by a thumb-screw which permits the rod to be rotated to any extent before using the fine adjustment. A leveling-screw, and a clamp-screw in the hub not shown in the figure are also desirable additions.

Universal Clamps.—The clamps shown in the drawing were designed to be used on the adjustable stand. Within the limits of their capacity they enable flat objects, and rods of round, square, triangular and oblong section, to be held very firmly in any position without marring. They can be easily adapted to any stand and modified in various ways. The clamps are attached to the supporting rod by a split cast-iron piece in the shape of two crossed cylinders, which are carefully bored at right angles to each other. The bolt which passes through the horizontal cylinder has the same size as the vertical rod, and in one form has for the head the iron disc *J*, which is permanently fastened to it. A similar disc revolving on the bolt, forms the second jaw. The two discs are turned, and their inner surfaces have parallel V grooves which accurately correspond, and a recess in each for a spiral spring which opens the jaws when the nut is loosened. The object to be held is fixed in the jaws, and the clamp to the stand by the single nut *N*.

The upper clamp is fixed to the vertical rod independently by the lever *L* which turns a screw in the split projection. The bolt *W* has a number of transverse holes which enable the right hand disc to be fastened in different positions by the pin *P*. This arrangement allows objects of considerable width to be held by their edges. A supporting screw in the movable disc opposite the groove is sometimes used to prevent tipping and wedging of the disc under strong pressure, but it is generally not required.

Universal Tripod Bases.—Of all laboratory implements the tripod stand is probably the one that is most constantly and universally employed. A tripod base forms the foundation of a great number of scientific instruments; it is therefore desirable to have a number of accurately made bases for use with interchangeable apparatus, and adaptable to a great variety of purposes.

The ordinary way of fastening the standard to a tripod base is by means of a screw on the end of the rod. This is permissible when the rod is to be left in position permanently, but when it has to be removed frequently, it is very inconvenient, as a special wrench is required for the operation. When accurate construction is required it is necessary to reduce the diameter of the lower end of the standard to form a shoulder, and to cut the screw in a lathe. This adds considerably to the expense and difficulty of fitting apparatus to the base. A much simpler and better mode of attachment can be employed which has proved itself to be very satisfactory in my laboratory. The bases that I have made are of two sizes. The larger one covers a circle of 30 cm. and weighs 5 kilograms. Its center is a cylinder 8 cm. in diameter and 7 cm. in height. This base is like that of the large adjustable stand which I have described, and is turned and bored on the lathe in exactly the same manner as that. The central hole has a diameter of 19 mm. and the standards are clamped in it by a large brass screw which passes horizontally through the center of the hub. As the screw has a large head with four spokes like the hand-nut on the universal clamp figured in the drawing, the rods and bushings are held with the greatest firmness, but they can be changed almost instantly. This kind of attachment allows a certain amount of vertical movement of the standard of a table, or of apparatus, when variation of height is desirable. When a more extensive elevation is necessary the tripod can be placed over a hole in the table through which the rod can pass, or it can be supported on rods clamped by brass set-screws in 13 mm. holes in the cylindrical feet. These supplementary rods may be used as substitutes for leveling-screws. If such screws are required they are made with brass cylindrical nuts which are clamped in the holes in the feet. These holes are exactly at right angles to the plane of the bottom of the feet, it is therefore possible to have four vertical rods, parallel to one another, attached to the same base. This is a great convenience in assembling complicated combinations of apparatus. Rods smaller than the holes can be clamped by means of bushings. When these bushings are of non-conductors the rods can be insulated, or the rods may be made of these materials.

The smaller base has all the features of the one just described, and weighs about three fourths of a kilogram. The holes in the feet are 10 mm. in diameter, and the central one 13 mm. These bases can be bored while clamped together in pairs. This insures exact correspondence of the holes when the bases are used together in combinations. They form excellent end supports for the horizontal rod of an optical bench, or similar apparatus. They may be used instead of flanges for table tops and wheels. They can be fastened easily to the wall or ceiling by screws passing through the holes in the feet, or be employed in the construction of a wall bracket of adjustable height. In order to make such a bracket two short rods in two of the supplementary holes are held in corresponding holes in a block of wood screwed to the wall. A long rod in the anterior leg terminates in a rectangular piece through which passes a horizontal rod abutting against the wall. A table top is attached to the central standard when an adjustment for height is desired, or it may be screwed or clamped to the anterior rod.

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