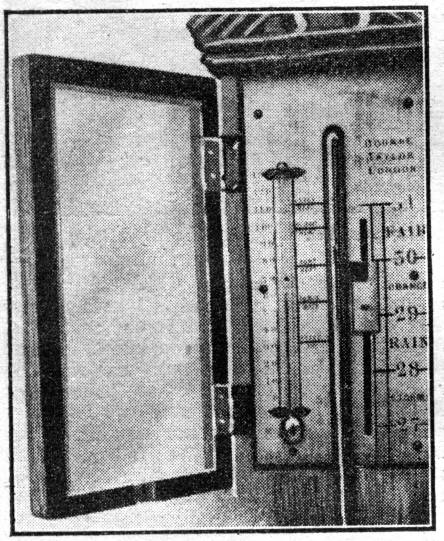
Restoring Mercurial Barometers

Practical Pointers for the Repairing and Refurbishing of a Common Household Article

By J. F. STIRLING

MORE, perhaps, than any other object of domestic convenience, the ordinary household barometer, as it hangs silently and uncomplainingly near the front door of the house, is liable to suffer from, and ultimately succumb to, the insidious ravages of time and of a long sequence of neglect. For, somehow or other, we are apt only to become aware of the hall barometer's presence when it ceases to function, much in the same way as we usually notice a household clock when we fail to hear its tick.

The ills which household barometers bear are mainly those which are due to dust, dirt



A close-up of the indicating plate of a "stick" barometer. As will be seen, the mercury-level is read off directly against the calibrated scale.

and rust, to corrosion and to excessive dampness, apart, of course, from the more severe ailments caused to such instruments by sudden and violent shocks, resulting in actual internal breakages of one kind or another.

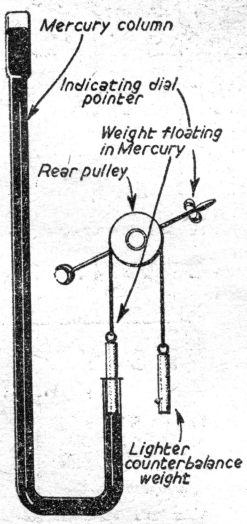
There are two types of barometer in common household use at the present day—the mercury type and the aneroid pattern. The mercury variety of barometer, with which this article is solely concerned, is to be found in two chief types: (a) the straight or "stick" barometer in which the level of the mercury column is read off by direct observation, and (b) the "wheel" or "banjo" type of barometer in which the mercury movement is manifested by the position of a pointer in front of a circular dial. For more than a century this has been the common type of household barometer, being, when carefully adjusted, more sensitive than the modern aneroid barometer, although not quite as accurate and sensitive as the still older "stick" type of instrument.

Operating Principles

A mere glance at the internal arrangements of the stick and of the wheel barometers will immediately indicate the principles on which these types operate. The stick type of barometer is entirely without working parts. It embodies nothing more than a barometric mercury column conveniently mounted, with a calibrated indicating scale placed behind the upper portion of the mercury tube so that the mercury level can be read off against the indications. In the wheel type of barometer, precisely the same pattern of mercury tube is used, but the rising and falling movement of the mercury is made to actuate the dial pointer by means of a small glass float which rests on the surface of the mercury in the lower end of the tube, being suspended thereon by means of a thread which is attached to one side of a small pulley mounted on the pointer spindle, and which is partially counterbalanced by a lighter glass float similarly secured to the opposite side of the pulley. Thus, as the mercury rises in the long tube, the indicating pointer moves clockwise against the dial and the counterbalance float descends, whilst, when the mercury falls in the tube, the counterbalance float rises and the dial needle moves anti-clockwise.

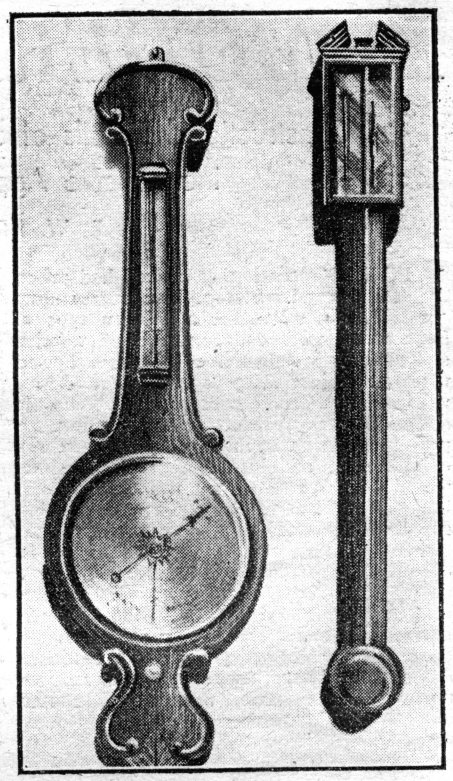
From a constructional viewpoint, nothing could be simpler than the operating principles of these two barometer types, and, often enough, a barometer which has been giving erratic readings or which has ceased to function altogether may at once be put into full working order by dint of a little care, cleaning and adjustment.

There are more serious cases, however, when the barometer tube has lost some of its mercury, or when, as a result of the instrument being turned upside down or knocked over in some way, air has attained access to the top of the mercury column. Similar instances occur also when the mercury has become badly contaminated with dust and dirt. In addition, there are small "mechanical" faults which are capable of bringing the needle movement of a wheel barometer to a standstill. Obvious faults these will be, such as the rusting of the central pointer spindle, the breakage of the thread holding the floats, the frictional contact of a bent indicating pointer against some part of the dial, and the more or less clogging up of the simple moving parts of the instrument with compacted, matted, damp-impregnated dust and fibrous debris of various kinds.



Schematic diagram of the operating principle of the wheel barometer.

For a mercury barometer of either

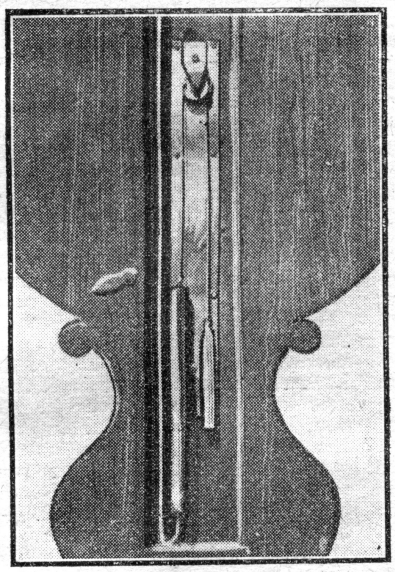


Two household mercury barometer types. The "wheel" barometer (left), and the "stick" or straight type of barometer (right).

wheel or stick type which has got into a really bad condition, there is no alternative but to detach the tube, remove the mercury and, after thoroughly cleaning it, replace it therein. This is a serious job, but it is by no means beyond the resources of any amateur who is prepared to work carefully and patiently.

Emptying the Tube

Removing the mercury from the tube is a fairly simple task. The tube is detached from its mounting and held vertically above a large non-metallic basin. The tube is now



The mechanical portion of a wheel barometer at the rear of the case. Note the glass float suspended in the lower mercury-tube limb, and also the free counterbalance weight whose relative movements actuate the pointer on the dial of the instrument.

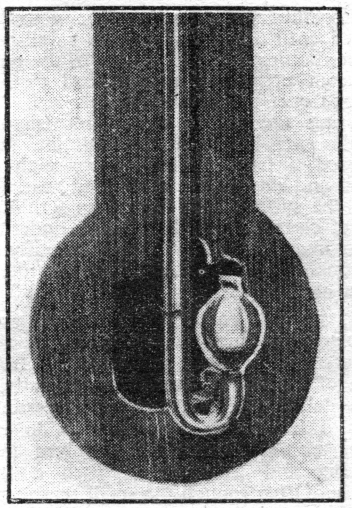
slowly inverted so that a little of the mercury spills out into the waiting basin. The operation is repeated again and again (perhaps 15 or 20 times), until all the mercury has been removed from the tube.

Usually, the glass tube itself will require cleaning. Chemical methods are necessary here, because, as a rule, the inner sides of an old tube will be found to be filmed with a greyish mercury sludge. This film can be readily dissolved away by partially filling the tube with diluted nitric acid (about 1 in 5) and then by shaking the liquid within the tube. The tube should then be rinsed out with water and then recharged with a clear soap solution. A small soft-bristle brush attached to the end of a long flexible wire should be carefully worked up and down inside the tube in order to " scrub " the tube walls and to free them from any adhering matter. Incidentally, these narrow-bore " tube brushes " may be obtained from most dealers in laboratory supplies. It is most essential, however, that the bristles are firmly attached lest any should remain in the tube, from which they would be removed only with difficulty.

After cleaning, the barometer tube is rinsed out with plain water three times, and with distilled water twice. It may then be put away in a warm place for a week to dry out thoroughly (a hot cylinder cupboard, for instance). It may be dried more rapidly by the expensive method of filling it with absolute alcohol, which will absorb the residual water from within the tube, shaking out the alcohol and partially filling the tube with ether, and subsequently shaking this out. The tube will now be perfectly clean and it will dry rapidly when placed in a warm situation. Remember, of course, that ether is very highly inflammable, and that a barometer tube containing ether or even a trace of it must not be placed near an open fire to dry out.

Cleaning the Mercury

The mercury itself is readily cleaned by preparing a little chamois-leather bag in the bottom of which a few needle holes have been made. The mercury is poured into this bag a little at a time. The bag is then screwed up between the fingers and the mercury is thus forced through the needle holes, descending as a fine, silvery shower into a waiting non-metallic receptacle below. This operation should be repeated three times. Unless the mercury is very badly contaminated, it will be sufficiently clean for refilling into the tube ; but if it still presents a dull surface, or if, when drawn across a surface of rough white paper, it leaves " tails," the metal is still contaminated, and it must be further purified by being squeezed through the chamois into a vessel of dilute nitric acid (1 in 5), this operation being repeated half a dozen times. The mercury is then shaken up with a large volume of water several times to rid it of the acid, after which it is poured into a clean, shallow basin or



The lower end of a " stick " barometer showing the V-tube whose shorter limb has been formed into a bulbous shape to act as a mercury " cistern."

saucer and the surplus moisture mopped up from it with white blotting paper. Do not put the mercury away into a hot, dry place, because, at elevated temperatures, mercury is appreciably volatile and some loss of the metal may result from this method.

Before filling the mercury into the tube it

Cleaning mercury or quicksilver by squeezing it through a chamois leather bag which has been pierced with a few needle holes.

is most essential to see that both tube and mercury are perfectly dry, for if the slightest trace of moisture is present it will ascend to the top of the tube above the mercury-level and will remain there in the form of water-vapour exerting a direct internal pressure on the mercury column and falsifying the reading of the barometer.

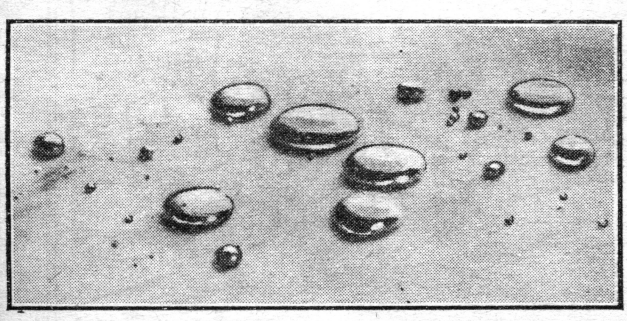
Recharging the mercury into the barometer tube is a critical and an exacting process. It depends more on knack than on skill. Hold the tube vertically with its closed end at the top and with its lower end facing upwards. Pour a little mercury into the lower end. Then place the thumb over the lower open end, completely closing it, and invert the whole tube with a rather sharp but not too violent a motion. This latter precaution is essential, because if the mercury is too vigorously shaken in the tube its heavy impact may fracture the glass.

In the above manner, some of the mercury will be jerked around the lower U-bend of the tube and will fall into the long limb of the latter. The operation is repeated until the long limb of the tube is completely filled with mercury. As the tube fills, the task of getting the mercury into it becomes more and more difficult since, in the later stages of the process, the very greatest care must be taken not to allow air bubbles to enter the tube above the mercury. The whole operation becomes one of getting mercury *into* the long tube and, at the same time, of getting air *out* of the tube.

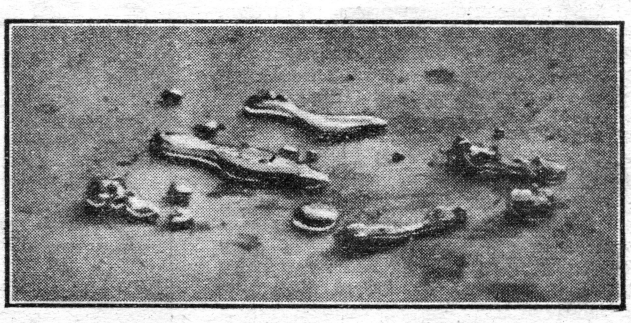
There are several methods of effecting this. One of them is to lay the entire tube on a bed of gently heated sand contained in a long, shallow tray. By this method, the air, becoming heated, is expanded in part out of the tube, so that when mercury is poured into the lower end of the same it tends to be sucked therein when the tube cools down by virtue of the partial vacuum thus created. Another, and, perhaps, a simpler method, is to allow fairly hot water to run down the outside of the tube. This has the same effect of air expansion and subsequent partial vacuum creation within the tube. At each addition of mercury to the lower end of the tube the latter must be sharply inverted (the thumb closing the open end of the tube), so that some of the mercury is jerked around the bend and sucked downwards into the long tube, some of the air being thereby forced out of the tube as it is displaced by the mercury.

The Torricellian Vacuum

The long tube must be filled *completely* with mercury. When it is then reinverted to its normal position, the mercury will sink a little in the tube, leaving above it an almost completely vacuous space—the well-known Torricellian vacuum—and the mercury-level in the tube will be the barometric level in the district under the prevailing atmospheric conditions. It will now be a simple matter to replace the tube in the older type of " stick " barometer. Care must be taken to replace it so that the mercury-level coincides with that day's barometric reading on the engraved scale behind the tube, and this necessitates reference to another reliably working barometer.



Clean, uncontaminated mercury for barometer use breaks up into globules or " buttons " when spilled on to a level surface.



Mercury which is dirty and thus unsuitable for barometer use leaves " tails " when poured over a level surface, and it tends to mark the surface with a greyish film.

In the case of a "wheel" barometer, after replacing the tube, the pair of glass "floats" (they are frequently portions of broken thermometer stems) are secured to ends of stout linen thread or thin gut lines which are themselves tied to opposite sides of the central pulley mounted on the indicating-pointer spindle. It is essential that the spindle should revolve freely and truly, otherwise the pointer itself will stick and will not adequately register the rise and fall of the mercury. From this simple type of indicating mechanism all possible sources of friction should be eradicated.

The worker who is making a thoroughly good job of the restoration, repair and refurbishing of an old barometer will naturally wish to clean up the discoloured brass fittings and mountings of the instrument. They should all be boiled in weak caustic soda solution (1 in 12) in order to soften and remove the old, and now possibly encrusted, brass lacquer. After this, the parts may be rinsed, dried and re-lacquered, using a colour lacquer. But if the colour of the natural brass is preferred, the brass parts would best be immersed for a moment in the following bright dip:

Strong sulphuric acid	...	109 ccs.
„ nitric acid ...	...	19 „
„ hydrochloric acid	...	0.5 „
Water	...	123 „

This bath should be made up accurately. It will impart a bright surface to clean brass or copper within a matter of seconds, after which the article is swilled in cold water, dried and clear-lacquered.

Resilvering

Barometer dials and indicating plates are readily resilvered by means of the special silvering powders which are sold by dealers in horological materials. Alternatively, the amateur may make a good instrument-silvering compound for himself from the following formula:—

Common salt	...	2 parts (by bulk)
Cream of tartar	...	2 „ „
Silver nitrate	...	1 part „

The ingredients are dried and are powdered separately. They are then ground up together (in a non-metallic vessel) and stored until use in the dark in a well-corked amber bottle. For use, a little of the powder is taken up with a soft, wetted cloth and rubbed over the area to be silvered. The silvering appears at once, and when the whole area has been covered the newly-silvered surface is rinsed down with plain water and allowed to dry without heat. When dry, the surface should be given a thin coating of clear lacquer. The surface under treatment must necessarily have previously been thoroughly cleansed and rendered quite free from old lacquer.

If, by any chance, the tube of an old barometer is found to be broken, it can be replaced by a new one obtained from a firm of laboratory furnishers. It is best to take delivery of the new tube personally, even if it involves a journey to do so, in order to obviate the risk involved in the packing and transport of such a fragile article. Often enough the small thermometer, which is usually incorporated as part and parcel of a mercurial barometer instrument, will be found to be broken. Such an article cannot be repaired, but it can usually be replaced at a very reasonable cost from the stock of any laboratory dealer. Indeed, such a necessary replacement should never be omitted, for an accompanying small thermometer is one of the features which so strongly characterise an old-world barometer of the mercury type and which serve to "make" it not only in style and in all-round serviceability, but also in actual monetary value.

To function well and reliably, the barometer tube itself should be guarded as much as possible against the entry of dust. It is advisable to tie down a circle of cellophane tissue over the open end of the shorter limb of the mercury tube, and then to puncture the stretched tissue with one or two needle holes. These will help enormously in keeping out dust, but, at the same time, they will allow quite adequately the necessary admittance of air.

Vertical Position Necessary

When placed on a wall, any mercury barometer must be positioned perfectly upright, for if the tube deviates from the upright the mercury movement will not be free enough, nor will the mercury reach its highest barometric level. Furthermore, in the case of a wheel barometer, the moving parts may tend to bind and thus to interfere with the true pointer-indications.

It should not lean, either forwards or backwards, against the wall, and if the wall is out of true (as is, unsuspectedly, often the case) one or more thin packing blocks will be necessary behind the instrument at its upper or lower ends to ensure that it is vertical.

A good barometer should be attached to the wall at both its upper and lower ends by means of Rawlplug fittings. The instrument will thus be held rigidly and no movement will be possible. It should not be necessary to tap on the face of a wheel barometer in order to get an accurate reading from the instrument. If any such tapping is found to be necessary the inference is that there is a lack of freedom at some point or other of the moving parts, and the trouble should be investigated at once.

Never place a barometer in a draughty position. Draught, in the average house, means dust, and the latter is one of the worst enemies of barometer working. Nor should the instrument be fixed against a wall which is perpetually damp, because dampness makes for corrosion of the metal parts and, usually, for the general deterioration of the instrument as a whole.

The ideal position for any type of barometer is against a flat, level, perfectly vertical wall which is not unduly damp, draughty or dusty, and which is exposed to a fairly equable temperature and humidity. So fixed, and guarded against accidental mechanical injury caused by objects falling against it and thereby breaking the dial glass or even the mercury tube itself, a well-adjusted mercurial barometer of any type will go on working accurately and consistently for year after year, being, in point of fact, only rivalled in reliability by that other familiar work of the old-time craftsmanship, the old English clock.

Items of Interest

Johnson's Photographic Competition Results

MESSRS. JOHNSONS of Hendon, have recently issued a list of prizewinners in their Autumn Competition, which closed on October 31st, 1951. A very high standard of photographs were submitted, particularly in the novices' class. In each of the first three classes prizes of £10, £2 and £1 were awarded. In Class 4 (Novices' Section), three first prizes of £3, two second prizes of £2, six third prizes of £1, and eight fourth prizes of 10s. were awarded. There were also forty-two consolation prizes, taken from all classes. The next competition closes on April 30th, 1952, and leaflets giving the rules, classes, etc., are obtainable free on application to Johnsons of Hendon, Ltd., Hendon Way, Hendon, London, N.W.4.

The Blackburn Universal Freighter

THIS new Universal Freighter is the civil variant of the GAL.60 military transport, and is sufficiently spacious to accommodate a thirty-seater coach. This huge aircraft, designed for the air haulage of bulky cargoes, is powered by Bristol Centaurus room of 10ft. The floor is designed to carry any load within the capacity of the aircraft without spreader beams. The floor panels and supporting structure are designed to take a maximum unit-distributed load of 325 lb./sq. ft. and a maximum axle load for vehicles of 9,000 lb.

New Union-Castle Liners

THE *Rhodesia Castle*, recently completed by Harland and Wolff in Belfast for the Union-Castle Line, is a twin-screw turbine vessel of 17,300 tons, and is at present on the "Round Africa" service. A sister ship, the *Kenya Castle*, is now being fitted out.