

comes short the tacks can be shifted half or a quarter of the error each if all or half is attributed to the range, both tacks being moved out or in, in which case the remaining pegs would have to be gone over again, starting from each end and working towards the centre with instrument, bar across arm, and plumb-bob. When 2 and 3 are visible from opposite ends it is best to put signal at 3 and start at 1 and put pegs in line until centre is reached. Set up at 4, set up signal at 2, and put pegs in line until centre is again reached. Where the mean standard lines of two streets do not differ more than 3 minutes and the cross-roads are not more than 10 or 12 chains apart it is best to increase one  $1\frac{1}{2}$  minutes and decrease the other a similar amount to make them parallel. The offsets can be varied between the different cross-roads to keep sides of roads parallel.

We next come to the method of rendering rods and sighting-tripods visible. I have found the following to be good. An ordinary flagpole is used, which must have no white about it, to which a short cross-arm is attached by a screw and washer which allows it to revolve, a diamond-shaped piece of double-thickness black and red cloth well sewn together and hemmed round the edges, to each corner of which is sewn a small brass ring. In using, the cross-arm is turned at right angles to the pole and the cloth screen hooked on to small hooks; when not in use the screen is unhooked and the cross-arm lies flat along the pole. It can be secured in this position by rolling the screen round it, or a piece of cord can be fastened to one end of the cross-arm to tie it to the pole with, and the screen removed. A hole is made in the ground behind the sighting-tripod, and the screen-pole driven in, or it can be attached to a tripod if a hole cannot be made in the road. The top of sighting-rods should be quite flat and not round, so that they present an even appearance against the screen, and no flags should be attached to them.

*Chaining, and Sighting-tripod.*—Top of tripod with sighting-vane inserted, which is flat brass with a round stem. The vane is black on one side and white on the other, to suit different backgrounds. It has three vanes of different sizes, to be used at different distances from 15 up to 70 or 80 chains. With screen behind it the tripod makes a good signal to observe to. It has a shifting head, and is levelled by laying a short level on upper circular plate. It clamps with ball and socket, has a shifting head, and is so constructed that the spindle can be rocked from side to side without affecting the plumb-bob. When used for chaining the sighting-vane is removed and a short spindle is inserted in its place, projecting above the main spindle only about  $\frac{1}{8}$  in. with a fine mark in its centre to chain to.

Under 10 or 15 chains the sight generally used is a steel rod and cross-bar driven into the ground, and a plumb-bob with well-chalked string hung on to it and adjusted exactly over the station-mark, a dark background being placed behind it. I have often used one of the sighting-tripods in a similar manner, placing it over the station with one of its legs in the line on the side farthest from the instrument—this leaves the side nearest open; then tie on black screen, on farthest side, and the plumb-string is clearly visible at 20 chains off.

*Rural Standard Survey* is carried out much in the same manner, but only the main lines are chained—no parallel offset lines are laid out. If the ground is smooth and flat a 5-chain  $\frac{1}{8}$  band marked at every link can be used: this is very convenient, as it allows of offsets being taken at any point that may be required. These offsets are generally taken with a 1-chain  $\frac{3}{8}$  in. figured steel band wound on a special drum which winds up rapidly; the right angle can be estimated by unwinding the band a few links beyond the measuring-band and estimating the right angles on both sides of it. By this method chaining and offsetting are carried out at the same time. This method of chaining requires at least three men. In rough ground the above-mentioned method cannot be used. I then chain from instrument to table, using just over 6 chains each stretch with the  $\frac{1}{8}$  in. band, which is supported at centre by a pole driven into the ground in line and a bradawl stuck in at the height to give a uniform grade, the vertical angle having first been observed direct and reversed. An offset can now be taken from instrument chaining-table and centre-pole. If intermediate offsets are required pegs can be driven in on line, measured to, and bearings and distances taken to the required points. I generally use two different  $\frac{1}{8}$  in. bands, chain with one band and check chain with the other. With one I use a constant strain and correct for sag. With the other I use a varying strain according to the amount hanging. In this case the strain is 10 lb. when laid flat on the ground and working up to 15.5 lb. with 6 chains hanging. Both methods appear to be equally accurate, the latter being the easier on the band, as the shorter the stretch the lighter the strain.

In both town and rural standard surveys a separate field-book is kept to enter the offsets in, the distances at which they are taken being copied out of the chainage-book as they are taken; these distances are always the actual ones affected by slope, &c., but when required reference to the chainage-book will give the corresponding reduced distances. When the centre of the band comes higher than the centre-pole, an extra square rod sliding through a block like a carpenter's gauge is placed on the top of the pole in the ground, and when at the proper height is clamped, the wire resting in a fork.

In this kind of work I generally set out a given offset from both sides of the road, using any existing pegs, boundaries, buildings, &c., putting up ranging-poles at each, from which I strike a mean line, and put in a peg at each end to hold the line. I generally peg two or three lines in this manner, and then get the intersections. I sometimes stretch a cord across from the opposite corners of the road and insert two pegs under it about a yard apart, to cover the standard lines. I then stretch a string between these pegs and get the intersections with the standard lines. It often happens that they do not intersect the cross-line at the same point, in which case they must be eased in to a common point. It is well to set the instrument up on this point and see that the half-angle strikes the opposite corners. If not, any alteration that can be made to improve matters must be effected. It will sometimes happen that in making one side of the road better the other is made worse. It is then best to leave the intersection alone. If both can be improved it is well to still further amend the standard lines until the best mean is obtained, care being taken to see which line can be shifted most with the least encroachment to the occupation.