for every one of the few violations of rules or regulations detected the employees found guilty were held just as responsible as if an accident had resulted, and penalties fitting the violations were imposed.

The methods employed to secure safe operation by the railroads in modified form are the only methods that will secure safety on the highways, and that is a system of checking on the observance of the rules of the road and the imposition of appropriate penalties for violations.

Recommendation

It is therefore recommended that this Road School take such action as may be necessary to secure a state-wide check of automobile driving on all of the roads of the State of Indiana for a period of, say, three days, three times a year, to detect all forms of careless or reckless driving and violations of law or rules of the road. At least 500 checkers, either officers of the law or other persons selected for the purpose, should be assigned to do the checking.

It is also recommended that the results of these checks be tabulated on forms to be provided for the purpose, summarized and distributed throughout the Commonwealth.

In no other way will the people of Indiana or any other state become apprised of the extent of the danger of driving on the highways. In no other way will public officials become impressed with the necessity for taking remedial action.

The accident record is bad enough, as everyone knows, but the number of accidents that actually occur as compared with the number of dangerous practices indulged in by the drivers of automobiles that might cause accidents are really insignificant. It is more a matter of good luck than safe driving that fatal injuries on the streets and highways and at railroad-highway crossings do not run up to, say 50,000 instead of 28,000 a year.

*Let's Get After Not Only The Reckless Drivers But Also The Drivers Who Do Not Realize The Dangers Involved in Operating An Automobile.*

**SURVEYOR'S INSTRUMENTS AND EQUIPMENT**

By William A. Ehrman,
Howard County Surveyor, Kokomo, Indiana.

The first instrument we shall speak of as a part of the surveyor’s equipment is the theodolite or transit. Originally the surveying instrument consisted of a long telescope
mounted on standards. This was for the measurement of horizontal angles and later means for measuring the vertical angle were added. Some of these telescopes measured three to four feet in length and were originally known as theodolites. With the development in optics, it was possible to shorten the length of the telescope until finally a surveying instrument was built having a telescope sufficiently short to turn over, or transit, in its standards. This, therefore, was named a "transit".

The transit is one of the most important of astronomical instruments, consisting of a telescope fixed to a horizontal axis, so as to revolve in the plane of the meridian and is employed, as its name denotes, in the observation of the meridian transits of heavenly bodies. The longer telescopes, originally used in the theodolites, had larger diameter lenses and a higher power magnification. Gradually, therefore, the word theodolite has come down to us as meaning a very precise surveying instrument. The American transit in its various modifications is by far the most important of all the instruments used by the surveyor or engineer. The complete transit is used: 1. To prolong lines. 2. To measure horizontal angles. 3. To measure vertical angles. 4. To run levels. 5. To establish grade lines.

The limbs are numbered differently on different makes of instruments. On some the method of numbering the graduations of the horizontal limb is double in opposite directions from 0 to 360°. Many engineers prefer this system of numbering.

For several years I have owned and used a set of Gurley instruments and prefer the markings as used on these instruments. The graduations are numbered in quadrants from 0 to 90° on both the vertical and horizontal limbs, and from 0 to 360° also on the horizontal limb. We each have our preference relative to these points, due largely to the way we have been schooled and with which particular type we are familiar. For these reasons we each prefer a certain make of instrument with its particular marking and makeup. Some instrument users seem to select an instrument almost solely by the diameter of the horizontal limb, others by the length of the telescope, some do not want a compass needle, while others would not do without it, and with still others the weight of the instrument seems to be the deciding factor. Therefore, the instrument maker who is trying to satisfy all users must be closely in touch with field conditions and so design his instruments that they will largely meet the requirements of the average engineer. There is a growing demand for lighter and more compact surveying equipment.

As deputy surveyor of Hendricks County from 1893 to 1903, I used a Gurley engineer's transit which weighed about 25 pounds. In those days I was possessed with much youth-
ful vigor and vitality which enabled me to carry this monster instrument over many miles of land surveys ranging from town lots to 800-acre tracts. At that time there were many land partitions of the large estates in Hendricks County, which lay in the range of the beautiful bluegrass section of Indiana.

Since 1903, I have owned and used a Gurley light mountain transit which I much prefer for all kinds of country work with but one exception—we prefer and use a heavy Buff transit on all our hard surface road work as we can use it both for levels and alignment work.

For convenience in measuring horizontal angles we prefer double verniers reading to minutes only for ordinary county work. In triangulation, topographical and trigonometrical surveys and traverse work, where very accurate closures are required, an instrument reading to seconds should be used. We also prefer transits equipped with stadia hairs of the disappearing type. By this arrangement there is less likelihood of error in taking levels, if the transit be used for this purpose.

In our county there is quite a bit of abrupt surface along Wildcat Creek and some smaller streams. We find the stadia measurements to be very convenient and more accurate than the tape in crossing streams and undulating or rough surfaces.

In land surveying, transits with compass verniers are much more preferable, as by this arrangement one can set off the magnetic declination which aids in finding true lines and bearing of former surveys.

**Magnetic Declination**

The line of no variation is a very irregular line coming from the east end of Cuba and the Atlantic Ocean southeast of Florida and running north through the west part of the Carolinas, Kentucky, Ohio and crossing over into Indiana near Richmond. It continues north through Michigan and Lake Superior, passing some distance west of the Rapids of Sault Sainte Marie.

Magnetic declination or variation, is the angle between true north and magnetic north and is considered east or west according as the compass needle points east or west of true north. There are three kinds of variation: 1. *Secular* change extending over a long period of years. 2. *Annual* change in one year. 3. *Diurnal* variation in the course of a day.

If a line one mile long were run about 8 o'clock in the morning and again about 2 o'clock in the afternoon, using the same starting point and the same compass bearing in each case, the terminal points of the two lines might be 20 feet or more apart because of the change in the direction of the compass needle during the day.
If the needle is allowed to swing freely, its magnetic axis will come to rest in the magnetic meridian, which generally differs from the true meridian. This difference, which changes continually, is called the declination of the needle. The declination is called east or west, depending on whether the north end of the needle points east or west while the line of sight is in the meridian. The variation of the needle at any place being known, (52° in our locality), a true meridian, or north and south line, may be run by moving the vernier to the proper side, (as the variation is east or west) until the arc passed over on the limb is equal to the angle of variation and then turning the telescope until the needle is made to cut the zero on the graduated circle. The line of sight will then give the direction of the true meridian of the place. In making up the record of surveys we also record the declination for the given date.

**The Level**

Leveling is the principal method of accurately measuring altitudes or determining the difference in elevation between different points; of obtaining the profile of a line, by determining the difference in elevation of various points along the line; and of establishing a grade after obtaining the profile. The instruments used mainly in leveling are of two types—the “Y” level and the dumpy level.

The “Y” level is the type most generally used. The convenience of adjusting this type of level is one of the main reasons for the preference which it enjoys in the engineering profession. However, the dumpy level has superior merits. The dumpy level is of more sturdy construction, being very compact and consists of fewer parts than the “Y” level. It is less liable to derangement in case of accident. Very little care is required to keep the level in working order and it stands rough usage, keeping its adjustment under unfavorable working conditions. But when out of adjustment it is more difficult of adjustment or repair.

An easy method to test the trueness of the horizontal cross hair of either level or transit is to establish two permanent points of elevation (150' or 200' apart), somewhere near your home or office, with an instrument that is in perfect adjustment. Then by taking readings on these points you can at any time make any needed adjustments by simply moving the upper and lower cross hair screws up or down, as the case may require.

**Steel Tapes**

As we have quite a bit of lot surveying in and around Kokomo, we had a special tape made. This tape is 100 feet in length from the initial, or zero point, back to the 100 foot
point, and has an extra foot in front of the initial point which is graduated in tenths outward from this point to ten tenths or one foot. This is very convenient in setting off the fractional parts of a foot.

In land surveying we prefer a tape graduated in links, each of which is 7.92 inches or .66 foot long. The chain, as you know, has 100 links, and is 66 feet long. With many, this type of chain is a back number. Yet I prefer its use to the 100 foot tape in land surveys as this is the way I have been schooled and as the calculations are much more simplified. For example, we have a tract of land 20 chains square to find the number of acres. All we need to do with the Gunter's Chain is to multiply 20 by 20, which gives a result of 400 square chains, or moving the decimal point one place to the left we have 40 acres in the tract. By the use of the 100-foot tape you would have 1,320 to be multiplied by 1,320 and the product to be divided by 43,560 square feet in an acre. Also where we have tracts with many sides requiring the method of finding areas by latitude and departure using traverse tables given in chains, the calculations are much simplified by the use of the Gunter's chain.

HIGHWAYS IN TERMS OF TRANSPORTATION

By J. G. McKay,

The past 20 years have seen the reemergence of highway transportation from a position of comparative unimportance to a place of first rank in our national scheme of transportation. The registration of approximately 23,500,000 motor vehicles in 1927 compared with approximately 5,000,000 in 1917 is a remarkable illustration of the rapid growth in motor vehicle ownership and the need for improved systems of roads to furnish economical highway transportation of people and goods.

In Ohio, the state highway system, 13.0 per cent of the total rural mileage, provided highway service for a traffic of 2,160,435,000 vehicle miles, equal to 57.7 per cent of the total traffic on rural roads in the state in 1925; the county highways, which include 27.1 per cent of the rural mileage, provided service for 1,108,870,000 vehicle miles, 29.6 per cent of the total traffic; and the township highways, which constitute 59.9 per cent of rural mileage provided only 12.7 per cent of total rural traffic. The daily traffic on the state system