A CONVENIENT POCKET TRANSIT.

BY A. FREDERICK COLLINS.

A pocket transit combining the useful features of a level, prismatic compass, and clinometer, is shown in the accompanying illustration. It was designed by W. D. Versehoyle, Esq., of London, England, a mining engineer who has wide experience in the use and application of various forms of instruments intended for preliminary surveys.

The distinguishing feature of the instrument is that, owing to its novel construction, only one observation is necessary to obtain both the magnetic bearing and the vertical angle of any distant point. It is also specially adapted for use in difficult positions such as are always liable to occur in filling in the rougher details in a mining survey.

For rapid topographical work and working in constrained positions, it saves half of the labor. Another important point is that its efficiency is not determined by the length of the diameter of the compass, as is ordinarily the case. With even a small instrument the same length of sight is obtained as would be possible with a 6-inch or 7-inch prismatic compass. The engineer can, himself, if necessary, make all the necessary adjustments.

To use the instrument for obtaining horizontal and vertical angles, after freeing the needle and unfolding the arm, the compass box is grasped in the left hand and with the extended fingers of the right hand the arm of the transit is lightly grasped, when the distant target or light is brought to the intersection of the cross lines at the end of the arm.

When the arm is held firmly in that position the compass box should be slightly revolved until the bubble in the small level is seen to be at the central mark. The magnetic bearing will now be plainly visible in the prism at the same time that the target is viewed along the sight line and the angle of depression or elevation is automatically recorded on the vertical arc. Both readings can then be taken at the same time without further observation.

A clinometer is an instrument used for taking the dip and strike of rock strata. In its commonest form it consists of a protractor with a pendulum attached. When the clinometer lies horizontally the indicator points to 0 deg., and when inclined the amount of inclination is shown at once by the pendulum. In the instrument under consideration the clinometer and compass are combined in one instrument. When the device is used as a clinometer the bottom side of the arm is laid on the object to be observed and, looking through the window at the top of the compass box, the latter is slightly revolved until the small bubble comes to the center, when the angle may be read off the vertical arc.

Should it be necessary to alter the relative position of the divided ring and the magnetic needle this can be done by removing the cover and altering the position of the needle immediately under the divided ring. Adjustment for magnetic variation may be obtained in this manner without disturbing the other adjustments.

The pocket transit is designed as a serviceable instrument and is built to withstand the rough usage an instrument of this nature is liable to receive.

NATURAL AND ARTIFICIAL MIXED COLONIES OF ANTS.

BY LOUIS I. DUBLIN, PH.D.

It is a commonplace in Nature that animals are subjected to a constant and severe struggle for existence. There are in every species more individuals than can be comfortably or even properly fed or housed. The result is competition all along the line. This is particularly true of such animals as the ants, for they are not only the commonest of all our insects, but living entirely on the ground, are more crowded than the rest, and are all the more subject to that destructive competition. We, accordingly, find here and there two or more colonies of the same or closely-related species thrown into close proximity, often living underneath the same stone and within the confines of the same nest. As might be expected in such cases, the two forms maintain independent households; for it is not choice but necessity that has brought them together. Ordinarily, ants are extremely jealous of their independence, and will not tolerate the intrusion of any stranger within their midst. In like manner, no single individual or a small number of individuals will venture into a strange nest. Within each home, the constant fighting of other animals is never observed. But how different when once a stranger is thrown into the nest! The

workers, that apparently never before knew violence, fall upon the intruder, and soon rend her or drive her out. This is almost an invariable experience, and is not limited to ants of distant relationship. Ants of the same species, if not of the same community, show this same antipathy toward each other. It is either the same blood or death.

If, then, through the stress of circumstances, two such colonies are thrown together, they remain at best

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quite indifferent to each other, build barriers between their two parts, and do not intermingle. These may be called cases of accidental association, the ants being closely related, and possessing very similar habits as to food and the character of the location for their nest.

Much more pronounced are the conditions in which the two different colonies are systematically united. Although they may be able to live alone, they are usually found together. There seems to be some advantage accruing to either one or even both of the neighbors from this mixing. Generally, it is a one-sided advantage.

The most interesting of these associations are those in which one species actually preys upon the other. Spread over most parts of the globe, is a group of tiny ants of the genus *Solenopsis*, whose plan of life is to kidnap the young of other ants for food. As might be expected, they are entirely subterranean, and therefore blind. Guided by their strong sense of smell, they pick out for their depredations the well-stocked nest of almost any one of the common species of larger ants, and locate their homes close by. Either surrounding the nests of the latter, or even right in among the galleries, they excavate their own tiny galleries and chambers. In this lies their protection; for while they have the easiest access into the home of their prey, the latter are absolutely unable to follow them and make a return raid.

Every little now and then, they make sallies in large numbers into the surrounding nest, and attack the

remarkable example of modified structure in adaptation to environment; perhaps the most striking in the ant world. Forel, the greatest of living ant students, says: "It is obvious that the small size of the worker is its safeguard. For owing to its minuteness, it succeeds in insinuating itself into the young brood of large ants without being seen by the defenders. . . . As it lives near its hosts, it requires neither size nor strength for seeking its food at a distance, and it is, therefore, in a position to nourish its enormous females and males with facility. Thus, it is easy to see how this form of parasitism should lead to a diminution in the size of the worker, in depriving it of its eyes, and in giving it a pale color, while the females and males which mate in the air retain their size, visual organs, and coloration."

Ordinarily, however, ants of one community are, as was pointed out above, very hostile to ants of different ones. It is interesting, then, to inquire how the ants determine the character of an intruder. One thing is certain: they do not make mistakes. Again and again have investigators removed one or more individuals from a colony, and after a year or even longer returned them to their nest. In every such case, the strangers were recognized and accepted with apparent glee. In one instance, the period was as long as two years.

From the study of the senses and sense organs of the ants, it is clear that no sense but that of smell could have served in this identification. This is confirmed by a multitude of circumstances. First, it is the antennæ or feelers of the ants which are put into immediate contact with the stranger. Second, if one of the same colony be covered with the blood of ants from a foreign nest, she will, in most cases, not be accepted, but treated as a stranger. Third, the young of strangers will be more readily tolerated than older individuals. There can be no doubt that ants of different colonies possess distinct odors, which become more diverse with the diversity of the two forms. These odors are the telltale, and it is they that make the ants intolerable to one another. The sense of smell is, therefore, the bar to the indiscriminate fraternizing of different colonies.

But, as is well known, the antennæ are the seat of the sense of smell. We have it, therefore, in our power to modify the life of these animals at our pleasure. If we remove the antennæ, we also destroy the mutual animosity. Indeed, it is necessary to remove only the last few segments of the feelers, inasmuch as it is in them that the power of distinguishing friends from enemies resides. The operation is neither difficult nor very painful to the ant, and has often been performed by various experimenters. Under proper care, the wound soon heals, and but for this slight loss, the animal is in much the same physical condition as before the operation. When placed together, ants of the most diverse origin can be made to live amicably.

There is one other method of attaining the same results which has considerable interest. Some twenty-five years ago, Sir John Lubbock, now Lord Avebury, studying the question of recognition among certain species of ants, discovered that if the unborn young still within the cocoon be isolated, permitted to emerge, and then replaced into the old nests, they would be received as friends. Here, however, his experiment stopped, and he just missed making the important discovery that if these newly-born individuals be placed together, even if they belong to colonies of deadly enemies, they would fraternize as do the sisters of the same mother. This discovery we owe to Miss A. M. Fielde.

The accompanying photograph is from one of Miss Fielde's remarkable mixed nests. You will observe side by side ants of four distinct species of very considerable diversity

in size and structure. Under ordinary conditions, these individuals would fight one another to the death, but in this nest they lived for a considerable period without the least disturbance. They were often seen feeding one another, playing, and in all other respects behaving as ants of one family.

A glance at the picture will show that all of these possess their feelers, and are not in any sense maimed. They were thrown together just before they had hatched. At that early period, they had not as yet

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well-advanced babies or pupæ. In groups of eight or ten they tear these defenseless young to pieces, and carry them off in large masses to their own lairs, where they feed both themselves and their large kings and queens at their leisure.

In a fight, they are the equal of the strongest. Even that renowned fighter, *Formica sanguinea*, the blood-red slave-maker, is overpowered by them. What they lack in size they make up in numbers and in the fierceness of their onslaught. We have in this species a