THE ADVANTAGES OF THE TOPOGRAPHIC ABNEY LEVEL FOR FOREST WORK.

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The instrument considered in this article is an adaption of the Abney level so well known to surveyors and foresters, the only difference being that the arc is not marked off in degrees but in divisions representing feet in elevation or depression corresponding with a base of fixed length. In American forestry two types are used, one graduated for a base of 66 feet, and the other graduated for a base of 100 feet, the latter, of course, giving results in percentages. The former type, working on a base length of one chain, is described in this article as it fits in better with present New Zealand practice. The Topographic Abney can be used for three purposes—measuring the heights of trees, setting out grades and measuring heights and reducing distances in chaining. By eliminating tables and reducing the number of calculations this instrument greatly simplifies and speeds up all these three operations.

Measuring the Height of Trees:

Using the degree Abney, there are two common methods of doing this. The first is to set the instrument at 45° and then back away from the tree until the instrument on this setting sights the top of the tree or log, then the distance measured by tape, from the instrument to the tree, is equal to the height of the tree above the level of the instrument, or eye level as it is more commonly called.

The second method is to measure out a fixed base, take a sight to the top of the tree, read this from the arc in degrees and minutes, then consult a table which will give for the measured base and read angle the height of the tree above eye level. In both these cases it is necessary either to estimate the distance from ground or stump height to eye level or to conduct a second series of measurements to find this distance.

With the Topographic Abney a base of 66 feet is measured o ff from the tree and with the instrument two angles are taken, one on the top and one to stump height. The two readings give in feet the distance from eye level to top of tree and from stump height to eye level. These readings are simply added together if stump level be below eye level, as is usually the case, or substracted if on a slope, stump height is above eye level.

Setting out of Grades:

The Abney level is much in use for the measuring and setting out of grades for roads, trams, etc. Wherever the Degree Abney is

used in this work, tablesst be mu carried, without the tables the instrument is useless. For example, a man wishing to lay out a grade of say 1 in 11 must first consult his tables and find that a grade of 1 in 11 is equivalent to an angle of 5° 12′ and he must then set his instrument on that reading. The Topographic Abney is graduated in feet per chain so that to obtain the necessary reading the grade number is simply divided into 66 and the result is the desired setting for the instrument, e.g. for a grade of 1 in 11 the instrument is set at 66 divided by 11 or 6 feet in the chain, no tables are needed. Conversely the reading divided into 66 gives the grade number. In this case a simple calculation does away with the necessity for carrying tables and the time spent in consulting them, at the same time giving results that, while they may not be so accurate as those of a degree Abney fitted with a vernier scale, are nevertheless sufficiently accurate for all practical purposes.

Method of Chaining :

Considerable use can also be made of the topographic Abney in chaining cruise lines and boundaries in timber cruising. The usual method is for the chainman to go ahead to the limit of visibility, in the bush actually about two chains, and cut and place a rod. The distance is then chained and the slope observed by the Abney level. Then the cruising officer notes the angle for later reduction in camp and marks the unreduced or slope chainage on the rods : or reduces the slope distance on the spot with the help of tables—doing this he can mark the rods with reduced chainages but the necessity of consulting tables and making a calculation on the spot slows up the rate of chaining considerably.

The best system for chaining would be to use the topographic Abney in conjunction with the American type steel tape. This is a wide and very strong tape, two and one half chains long. Beyond each chain mark there is a series of divisions giving the distance to be added for various slope degrees. To use this tape the chainman is sent ahead, say 2 chains, the cruising officer then reads on his Abney the slope to the chainman, say 15 feet in the chain, and then allows the chain to go forward till the mark 15 beyond the 2 chain mark. This gives the slope distance corresponding to two chains horizontal at an angle of 15 feet in the chain. Then all the surveyor has to book is the distance two chains and the change in height 2 x 15 = 30 feet. No tables need be consulted and the reduced chainage and height are instantly available in the field.

The writer has devised a system for using the topographic Abney together with the steel tape commonly used by surveyors in New Zealand. This involves the use of a table, given here, which, however, is small enough to be easily fitted into the field book and so can be consulted instantly. The writer fastens his table to the top of the

page of the field book in use with a clip or rubber band. Using this method, the cruising officer holds the chain at the point between the reader and the band commonly known as "the swivel." The chainman goes ahead as far as he can be easily seen, stopping at the nearest chain mark to the limit of visibility, say two chains. The officer then takes a reading with his instrument, say 15 feet, then consults his tables and finds that the extra distance for 2 chains at an elevation of 15 feet is 5 links. He then lets the chain go these 5 links beyond the "swivel" and here the chainman tightens up his chain and makes his mark. The distance measured is thus the slope distance corresponding with a horizontal distance of 2 chains and all the officer has to book is the horizontal distance, 2 chains, and the elevation, 2 x 15=30 feet. This method does away with the consultation of tables and calculations which have to be done either in the field or in camp when the degree Abney is used. It is quicker, simpler and has proved absolutely accurate in practice.

Summing up the advantages of the topographic Abney Level over the same instrument graduated in degrees as commonly used in New Zealand are :

(1) It is quicker, easier and simpler to read, the graduation being widely spaced and no vernier being used.

(2) It does away with the necessity of consulting tables, thereby making a great saving of time and extending the use of the instrument to occasions when the necessary tables are not available.

(3) In measuring the height of trees, it is more accurate in that it takes readings of distances both above and below eye level, where with the degree Abney the distance below eye level is usually estimated.

It may be argued that the Topographic Abney having the large graduations and not being a vernier is not sufficiently accurate but for forestry purposes, where the accuracy demanded is not so high as in standard surveying and time is of more importance, this instrument has in actual practice proved itself quite suitable and a great deal quicker in operation than the standard methods.

Note.—The instrument used by the writer was made by Keufel, Esser & Co. of New York, and is believed to be typical of those commonly used by surveyors and foresters in the United States.

REDUCTION TABLE FOR TOPOGRAPHIC ABNEY

Elevations are given in feet per chain horizontal. The figures in links, must be added to the slope distance to give the correct horizontal distance for the corresponding angle.

ev.	100	200	300	400	500	Elev.	100	200	300	400	500
1	—	—	—	—	—	31	11	21	32	42	53
2	—	—	—	—	—	32	11	22	33	44	56
3	—	—	—	—	1	33	12	24	35	47	59
4	—	—	1	1	1	34	12	25	37	50	61
5	—	1	1	1	1	35	13	27	40	53	66
6	—	1	1	2	2	36	14	28	42	56	70
7	1	1	2	2	3	37	15	29	44	59	73
8	1	1	2	3	4	38	15	31	46	61	77
9	1	2	3	4	5	39	16	32	48	65	81
10	1	2	3	5	6	40	17	34	51	68	85
11	1	3	4	6	7	41	18	35	53	71	89
12	2	3	5	7	8	42	18	37	55	74	93
13	2	4	6	8	9	43	19	39	58	77	97
14	2	5	7	9	11	44	20	40	61	81	101
15	3	5	8	10	13	45	21	42	63	84	105
16	3	6	9	12	14	46	22	44	66	88	110
17	3	7	10	13	16	47	23	45	68	91	114
18	4	7	11	15	18	48	24	47	71	94	118
19	4	8	12	16	20	49	25	49	74	98	123
20	4	9	13	17	22	50	25	51	76	102	127
21	5	10	15	20	25	51	26	53	79	106	132
22	5	11	16	22	27	52	27	55	82	110	136
23	6	12	18	24	30	53	28	57	85	113	142
24	6	13	19	26	32	54	29	58	88	117	146
25	7	14	21	28	35	55	30	60	91	121	151
26	8	15	23	30	38	56	31	62	93	125	155
27	8	16	24	32	40	57	32	64	96	129	160
28	9	17	26	35	43	58	33	66	99	133	166
29	9	18	28	37	46	59	34	68	102	137	171
30	10	20	30	40	50	60	35	70	105	141	176