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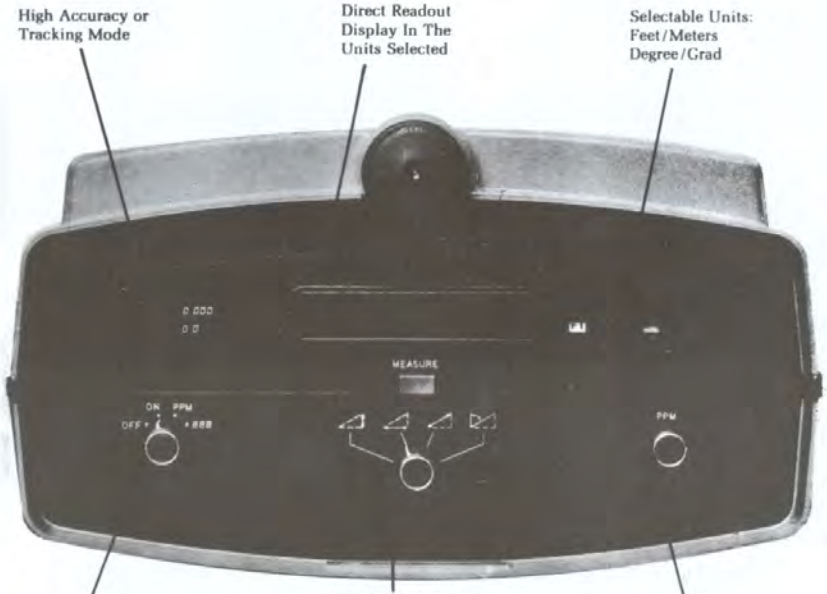

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The Journal

OF THE

ASSOCIATION OF SURVEYORS OF PAPUA NEW GUINEA

Vol. 6 March 1976 No. 1

Editor
T.M. Nacino

Business Manager
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Eleventh Survey Congress

Madang

In this issue of the Journal you will receive a Congress Newsletter, and Registration Forms. You will notice from the Newsletter that the Congress is a little shorter than has been the case in the past. This was brought about by your Association's awareness of the current economic climate in the Country, and the desire to heed the Government's call for restraint from all sections of the Community.

We have been able to keep the fees to a low level, and with the profit from last year's Congress we are able to subsidise our National and Student members. However, in regard to fees note carefully that the K10 rebate applies only if we receive your Cheque by 31st May. So fill in your registration form NOW.

The weather in Madang in July should be perfect, and the town will be a perfect setting for the Congress. We are looking forward to seeing you here.

Remember Congress starts with the President's Cocktail party on Monday, 12th July and concludes with the Annual General Meeting on Friday, 16th July.

SOME REMARKS ON PUISSANT'S FORMULAE

By: Professor Herbert W. Stoughton

In the June 1975, issue of The Journal of the Association of Surveyors of Papua New Guinea (Volume 5, No. 2) page 7 G. H. Phillips has written a good paper on the forward geodetic position computation. On page 7 and 8 is written a discussion of Puissant's formulae. Until recently, these formulae were employed by the National Geodetic Survey (formerly the U.S. Coast & Geodetic Survey), and can be found in most of their publications related to geodetic computations. The formulae presented in the article and printed in the second and third editions of Bomford's Geodesy and the fourth and fifth editions of Plane And Geodetic Surveying for Engineers - Volume Two - Higher Surveying by David Clark, revised by James Clendinning are incomplete as employed by U.S.C. & G.S. About five years ago I researched the subject, and I would like to "pass on" to your readers some additional information on the subject, which, as far as I can ascertain, has not been published in English survey books.

The formula as presented in the paper is the original formula adopted by U.S.C. & G.E. at a very early date. Although the Coast Survey employed Bessel's figure of the earth in most of their work prior to 1880, they employed Puissant's formulae for their work. Puissant's text - Traite de Geodesie - appeared about 1800, and several editions appeared until about 1850. Since Puissant's work was one of the few major works in geodesy during this period, it is natural for the Coast Survey (later C. & G.S.) to employ these formulae. About 1876 George B. Davidson, of the U.S. Coast Survey observed triangulation with lines from about 80 to about 320 kilometers in length in what is now known as the Davidson Quads. To compute the geodetic positions for this work M. H. Doolittle, developer of the Gauss-Doolittle technique of solving normal equations, studied Puissant's formulae, and added three terms to the classical formulae published in Phillips' paper.

Following is the notation, formulae, and special applications of Puissant's formulae.

Notation: For a line from A to B.

Latitude of A = ϕ Latitude of B = ϕ'

Longitude of A = λ Longitude of B = λ'

Azimuth from A to B = α

Azimuth from B to A = α'

Azimuth is the clockwise angle from the meridian looking to the equator.

Note: In the northern hemisphere for eastern longitudes

$$\lambda = 360^{o} - \lambda_{E}$$

Professor Herbert W. Stoughton, B.S.E., M.S.E., Geodetic Engineer, Licensed Surveyor. He is a Member of the State of New York Board of Examiners for Engineers and Land Surveyors.

In the southern hemisphere for western longitudes

$$\lambda = 360^{o} - \lambda_{W}$$

Where:

λ = the published longitude of the survey station.

Radius of curvature in the meridian:

$$R_{\phi} = \frac{a(1-e^2)}{(1-e^2\sin^2\phi)^{3/2}}$$

Radius of curvature in the prime vertical:

$$N = \frac{a}{(1-e^2\sin^2\phi)^{1/2}}$$

Where:

a = length of the semi-major axis.

e^2 = square of the eccentricity of the ellipsoid.

ϕ = latitude of the survey station

The approximate difference in latitude is:

$$-\delta\phi = \frac{s\cos\alpha}{R_{\phi}\sin 1''} + \frac{s^2\sin^2\alpha\tan\phi}{2NR_{\phi}\sin 1''} - \frac{s\cos\alpha\sin^2\alpha}{R_{\phi}\sin 1''}\left(\frac{1+3\tan^2\phi}{6N^2}\right)$$

Note: $\delta\phi$ is in seconds of arc.

Approximate latitude of B:

$$\bar{\phi} = \phi + \delta\phi$$

The exact formula incorporating the Doolittle correction terms is:

$$-\Delta\phi = \frac{s\cos\alpha}{R_{\phi}\sin 1''} + \frac{s^2\sin^2\alpha\tan\phi}{2NR_{\phi}\sin 1''} - \frac{s\cos\alpha\sin^2\alpha}{R_{\phi}\sin 1''}\left(\frac{1+3\tan^2\phi}{6N^2}\right) + (\delta\phi)^2\frac{3e^2\sin\phi\cos\phi\sin 1''}{2(1-e^2\sin^2\phi)} - \frac{s^4\sin^2\alpha\tan\phi}{24R_{\phi}N^3\sin 1''}(1+3\tan^2\phi) + \frac{s^4\sin^2\alpha\cos^2\alpha\tan\phi}{8R_{\phi}N^3\sin^2 1''}(1+3\tan^2\phi) + \frac{s^4\sin^2\alpha\cos^2\alpha\sec^2\phi(\text{arc }1'')^2\tan\phi}{4R_{\phi}N\bar{N}'^2\sin^3 1''}$$

Where:

$$\bar{N}' = \frac{a}{(1-e^2\sin^2\bar{\phi})^{1/2}}$$

s = geodetic distance between A and B.

Rearranging:

$$-\Delta\phi = (\delta\phi)\left\{1 - 3(\delta\phi)\frac{e^2\sin\phi\cos\phi\sin 1''}{2(1-e^2\sin^2\phi)}\right\} - \frac{s^2\sin^2\alpha\tan\phi}{4R_{\phi}N\sin 1''}\left\{\frac{(1+3\tan^2\phi)}{2N}\left[\frac{1}{3} - \frac{s^2\cos^2\alpha}{N}\right] - \frac{s^2\cos^2\alpha\sec^2\phi(\text{arc}1'')^2}{\bar{N}'^2\sin^2 1''}\right\}$$

$\Delta\phi$ is in seconds of arc

But arc 1" = sin 1"

Then

$$-\Delta\phi = (\delta\phi)\left\{1 + 3(\delta\phi)\frac{e^2 \sin\phi\cos\phi \sin 1''}{2(1-e^2\sin^2\phi)}\right\} - \frac{s^2\sin^2\alpha\tan\phi}{4R_\phi N \sin 1''}\left\{\frac{(1+3\tan^2\phi)}{2N}\left[\frac{1}{3} - \frac{s^2\cos^2\alpha}{N}\right] - \frac{s^2\cos^2\alpha\sec^2\phi}{\bar{N}'^2}\right\} \quad (1)$$

The formula can be simplified in the following manner:

$$B = \frac{1}{R_\phi \sin 1''} = \frac{(1-e^2\sin^2\phi)^{3/2}}{a(1-e^2)\sin 1''}$$

$$C = \frac{\tan\phi}{2R_\phi N \sin 1''} = \frac{\tan\phi(1-e^2\sin^2\phi)^2}{2a^2(1-e^2)\sin 1''}$$

$$D = \frac{3e^2\sin\phi\cos\phi\sin 1''}{2(1-e^2\sin^2\phi)}$$

$$E = \frac{1+3\tan^2\phi}{6N^2} = \frac{(1-3\tan^2\phi)(1-e^2\sin^2\phi)}{6a^2}$$

$$k = s^2\sin^2\alpha\, C = \frac{s^2\sin^2\alpha\tan\phi(1-e^2\sin^2\phi)^2}{2a^2(1-e^2)\sin 1''}$$

$$h = \frac{s\cos\alpha}{R_\phi \sin 1''} = \frac{s\cos\alpha(1-e^2\sin^2\phi)^{3/2}}{a(1-e^2)\sin 1''}$$

Then:

$$-\delta\phi = sB\cos\alpha + s^2 C\sin^2\alpha - hs^2 E\sin^2\alpha$$

$$-\Delta\phi = (\delta\phi)\left\{1 + (\delta\phi)D\right\} - \frac{1}{2}s^2 kE + \frac{3}{2}s^2 kE\cos^2\alpha + \frac{1}{2}s^2 A^2 k\cos^2\alpha\sec^2\phi(\text{arc }1'')^2 \quad (2)$$

Where: $A = \frac{(1-e^2\sin^2(\phi+\delta\phi))^{3/2}}{a\sin 1''} = \frac{1}{\bar{N}'\sin 1''}$

Formula (2) is the form usually seen in United States survey literature.

Then, $\phi' = \phi + \Delta\phi$ (3)

The difference in longitude, $\Delta\lambda$, is (exact formula):

$$\sin\Delta\lambda = \sin\left(\frac{s}{N'}\right)\frac{\sin\alpha}{\cos\phi'} = \sin\left[\frac{s(1-e^2\sin^2\phi')^{1/2}}{a}\right]\frac{\sin\alpha}{\cos\phi'} \quad (4)$$

Then,

$$\lambda' = \lambda + \Delta\lambda \quad (5)$$

The correction to the azimuth for convergence of the meridian:

$$-\Delta\alpha = \Delta\lambda\sin\left(\frac{\phi+\phi'}{2}\right)\sec\left(\frac{\phi-\phi'}{2}\right) + \frac{1}{12}(\Delta\lambda)^3\sin\left(\frac{\phi+\phi'}{2}\right)\cos^2\left(\frac{\phi+\phi'}{2}\right)(\text{arc }1'')^2$$

Let

$$F = \frac{1}{12}\sin\left(\frac{\phi+\phi'}{2}\right)\cos^2\left(\frac{\phi+\phi'}{2}\right)(\text{arc }1'')^2$$

Then

$$-\Delta\alpha = \Delta\lambda\sin\left(\frac{\phi+\phi'}{2}\right)\sec\left(\frac{\phi-\phi'}{2}\right) + (\Delta\lambda)^3 F \quad (6)$$

The units of $\Delta\alpha$ are the same as units of $\Delta\lambda$.

$$\alpha' = \alpha + \Delta\alpha \pm 180^\circ \quad (7)$$

If the engineer will adhere to the definitions of azimuth and longitude (with respect to the quadrasphere) the algebraic signs of $\Delta\phi$, $\Delta\lambda$ and $\Delta\alpha$ will be correct for formulae (3), (5), and (7). Note: the definition of azimuth is a novel approach. This definition makes the formulae amenable to computers. Note: Puissant's formulae cannot be employed in polar regions since tangent of ninety degrees is infinity.

References:

Hosmer, George L. Geodesy; 2nd edition; John Wiley & Sons., (Chapman & Hull Ltd., London); New York; 1929, 1946.

Crandall, Charles L. Textbook on Geodesy and Least Squares, 1st edition; John Wiley & Sons; 1907 Formulas and Tables for the Computation of Geodetic Positions; U.S. Coast & Geodetic Survey Special Publication No. 8; Washington, D.C.

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THE USE OF THE HP 45 CALCULATOR AS A CHRONOMETER

By: G. H. PHILLIPS

I am indebted to Mike Page for drawing to my attention the fact that a HP 45 calculator can be used as a recording chronometer of remarkable accuracy.

Whilst it is becoming fairly common knowledge nowadays there must still be many HP 45 owners who are not aware of this phenomenon or unsure of how to use this to their advantage.

Setting the Machine Up

To set the chronometer counting you should press the following keys [EEX], then, [RCL], followed by, [ENTER] [-] [7]. The last three keys must be pressed sharply and simultaneously.

The pressing operation and resultant display is shown in the diagram below:-

Step	Key	Display	Remarks
1	Switch On	0.00	
2	[EEX]	1. 00	
3	[RCL]	1. 00	
4	[ENTER] [-] [7]	01. 00 00 00	Ready for counting in the Sexagisimal system.

If after Step 4 the display reverts to 0.00 you did not press [ENTER] [-] and [7] SIMULTANEOUSLY. Return to step 2 and try again.

If you have achieved the display shown press [CLX] to clear the figure 1 in hours column and to start the counting procedure press [CHS]. The display will count in a sexagisimal system the figures on far right representing decimals of a second.

Mr. G. H. Phillips, B. Surv (U.N.S.W.) L.S., M.A.S.P.N.G. is a Lecturer in Surveying at the Papua New Guinea University of Technology.

00. 00 00 00

Hours Min Sec Decimals of a Second.

To stop counting press [CHS] . To re-commence counting press [CHS] once again.

To revert to the zero state after stopping press [CLX] . By pressing [EEX] the Decimals of a second will not be displayed, this will not effect the counting.

Readers will find that the pressing sequence described (steps 1 to 4) is not the only one by which this result can be obtained.

Recording the Instant of Observation

The most interesting feature of this phenomenon is that the time of observation can be automatically recorded within the machine memory and later recalled.

To record the time of an observation press the number 1 (or 2 or 3 ..... or 9). The recording of these instants does not in any way affect the counting.

Upon completion of your set of observation press [CHS] to stop counting, then to recall the times recorded simply press the number required (1, 2, 3, 4, 5, 6, 7, 8, or 9). Note that if you press 0 the time recalled is the instant of stopping, therefore it is possible to make and record 10 observations of time.

HP 45 Time and Mean Time

By this stage the reader has probably compared his calculator with his watch - discovered that the calculator is about 5 seconds slow in 1 minute. This does not detract in any way from the usefulness of instrument.

A surveyor carrying out timed astro-observations should always compare his time piece with a reference standard such as radio time signals and apply a clock correction if necessary. It does not matter if his timepiece is 30 seconds slow, 5 seconds slow or 0.001 seconds fast per minute. The important thing is that the rate of timing should be constant over the time of observation.

I tested my calculator over a 20 minute time interval by comparison with the radio signals V.N.G. Lyndhurst Victoria (4.5, 7.5 12 $M.H_2$) with the following results.

Radio elapsed Time	HP45 elapsed Time	Seconds Slow	Sec/min.
01^m00^s	$00^m54.^s10$	5.90	5.90
02^m00^s	$01^m48.^s17$	11.83	5.92
04^m00^s	$03^m36.^s55$	23.45	5.86
06^m00^s	$05^m24.^s90$	35.10	5.85
08^m00^s	$07^m13.^s32$	46.68	5.84
10^m00^s	$09^m01.^s57$	58.43	5.84
13^m00^s	$11^m44.^s25$	75.75	5.83
15^m00^s	$13^m32.^s56$	87.44	5.83
17^m00^s	$15^m20.^s95$	99.05	5.83
19^m00^s	$17^m09.^s33$	110.67	5.82

The consistency over the short period is therefore remarkably high and the instrument is imminently suitable as an astronomical chronometer.

Use as an Astronomical Chronometer

1. First establish a clock correction by comparison with the radio signal as above.

2. Start the clock counting at a known radio time. The VNG signals are fairly easy to follow, readers unfamiliar with the signal can obtain information by writing to

   PMG Research Laboratories
   Frequency Standard Division
   59 Little Collins Street
   MELBOURNE, VIC. 3000.

3. Commence your astro or sun observations. At the instant of observing press 1, 2, 3, ... 7, 8 to store the required time.

4. At the conclusion of the observation make two more clock comparisons by pressing 9 at a known radio time and [CHS] to stop counting out another known time.

The Use of the HP 45 Calculator As a Chronometer

5. The observation times and clock comparisons can now be recalled and noted in the field book.

6. Calculate the correction and apply to each HP 45 time as per the following example:-

   Correction to be applied to calculator time is $+5^{s}.82$ for each $54.^{s}18$ of calculator time.

   $$\text{Adjusted Time} + \text{Observed Time}\ (1 + \frac{5.82}{54.18})$$

7. Convert Adjusted HP 45 Time to EST or GMT as required.

EXAMPLE OF OBSERVATION

To Recall Press	RADIO TIME	HP 45 TIME	Adjusted HP 45 Time	Remarks
	$22^{hr}40^{m}00^{s}$	$0^{hr}00^{m}00.^{s}00$	$0^{hr}00^{m}00.^{s}00$	First Clock Comparison Chronometer Started
1		$0^{hr}00^{m}34.^{s}19$	$0^{hr}00^{m}37.^{s}86$	1st Astro. obs.
2		$0^{hr}00^{m}42.^{s}88$	$0^{hr}00^{m}47.^{s}49$	
3		$0^{hr}00^{m}58.^{s}83$	$0^{hr}01^{m}05.^{s}15$	
4		$0^{hr}01^{m}15.^{s}01$	$0^{hr}01^{m}23.^{s}07$	
5		$0^{hr}01^{m}30.^{s}28$	$0^{hr}01^{m}39.^{s}98$	
6		$0^{hr}01^{m}42.^{s}53$	$0^{hr}01^{m}53.^{s}54$	
7		$0^{hr}02^{m}02.^{s}11$	$0^{hr}02^{m}15.^{s}23$	
8		$0^{hr}02^{m}14.^{s}41$	$0^{hr}02^{m}28.^{s}85$	last Astro. obs.
9	$22^{hr}45^{m}00^{s}$	$0^{hr}04^{m}30.^{s}90$	$0^{hr}05^{m}00.^{s}22$	2nd clock Comparison
0	$22^{hr}46^{m}00^{s}$	$0^{hr}05^{m}25.^{s}34$	$0^{hr}06^{m}00.^{s}29$	3rd clock Comparison

The mean of the 3 clock comparisons indicates that our HP 45 is $0.^{s}10$ fast. This should be subtracted from each adjusted time then $22^{hr}\ 40^{m}\ 00^{s}$ added to give E.S.T.

The accuracy of the observation of time is limited by the clock comparison - no less than 3 should be taken.

TOPOGRAPHICAL AND GEOLOGICAL SURVEYING IN THE SEPIK DISTRICT OF NEW GUINEA

(Reproduced from "The Australian Surveyor" with the permission of the Executive Officer. This is the first of two parts.)

The main purpose of this paper is to outline the organization, objects, methods, and difficulties of a topographical and geological survey in a tropical country. No attempt is made to repeat information contained in standard text-books.

For the past six years geological survey work has been carried on in the Sepik District of the Mandated Territory of New Guinea, and it is through the courtesy of the managing director of Oil Search Limited, Sydney, that this paper is read.

Much has been written of New Guinea, but few seem to realize the immensity of the area in the main island that remains unexplored, unmapped and uncontrolled.' It is difficult when writing a paper of this nature to exclude remarks of geographical and general interest, and in order to make future references intelligible, a very brief description of the area and available maps will be attempted.

The Sepik District covers an area of about 45,000 square miles, and with the exception of a fringe along the coast and part of the Sepik River, the area is unpatrolled.' It is bounded on the west by Dutch territory, on the south by Papua, on the east by the Ramu River, and on the north by the Pacific Ocean. No vehicular roads exist, and the European population numbers some hundreds in comparison with a probable native population, of 150,000. The mighty Sepik River divides the district into two halves. Most of the southern half is uncontrolled and practically entirely unmapped, even in a rough way. Early surveys for navigation purposes were made by the Germans, and the best maps available today are the German chart of the coast, and Behmann's map of the Sepik River published in 1921. The government "Map of the Sepik District" on the scale of 1: 500,000 published in 1935, adopts their work as a basis.' Additional information obtained from patrols, coastal land surveys by members of private companies has been shown, but the degree of accuracy and quality of draftmanship is very low, and at best the "map" can only be regarded as a sketch.

The Sepik River boasts three government stations - at Angoram, Ambunti and the Yellow River. Each station has two European officers, whose duty is to administer and patrol their sub-district. Marienberg, some 18 miles below Angoram, is the headquarters of the German Roman Catholic mission on the Sepik River, and the site of their industrious timber factory. On the north coast are situated the Administration towns of Wewak and Aitape. Wewak, some 60 miles west from the Sepik mouth, is the headquarters of the Sepik District Administration. During the last year its expansion has been remarkable. Government bungalows, offices, stores, jail, native hospital, European hospital, and an A.W.A. radio station have been erected

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CARE & CALIBRATION OF EDM EQUIPMENT

This is the second of two articles dealing with the care and calibration of Electronic Distance Measuring equipment (EDM). In this article, the methods available for EDM calibration will be discussed.

(Submitted by Peter Philipp, Calculator/Distance Meter Staff Engineer, Hewlett-Packard Australia Pty. Ltd.)

CALIBRATION

There are two general methods available for the calibration of electronic distance meters.

1) Where an accurately known baseline is available, and
2) Where an accurately known baseline is not available.

Accurately Known Base

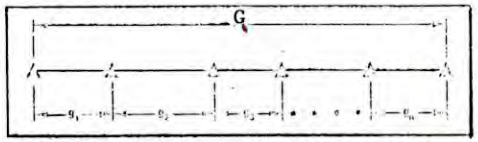
This offers the best conditions for calibration as the zero correction or offset error can be determined by direct comparison between the value for the base and the distance meter value for the base.

The value of the base must be traceable to the legal standard of measurement in the country where it is intended to use the distance meter. The method used to determine the baseline and the precision of measurement should be known.

The atmospheric temperature and pressure should be determined so the refractive index of the air can be determined or the ppm value set in the instrument. The distance meter and reflector (s) should be carefully plumbed over the terminal stations and the distance measured. The elevation of the instrument and reflector station or the vertical angle between the instrument and the reflector should be known. The displayed distance should be reduced to the horizontal at the same elevation as the original baseline measurement before the comparison is made. The difference (known value - measured value) represents the zero correction or offset correction.

Accurately Known Base Not Available

When an accurately known base is not available, the offset correction or zero correction can be found by measuring a line and then measuring the same line in a number of sections (two being the minimum). This method is based on the following theory.



Let zero error be constant and equal to Δ. Then the displayed measurement (reduced for slope and refractive index) for the total line will be $(G + \Delta)$. It follows that the displayed measurement (reduced for slope and refractive index) for the sections of the line will be $(g_1 + \Delta)$, $(g_2 + \Delta)$, ... $(g_n + \Delta)$. If any of the lines are short, then the short range aiming techniques suggested by the manufacturer should be followed.

It follows that $(G + \Delta) = (g_1 + \Delta) + (g_2 + \Delta) + (g_3 + \Delta) + ... + (g_n + \Delta) - (n - 1)\Delta$

$$\therefore \Delta = \frac{(g_1+\Delta)+(g_2+\Delta)+..(g_n+\Delta)-(G+\Delta)}{(n-1)}$$

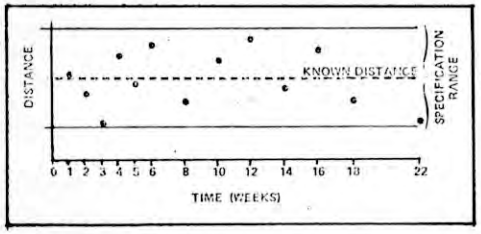
This method assumes the zero error is constant and, if the original distance G is divided into many sections such that each section has a different unit digit (e.g. four sections, $g_1 = 171$; $g_2 = 169$; $g_3 = 164$; $g_4 = 172$ and $G = 676$) then the effect of linearity or cyclic error will be meaned and the resultant effect on the zero correction should be small. The ideal is to have nine sections (ten measurements).

When a surveyor purchases a new distance meter, he needs to know the instrument measures distances within the stated specifications. He has no idea whether the displayed distance is correct or not, unless he measures a known line. One way of checking the instrument's operation is to measure a known line before and after its use in the field and compare the results. This, however, becomes a tedious operation if it is to be done before and after each day's use!

It is suggested that a line be established and that this line be measured, say once a week, then once each two weeks and then, as confidence in the unit is built up, once a month. It is most important to be particularly careful when carrying out these measurements as the idea behind the measurements is to monitor a change in distance due only to a change in the instrument's function.

It is suggested that the same tripod and tribrach be used with the distance meter for each measurement and also the same tripod and tribrach be used with the same prism for each measurement. The tripod and tribrach should be checked before use and, if necessary, adjusted. When measuring the distance, the measuring and aiming technique suggested by the manufacturer should be used. The distance should be measured a number of times (say 10) and the mean of the measurements calculated. The meteorological observations should be taken with care and a record of these observations as well as the return signal strength, stability of balance and null meter (if applicable) should be kept.

The mean of the recorded distance should then be plotted against the date of the measurement. The graph resulting from a series of measurements will show the user how well the instrument is "holding calibration". It may be of interest to also plot temperature, pressure and return signal strength against time to see if there is any correlation between a change in these values and a change in distance. If the observations are taken with care, then any change in distance should be directly related to a change in instrument's function. Ideally, the graph should be a straight horizontal line, (within the specifications range).

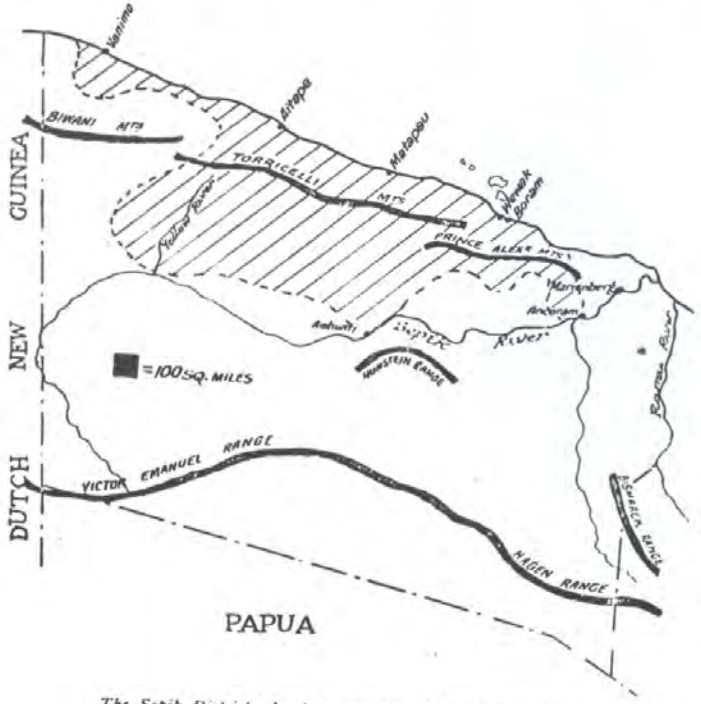


CONCLUSION

It is suggested that the techniques on care and calibration as outlined above be followed. This should insure that the distance meter and the auxiliary equipment will function when it is required, thus avoiding costly down times. Further, it will give the surveyor equipment on which he can rely and should give field results that are within instrument specifications.

....

according to the latest tropical designs on a subdivision prepared by the Government Surveyor, Sheldon. The mission and Boram plantations adjoin Wewak to the east. The influx of miners and prospectors to the new alluvial gold field to the south-west some 30 miles has brought increased activity to Wewak and the Boram European store. A regular aerial service has already been established. Aitape, situated westerly along the coast about 100 miles, was formerly the headquarters of the Sepik District, but now consists of four bungalows, a government office, native hospital, a European and a Chinese store, with a usual total resident European population of five. Aitape serves as the present base for the geological survey. Midway between Wewak and Aitape lies Matapau, former chief coastal base of the survey, and the site of oil seeps. Drilling activity took place here in 1923 without any adequate preliminary survey. Results was disappointing. Vanimo is an abandoned government station a further 80 miles west from Aitape along the coast, and possesses the only good harbour in the district. From Vanimo to the Dutch border is about 24 miles. The area over which the present survey extends covers 20,000 square miles, and the author in the course of work has walked from Vanimo and Angoram.



The Sepik District, showing area covered by surveys to date.

Topographical and Geological Surveying
in the Sepik District of New Guinea

Geological survey work for the discovery of a commercial oil field in the Sepik District extends back to 1921, when the Anglo-Persian Oil Company sent geologists to inspect Matapau and make a rapid reconnaisance to the south-west. In 1927, following on renewed government interest, Anglo-Persian Oil geologists were requested to direct their attention to the following concessions: Marienberg (Ormildah) Sepik Valley (Sepik River Oil Company), Aitape (Aitape Oil Fields), Vanimo (Colonial Exploration and Development Syndicate), and Matapau (Mandated Development). By the end of 1929 surveys with the exception of Matapau were complete. In view of unoptimistic reports, government operations ceased in 1930. Since 1930 private enterprise has continued the work, and the author has had the honour of being associated therewith since October, 1934. It is interesting to note that practically the whole area between the Sepik River and the coast has now been topographically and geologically examined, and mapped on a scale of 3 in. to a mile. In places large unknown areas have as yet only been "cut across", but in other sections intensive mapping on 6 in. to 18 in. to a mile has been completed. The finished map, in nine sheets reduced to 1 in. = 1 mile, is a triumph of private enterprise both for the accuracy and detail of the geological and topographical information that has been recorded. It is from such a map that the geologist is able to eliminate from consideration areas which lack formations such as are known to be favourable for the origin and preservation of petroleum.

The organization of an expedition to conduct geological survey work in heavily forested tropical countries requires careful consideration. The basic requirements are an approximate knowledge of:

1. The area that may be required to be mapped.
2. The scale that is required.
3. Method to be used.
4. Speed of work that is desirable.
5. Native labour available.
6. Native food supply and trading methods.
7. Living conditions and prevalent diseases.
8. Climatic conditions.
9. Type of native resident in locality, and his state of civilization.
10. Mode of transport.

Bearing these factors in mind, the personnel of the party is selected, suitable survey and camping equipment, medical and surgical gear, foodstuffs and weapons are purchased, and the necessary transport is arranged. In obtaining equipment it must be remembered that a tropical climate rapidly decomposes iron and aluminium, whether in instruments, tables or boots, photographic material and lenses must be specially protected from fungoids and damp, boxes for transport of stores over rivers and swamps and through tropical downpours must be of suitable size and watertight, equipment must be strong enough to withstand native handling,

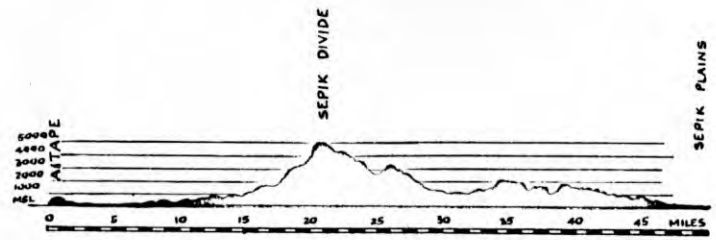
clothes must be suitable (fabric materials rapidly rot), and above all spare parts for everything must be on hand.

Once the party and stores are safely landed through the surf on the coast, repacking and reorganization take place. Recruited and casual labour is gathered together for survey and porterage. A native labourer, who receives generally from 6/- to 10/- per month (but who actually costs about 30/-), will carry in ordinary country a 50 lb. load 12 miles. In survey work it has been found that a 35 lb. load enables a native to move more rapidly, efficiently and safely. As far as possible single-man loads are made up. Double loads are carried on a dry pole or bamboo, and this method is preferable in level country or over rivers. The surveyor usually finds that a line of 50 "boys" is sufficient to carry on survey work on monthly circuits from base camp to base camp. From Aitape a party would travel for four or five days to an inland base camp to the south of the Torricelli Mountains, where work is at present proceeding in uncontrolled areas. The base must be situated in a friendly district, with safe access for native carriers to the coast. The route inland follows native tracks, creeks and rivers to the 5,000 feet bulwark of the Torricelli Mountains that frowns down on the sweltering forest slopes and coastal plains. Villages in this area are small and far apart. Immediately to the south of the Torricelli Mountains the population is more dense and scattered, whilst on the fringe, of the kunai surprisingly large villages are often found separated by many miles of forest. Once the mountains are crossed the country falls more easily by forest ridges to the kunai and swampy plains of the Sepik River, but rivers have cut deep valleys, gorges and bsins, leaving cuestas, hogbacks and plateaus due to differential erosion.

At the inland base the party again reorganizes itself and prepares for a series of circuits into a selected area, most often one into which no white man except company officers have been before.

In the field, the search for oil is not a direct one. The geographical position of the Sepik District has suggested to geologists the probability of the repetition of the particular geological and structural conditions which are known to govern the distribution of the commerical oil fields of the East Indies. Oil seepages are important evidence that certain strata are favourable for the origin of oil, but may be an indication that such oil, instead of accumulating, has seeped away through open beds or faults. Not all sedimentary basins present possibilities since much depends on the mode of origin of the sediments, their richness in organic material, texture, degree of lithification and folding, stratigraphic sequence and various other factors. When the geologist concludes that an area has petroliferous possibilities, the next step is to organize the survey to cover areas in which structural attitudes suggest the localization of oil and gas into commercial quantities at a reasonable depth. In the search for a suitable dome or pericline, in which many anticlines may be found and critically examined, the general tectonics and stratigraphy of the area are gradually elucidated. In the Sepik District, the Bewani, Torricelli and Prince Alexander Mountains form, generally speaking, a basement mass

with sedimentaries dipping away and downwards into respective geosynclinal basins. The geologists of the party have been able to correlate the sedimentary series throughout the area with the series first proposed by Dutch geologists, and with the exception of minor complex structural problems, a complete generalized picture of the type and extent of the folding has been obtained. This has been made possible by the geologist and surveyor preparing profile sections across the geosyncline to show the stratigraphic sequence, relative thickness of strata, marker beds, petroliferous beds, unconformities, faults and folds. In making these section surveys it is impossible to run a single line of section and obtain both topographical and geological information at the same time. Outcrops, except in streams and villages, are generally non-existent. It thus becomes necessary for the geologist to traverse streams as near as possible to selected line of section. Dips and lithology are carefully recorded, specimens for field laboratory examination and reference are selected, often at pre-determined stratigraphic levels. The surveyor runs a tie traverse, generally along ridges and paths, making where necessary intersecting panoramic sketches which can later be superimposed on the profile line. Levels are carried through with appropriate accuracy, the traverse being contoured. Names of streams and villages are recorded, topographic forms noted and sketched, and such geological evidence as presents itself noted for the use of the geologist in preparing the geological section.



Exaggerated profile section, Aitape, southerly to Sepik Plains.

The problems that arise in projecting the planes of stratification on to the vertical plane of section, and the geometrical construction of the position of sub-surface beds in the section line are intriguing and the author refers the student to any standard work on Projections, Geometrical Drawing, to "Earth Flexures", by H. G. Busk, 1929, and to

"Field Geology", by F. H. Lahee. Graphic geometrical methods give an accuracy appropriate to geological survey observations. For example, in a syncline, geometrical construction from recorded dips shows that a particular bed after disappearing from the surface describes a series of concave arcs of varying radius to theoretically emerge at some other point perhaps two miles away. Adjustment for such a small amount is then made in the geometrical construction. A larger discrepancy might reveal a fault that was not recorded in the field, attenuation of strata in the limbs of the fold or overlapping of beds, and so on.

Plotting of a geological section is usually done on a true scale. Where the vertical scale is exaggerated, the actual dip to be plotted on the section becomes:

$$\phi = \cot^{-1} E \tan B \cos A$$

where ϕ = the dip to be plotted on the exaggerated section.

E = the ratio of the vertical to the horizontal scale.

B = the amount of dip recorded.

A = inclination of the direction of dip to the direction of the line of section.

The instruments used by the surveyor and geologist in preparation of topographical and geological maps are the plane-table, telescopic alidade, stadia slide rule, stadia measuring staves, prismatic compass, dip compass, Abney level, aneroid barometer and chain. For the necessary astronomical observations a portable wireless transmitter and receiver and a light theodolite, chronometer and stop-watch are to be employed.

The type of alidade supplied to each officer varies, but from my experience in the district the best all-around instrument is the Watts improved simple telescopic alidade. The telescope is similar to that of a theodolite, and possesses a stadia-lined diaphragm 1: 100. The vertical circle of $4\frac{1}{2}$ in. diameter is complete, and reads by vernier to one minute, with clamp and slow motion screw. The vertical circle moves with the telescope and the vernier is attached to an adjustable 45" bubble, which is also provided with a slow motion screw. All readings are made from the eye end of the telescope. A circular bubble and 6 in. trough compass are fitted on the face of the sight rule, which is provided with a 14 in. parallel rule attachment. The instrument is carried in a canvas and leather covered mahogany case. By using the vernier bubble and reading R.F.' and L.F., vertical angles of any amount can be read to 20 seconds. Horizontal deflection of the line of error of five minutes, which for all but very long nights is immaterial. In actual practice a graphic intersection made from a number of points on a north-south traverse subtending an angle of about 30 degrees to a point some 11 miles westwards resulted in a probable error of 50 feet

, north and south, by 100 feet east and west in plan, and $\pm$ 10 feet in elevation.

The types of table used are copies or modifications of the Coast Survey and the Johnson. Both paper and celluloid sheets are employed in mapping. The shrinking of paper after removal is often 1 in 200, but is generally regular, and is measured by the grid drawn on the sheet after mounting. Frosted celluloid is impervious to water, and pencil lines adhere under roughest conditions. The great advantage of celluloid is that helio prints can be made immediately after the sheet has been removed and inked in, but the distortional effects in this process are severe and irregular, and the use of colour is not possible. Also, after inking a sheet it cannot be used again on the board without the greatest care. The weight of a number of sheets is also considerable. The think type of celluloid has been tested, but found lacking in strength, and subject to very serious distortions.

In general surveys, measurements are made by stadia methods. Special folding 14 feet staves are used, which permit of direct reading of distances up to 2,800 feet from the wires 1: 200. For the measurement of greater distances, natural beacons may be utilized and visited later for vertical measurement, or bamboo poles with attached marks may rapidly be prepared and subtense methods employed.' In such a way distances of over a mile have been accurately determined, the formula being

$$d = \frac{T.S \cos^2 A}{T \sin B}$$

where d = the horizontal distance to signal.

T is any integer enabling the small angle B to be placed on slide rule graduations.

A = the angle of depression or elevation to the centre of the intercept.

S = the vertical intercept on the signal mark.

B = the small angle subtended by S.

The value of d is computed on the slide rule in a few seconds.

The accuracy of stadia measurement and magnetic pointing is greater than that of plotting on 6 in. = 1 mile, and since the production of an accurate geological map is the main object, the advantage of the plane-table method far outweighs any of its disadvantages. Remarkable closures in long surrounds have been obtained, a few hundred feet in 20 or 30 miles being quite the usual thing. In 10 miles of stadia levels an error of 20 feet might be expected, but most errors are caused not by instrumental deficiencies, but by undetected mistakes of native assistants. The greateast errors lie in the pricking of points - a point on 6 in. to 1 mile scaling 10 feet in diameter. To combat a

Topographical and Geological Surveying in the Sepik District of New Guinea

constant plotting error, the author has considered the possibility of attaching a small simple plotting device and scale to the movable parallel edge of the alidade. When the instrument is oriented and the telescope sighted on the back mark and distance noted, the parallel edge is moved across to intersect the pricked position of the back sight. The sliding scale carrying two needle points moves along the rule until the zero needle drops into that point. The forward spring needle point is then moved to the desired distance read by vernier and the needle point pressed into the paper. The needle points being so placed as to be exactly parallel to the line of sight or at a constant variation to it, and the distance being read by vernier, the resulting accuracy in long traverses should be theoretically perfect.

The second part of this article will be presented in the next issue.

REPORT ON THE STATUS OF THE PHILIPPINE CADASTRAL SYSTEM

By: Amante R. Dumag

(Submitted to the Inter-Regional Seminar on Cadastral Surveying and Urban Mapping, 24 June - 12 July 1974 Berlin (West) Federal Republic of Germany).

General Background Information

1. The REPUBLIC OF THE PHILIPPINES, an archipelago of more than 7,000 islands and 21,500 miles of coastlines lying 500 miles of the southeast coast of mainland Asia, is between latitudes 4 degrees 23 minutes North and 21 degrees 25 minutes North, and longitudes 116 degrees East and 126 degrees 20 minutes East. It extends 1,152 miles (1,855 kms.) from north to south and 688 miles (1,108 kms.) from east to west. It is bounded by the China Sea on the west, the Pacific Ocean on the east, the Celebes Sea and coastal waters of Borneo on the south and Formosa (Taiwan) is 65 miles northwest.

Land Area

2. The total land area is 115,830 square miles or about 30 million hectares, functionally certified as Timberlan areas, 8,936,532 hectares or 29.78%; Unclassified areas - 8,255, 475 hectares or 27.93%; and Alienable and Disposable area - 12, 807,993 hectares or 42.69% (Agricultural, Residential, Industrial and Commercial).

3. Of the unclassified land area it is expected that 3,663,468 hectares of 12.22% will be for additional timberland and 7,592,007 hectares or 15.31% will be for alienation and disposition. It has been recommended that to maintain an ecological balance, 42% of the total land area must be reserved for forest cover.

Political & Administrative Area Subdivision

4. The country is subdivided for political purposes into 71 provinces, 1,523 cities, municipalities and municipal district and 38,832 barrios.

5. For expediency and better administrative control and supervision, almost all departments and Bureau executive branch of government are regionally divided into 11 areas.

Agency Responsible for and the Status of Cadastral Survey

6. The Bureau of Lands under the Philippine "Cadastral Law" of 1906 which instituted a cadastral system for purpose of issuing Torrens Title and under other related subsequent laws, is charged with the responsibility of survey of all cities and municipalities. The Bureau of Lands is also responsible for the administration and disposition of alienable and disposable lands of the public domain.

Mr. Amante R. Dumag, Chief Planning and Management Officer, Bureau of Lands, PHILIPPINES.

7. The cumulative land area surveyed reached 13 million hectares of disposable land. Over the years, complete municipal cadastral survey has been finished in 6.5 million hectares approximately (22% total land area) covering 511 municipalities cities and municipal districts or about 1/3 of the total of 1,523 municipalities, cities and districts in the country. This leaves 1,012 municipalities, cities and districts untouched by any cadastre. Partial municipal cadastre has been accomplished in 4.6 million hectares (15%) while individual surveys completed embrace 2 million hectares of individual land properties (6.06%). Bridging the chasm between the hesitant pace of work of the Bureau of Lands and the vast disposable lands still to be surveyed and registered - not to mention additional work in the 4.6 million hectares expected to be certified for disposition and alienation - will take a lot of drastic logistical preparations. No doubt the conventional technique of numerical surveying with its bias for hairsplitting accuracy, and the traditional concept of land administration, have to be radically modified if a forward leap to large scale land mapping and distribution is to be realized.

8. To be able to really reap a rich harvest of accomplishment in the land distribution program and in the proper management of land resources, a thorough modification of conventional methods and traditional concept is being done.

9. On the one hand, all legal possibilities and measures - leading to a codification of land laws - is being exhausted to introduce ample technical simplifications in clarifying land property over areas and boundaries. This move will specially facilitate the land reform program of dividing ownership of private estates among tenant-tillers at a fast clip. On the other hand arrangement are being made to allow the use of modern photogrammetric techniques which will develop a tool for maintaining land resources up-to-dately.

Simplification of Land Registration Procedures

10. At the root of most land disputes are imprecise boundaries and absence of official documentation by which land properties are recognised. That more than 6% of the land area in the country is under protracted litigation mirrors this unfortunate conditions. Delay in the issuance of land titles and consequently, indefinite postponement of infrastructure development on the lands in dispute; inevitably result.

11. Underlaid in this issue is the expensive and cumbersome legal process of securing a title. Normal legal procedures embodied in the Torrens Title System of registration bog down because they require that steps be completed in a fixed sequence. The preliminary stage alone, which involves boundary survey work, is a time consuming activity requiring unnecessary accuracy.

12. A measurement shortage of a few centimeters of land is enough to send the owner to court to recover the lost portion. To compound the matter, there is no up-to-date large scale mapping which will serve as a reference for securing official proof of ownership. Even if this were available, however, its purpose would have been defeated by the required to-the-nearest centimeter descriptions. That is why even in ideal condition, it usually takes years for the Bureau of Lands to conduct survey work from area to area. The proposed solution is to anchor the Torrens System to the photo-cadastral system. For simplifications, photo-interpretation, in conjunction with a field inspection, will suffice to record the boundaries and other land descriptions.

A Land Reform Titling Technique Initiated

13. An elaboration of simplified land registration procedure with accent on agrarian reform is performing a rough calculation first followed by an accurate measure later. The "identify now, measure later" method is a large-scale activity calling for a two-phase cadastral mapping work: initially a graphical (sketching) survey to reckon with preliminary on the land leading to the granting of a bankable land transfer certificate; then a numerical survey for obtaining refinements and corrections in the technical detail, leading to the issuance of a title.

14. Aerial photographs are being used in the identification phase to facilitate convenience and rough accuracy in sketching work and hence quicken the progress of land transfer operations. This is compiled with the conventional transit-and-stadia survey method in hilly areas and surfaces with thick vegetative cover.

Establishment or Strenghtening of Photogrammetric Cadastre Capability

15. In order to meet the need in the interest of agrarian peace, to strengthen a cadastral survey program and to effect a more efficient and expeditious land titling system and much more a modern cadastral map program with large scale economic base map for use in entire land resource management and control reflective of the goals and development thrusts of the New Society in the country, a photogrammetric cadastre capability must be established.

16. Under the scheme, photography flown at selected altitudes - to obtain the desired scales - produce the required types of controlled map and controlled mosaics. High altitude photography permits bridging over long stretches of land. Existing control points can be used more effectively as reference although a corollary need is the establishment of a dense geodetic control network to fortify the reference system. Low altitude photography, on the other hand produces sharp images to facilitate accurate resource identification. In many ways overlapping surveys are eliminated because the maps satisfy different requirements.

17. Map controlled photography is an invaluable instrument for administering the cadastre constantly in up-to-date status. It can be used, as it has been repeated many times, as a basis for a multi-purpose map providing data for infrastructure development as well as for social and economic development planning. It can be utilized for soil analysis, studies of plant diseases, mining and oil exploration, forest inventory, land use classification and irrigation and dam designs. As it is a gigantic undertaking, a fund must have to be needed for the provisions of photographic equipment. In the same way there is a need for a study program to train selected personnel. If adopted, it can be devoted to the conventional cadastral system. Its design may be made to the level of sophistication easily mastered by Bureau of Lands personnel.

Proposed UNDP/FAO Cadastral Assistance

18. A UNDP/FAO package project recommended in February 1973 by a UN Cadastral Mission which observed Philippine cadastre in late 1971, intends to set in motion a machinery for the production of all-purpose economic maps, based on orthophotography, that will facilitate infra-structure development.

19. The UN Cadastral Mission, however, was not able to consider the development that cause later - that is the issuance of Presidential Decree No. 27 of 21 October 1972 which requires the speedy implementation of the Philippine land reform programme on a nation wide basis. The most expeditious ways and means had to be adopted, as was, earlier discussed briefly in this report, in conferring land ownership to tenant-farmers on a massive scale. In view of this development, the project as finally proposed would start after land ownership is conferred on the tenants.

20. The 1971 UN Cadastral Mission to the Philippines have made significant findings, comments and proposals for recommendations along the following areas outlined as terms of reference of the mission:

20.1. The changes to be made in organization, procedures, techniques and legislation;

20.2. The changes to be introduced in cadastral maps and records so that they may provide data and information and agriculture and natural resources development planning;

20.3. The extent to which and how aerial photogrammetric technique may be introduced in expediting cadastral survey, and the equipment and expertise that would be required.

20.4. The arrangements to be made to establish a modern cadastral map programme together with a large scale economic base map for further use in Government's expanded economic and social development programmes such as natural resources inventories and classifications; infrastructure planning and engineering.

PERSONAL NOTES

Dennis Puniard at 8th Field Survey Squadron, Wewak invites Association members visiting the Area to look over the unit and enjoy a few ales in the mess.

Graeme Arman was recently in town and had a champagne and pool party at Geoffrey Browns residence. The party was to celebrate a special occasion.

Messrs Hole, van As, Brown and Larmer amongst a host of others assisted in the celebrations. The only bloke not limping the next day was Gil Hole who insists on swimming with his boots on at these functions.

Maurie Whish-Wilson and Janet have just left for six weeks leave in Australia. Maries timing was perfect, a mere 48 hours before the Central Mapping Bureau began the big move out to Waigani.

Marion Chicoke recently returned from Noumea with the harrowing story that the Scale of Fees in that country is higher than Papua New Guinea.

Francis Posanau left for a business trip to Singapore, Jakarta and a couple of other hardship posts on March 7th. He is representing the P.S.A. at a Conference in Kuala Lumpur, also hopes to have a look at the land tenure system in Indonesia.

Tony Quick was recently in Port Moresby where he did some engineering work at and around the traffic lights at the Taurama Road intersection. He escaped intact but says he would prefer to peg the centreline of Pitt Street Sydney at one metre intervals than go through it all again.

It has all been too much for Rodger Machin. He was seen packing his surf-board at Hagen and heading for Wewak.

Shaved, shorn and subdued Noel Sharp is so tired in the mornings that he needs bedside controls for his computer. Welcome back Noel and Very Best Wishes to you both.

Joe Wolfe and Clive Carson were seen on a working day on top of the Kimel Gap, looking at Tabibuga airstrip in the distance obviously dreaming of the days gone by.

You have to be tough! In two days this man lost his '45', broke his distance measuring machine, ruined his personally imported watch, squashed his partner's radio aerial in the car door, all while starting a job which was cancelled. He used to be called 'Lucky' but now as plain John Hunter.

PERSONAL NOTES

Dick Moody has spent some months now working on Hagen Control (Office filing systems) however he works out his frustrations on the cricket oval with a good deal of sucess.

Tony Ferris is taking it easier at Menyamya now that his fair wife has found a job.

It is nice to see the Regional Surveyor's chair in Mt. Hagen being warmed again. Welcome back Sue and Bob George.

Christmas time was holiday time in Madang with Brian Mennis and Jason Garrett both away for two months each. Norm Leet took his leave at the end of January.

Vaki Vailala was another one of the leave brigade. His was extended by two weeks by a course in Port Moresby. Another one of the Alphatetical company has left our fair land. Peter Fagan departed last November, and is now working in New Zealand. He will notice the difference in working conditions when winter starts.

Congratulations to Adelbert Alois of Lands Madang, who becomes the Association's first Technical Associate.

Dave Rumble is spending a well earnt leave in Australia after a strenuous year in Bougainville. It is understood that his iron lung will receive a complete overhaul while he is away.

Max Muller is "going finish" in June to a newsagency business in Brisbane. No doubt he will carry out a few "ident" surveys as he hurls the newspapers over the fences.

It is rumoured that Stuart Scriven was seen stumbling around the Rabaul Golf Course in the dark hours mumbling to himself and swinging a bush knife at every tree.

"Scruffy" Kendall claims he is now qualified to wear the bread brimmed graziers' hat. On his property in Queensland he has 27 cows and a nineteen year old horse. Careful the horse doesn't throw you, Scruffy!

Clive Bassett is in a quandary - he doesn't know whether to drink up, close up or throw up.

Mal Gray is lecturing to survey students in Australia. Hope you manage to keep a couple of pages ahead of the class, Mal!

Gil Hole is the only fellow known who has to shake his wrist to keep his automatic watch going.

David Johnstone had a letter from Graeme Arman who was holidaying in Manila. Seems he met an "old" friend of David's there. Amazing out of all those millions must have been a bit of undercover work involved.

John Kronnenburg is going to the Gold Coast Surveyors Congress. Enough said.

Of David Forster there is little to say just read the second last page fifth column third paragraph from the bottom of March 16th 1976 edition of the Post Courier. (Copies are available from him free.)

David Thompson has been offered the use of a large fish bowl while he smokes those Rockefeller type cigars. His chauffer has been off sick lately.

It has been brought to the notice of the Surveyor General through complaints from the Hash House Harriers that G.I.P.'s are not being placed in accordance with the Regulations causing considerable pain to the toes of some runners. On investigation of the relevant Catalogue plans, the culprit's name was noted. Please contact the Department of Transport, Works & Supply, Survey Section's Mr. Johnstone for futher information and arrangements can be made for a suitable meeting place.

Since squashing and yatching and boozing had been getting a bit of a flogging in recent journals it was decided that no remarks of such would be mentioned of the above five fellows.

Alan McCarthy has returned from a year's study leave in Australia. "Big Al" studied at N.S.W. University and successfully completed the course work for his M Sc in Surveying. All that he has to do now is to produce his thesis. Pam and the kids will be re-joinning Al in June when the new addition is big enough to travel.

Galicano and Isabel Taduran joined the University staff at the end of 1975. "Gally's" qualifications include a B.Sc. Geod. Eng., B.Sc. Photogrammetric Engineering and a Master's degree in Business Management. Most certainly an asset to the University.

Ted Nacino goes into hospital shortly to have a few teeth removed. Most probably due to excessive pencil-chewing whilst trying to meet the deadline.

Friends of Grant Phillips will be pleased to know that Margret returns soon from "Down South". Rumour has it that the shopping bill will preclude any future solo trips.

Six out of nine Graduands attended an Association dinner held at the Huon Gulf Motel the night before graduation. A fine meal, good wine and bad jokes made for a most enjoyable evening. I trust that this dinner will become a part of the Association's tradition. (To rank with the "Order of the Oyster").

ASSOCIATION DINNER FOR THE 1975 GRADUANDS
Held at the Huon Gulf Motel, Lae.

Sydney 5th January, 1976

Dear Sir,

I refer to the article "A Brief Summary of Recent Developments in Electronic Distance Measuring Equipment", published in the December 1975 issue of your journal and would like to make the following comments in an endeavour to correct what may well be erroneous impressions created by some of the statements made by the author.

"Some wear on the trunnion axis is likely to occur."

This statement needs qualification to the extent that it depends on the quality of the material and workmanship used in the construction of the theodolite. If one purchases the lower priced theodolites one cannot expect that they will give the same consistently reliable performance as the better made instruments.

I cannot agree with the author's assertion that "it is not practical to purchase equipment to last so long". Even if electronic and self-recording theodolites do become available in five years time, they will undoubtedly be too expensive to be purchased for use in the many minor and routine tasks performed by the surveyor. There will always be a need for good quality theodolites and the longer they are in use, the more economically justifiable becomes the purchase of such an instrument.

I now refer to the comparison table compiled by the author. I cannot comment on other manufacturers equipment, but would like to correct a few inaccurate figures quoted by the author, together with a somewhat unfair comparison of comparative weights in respect of the D13 and DI10 Distomats.

I consider that the author should have divided the weight into three components as set out below:

	WILD DI3	WILD DI10	AGA 12
Aiming Head	2.2kg	3.1kg	2.8kg
Control Unit	4.0kg	14.7kg	-
Carrying Case	5.7kg	4.0kg	?
	11.9kg	21.8kg	?

As you will see, this gives a more direct comparison of the weight actually attached to the theodolite.

The range to one prism with the D13 is 400m, not 300m as quoted, and to three prisms with the DI10 is 1,200m, not 900m as quoted. In practice, these ranges have been exceeded by 50% or more, under favourable conditions.

With the Wild D13 it is possible to plunge or transit the telescope on the new model T1 and T16 theodolites without removing the aiming head.

The D13 and DI10 aiming heads will be attached to any suitable theodolite on request. It must be understood, however, that Wild cannot guarantee any theodolite, especially the lower priced ones, other than their own manufacture.

The accuracy of the D13 is $\pm$(5mm + 5 x 10^{-6} D) at any distance.

If the author had checked with Wild before presenting his article to you for publication, this information would have been readily supplied and the need to write this letter would not have arisen.

Yours faithfully
WILD (AUSTRALIA) PTY. LIMITED

A. Cawthorne
MANAGER
SURVEYING INSTRUMENTS DIVISION.

The Editor has recently had communication from Lt. Col. A. (Alex) W. Laing who wishes to be remembered by his friends and associates in Papua New Guinea.

"As you can see I am now ensconsed ? in the Embassy in Jakarta and attempting to take over from Graeme Arman and Mick Larmer - actually I'm attached to the Indonesian Army Survey Corps as an adviser. You might pass on to anybody who visits here that I'm in the Embassy (Ext. 64) as I maybe of use to them as I have ready access to most Trig data etc. in the country. My address for the next two years is

Lt. Col. A.W. Laing
Australian Embassy
JL THAMRIN 15
JAKARTA, INDONESIA.

My regards to all in Lae."

The Journal of the A.S.P.N.G., March 1976, Vol. 6, No. 1

The DH-1 has a computer built into the control unit. This makes it possible to set the vertical angle on the control unit and then display directly either slope distance, horizontal distance or difference in elevation. (option)

The SOKKISHA DISTANCE METER comes complete with triple prism, interface to tribrach, tribrach, battery, recharger unit and range pole. * Immediate Delivery *

All up price is K5995

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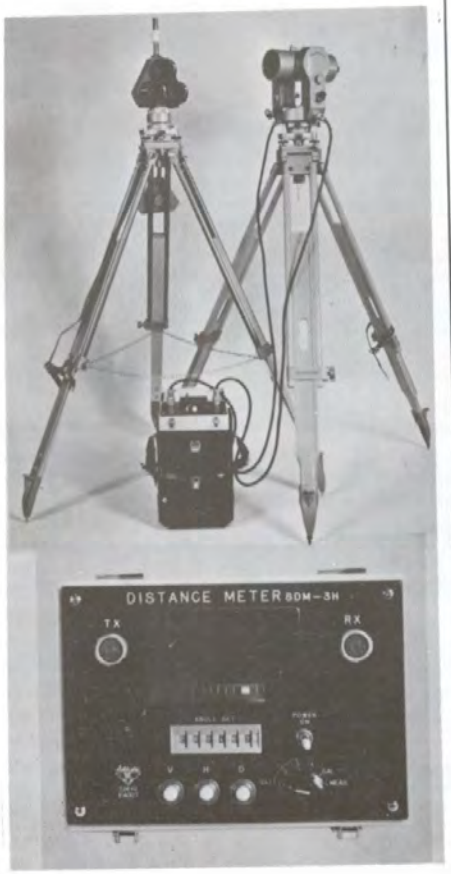

SPECIFICATIONS SDM-3C

DISTANCE MEASUREMENT

Measuring range:	up to 1,000m with 1 retroprism in excess of 1,600m with 3 retroprisms
These ranges vary according to atmospheric conditions.	
Accuracy:	$\pm$ (5mm + 5 x 10^{-6}D)
Measuring time:	4 seconds
Read out:	Digital 6 digits reading directly up to 999.999m
Light source:	Infrared Light Emitting Diode
Power supply:	Ni-Cd rechargeable battery pack This provides 3 hours continual operation at 20°C (68°F), approximately 1,000 measurements.
Operating temperature range:	−10°C to 50°C (14°F to 122°F)

ANGLE MEASUREMENT

Telescope:	
Length	290mm
Objective aperture	35mm (90mm including transceiver)
Image	Erect
Magnification	20 X
Resolving power	4"
Field of view	1° 20'
Minimum focus	8m
Stadia ratio	1 : 100
Additional constant	0
Horizontal Circle:	
Diameter	92mm
Graduation	20' (1g)
Micrometer reading	10" (50cc)
Estimation	1" (5cc)
Vertical Circle:	
Diameter	90mm
Graduation	20' (1g)
Micrometer reading	10" (50cc)
Estimation	1" (5cc)
Level Vials:	
Sensitivity of circular level	10'/2mm
Sensitivity of plate level	40"/2mm
Sensitivity of telescope level	30"/2mm
Optical plummet:	
Magnification	2 X, Erect image

Weight of instrument: 9.1 kg

Control unit complete with battery: 8.0 kg

RETROPRISM

Type:
Precision ground corner cube retroprism

Aperture: 72mm clear

Constant: 30mm

Maximum divergence: ±2"

AGA

GEODIMETER - MODEL 710

NEW FEATURES.

The MODEL 710 is a development of the MODEL 700. The new instrument gives a continuous indication of ***Height difference (ΔH) and of horizontal distance,*** slope distance, vertical angle, horizontal angle automatically in digital form ***up to 4.8 Km,*** to one second of arc and 5 mm accuracy. Under favourable conditions the MODEL 710 ***will measure up to 9 Km.*** The 710 has a lightweight fibreglass transport case and a continuous power supply.

APPLICATIONS.

Any survey, big or small, viz:- all setting out work, all traversing; construction work; urban and rural subdivisions; detail surveys; breaking down triangulation nets; supplementing cartographic work; trigonometric height measurments; underground measurements in mines and tunnels; photo control; Tacheometry, etc.

WITHOUT AUTOMATIC RECORDER.

The MODEL 710 is available with or without automatic recorder for collection of data or observations. The 710 can be used for all phases of subdivision work. Picking up detail and contouring for design purposes can be completed in ⅓th the time required by a conventional theodolite with attached distance meter. Similarly traversing is completed in ½ the time and setting out in ⅓rd of the time. From the control points, the surround boundaries can be redefined, detail and contouring completed, road centrelines and angle points in the subdivision can be pegged and levelled. ***160 points*** can be set-out in one day. Once the subdivision and control is co-ordinated, the 710 can be set up ***anywhere*** on the subdivision and the unknown instrument station co-ordinated three dimensonally in three minutes by resection. This technique of "random set-up" can be used on many surveys. Three dimensional setting-out can be performed on construction sites. With the target height at the same height as the instrument the difference in level is immediately displayed

WITH AUTOMATIC RECORDER.

The GEODAT 700 punch tape is attached to the MODEL 710 and used to record and code all observations. With the GEODAT 700 punch tape comes the GEOCLEAN program which reduces, cross-checks and lists the punched information under station numbers in polar co-ordinate form. Some examples:-

1. A punch tape containing ***500 observations for contouring*** can be read and reduced ready for plotting ***in 3 minutes.*** A plot of the 500 observations can be automatically plotted in 30 minutes. This includes time required to specify points, e.g. type of tree and diameter. Contour intervals, not normally obtainable by photogrammetric methods are obtained, apart from being cheaper, more convenient and quicker. ***Over 600 observations*** can be recorded in a day.
2. **Cross sections** can be punched, reduced and plotted, and earthworks quantities produced very quickly.
3. **Terrain models** can be stored for future mass calculations and can be compiled quickly and inexpensively and updated at any time.
4. The horizontal distance and bearing displayed by the 710 can keep up with an object moving at 37 Km/hour (23 mph) so it is ideal for ***hydrographic work*** and saves time consuming intersections and plotting.

For demonstrations and further information on applications, please contact AGA or any of AGA's interstate agents.
The Model 700 geodimeter is still available at special prices.

THE MODEL 710 CHANGES WEEKS TO DAYS AND DAYS TO HOURS.

AGA2355

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