THE JOURNAL
of the
Association of Surveyors
of Papua New Guinea

VOL. 10 DECEMBER AND MARCH 1981 NOS. 4 & 5

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The Journal

OF THE
ASSOCIATION OF SURVEYORS OF PAPUA NEW GUINEA

VOL. 10 DECEMBER AND MARCH 1981 NOS. 4 & 5

Editor
Geoff Bebb

INDEX PAGE

Editorial

It's time that the profession in PNG took stock of just where it stands on the issue of the education and training of young surveyors - particularly practical training. The practical year of the current University course stands in danger of falling into disrepute by virtue of the hypocritical thinking of members of the profession.

The University offers a facility which is quite unique in these parts of the world - a practical year in mid course aimed at providing thorough practical training of undergraduates in an on-the-job environment The original purpose of the Practical Year was to offset criticism usually levelled at University courses; that the graduates lack practical good sense.

What a great idea! In addition to working on real projects the practical year students also have to complete a minimum of 7 tasks which the University uses to evaluate the students progress during the year. It all sounds so good.

But in reality we find students working without adequate supervision - supervisors taking no interest in the students' performance - accepting work which is below standard and giving students advice which is quite incorrect.

Of course there are exceptions. Some of the supervisors take their responsibilities seriously and do a good job of practical training. But a distressingly large % - nearly 30% of this year's supervisors are failing in their duty.

What is to be done? The profession must make up its collective mind. Is practical training the province of the profession or not. If it <u>is</u>, and I strongly advocate it, then everyone from Surveyor General to the most recent graduate - must be prepared to play an honest part in the practical training of young surveyors. If we don't all do our bit, the country will reap the inevitable harvest of shoddy work in the future.

HYDROGRAPHIC CHARTING BY SATELLITE SENSING: APPROPRIATE TECHNOLOGY FOR PAPUA NEW GUINEA

by

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ABSTRACT

Papua New Guinea needs up-to-date and reliable hydrographic charts of its ocean area. As conventional charting methods are slow, hazardous and expensive, data from an alternative technology, that of satellite sensing, can be utilised to assist in meeting the charting needs. Satellite sensing is also appropriate technology for Papua New Guinea as it is cost effective and beneficial, and within the limits of reasonable technical advancement for a developing country.

INTRODUCTION

1. Satellite sensing of the ocean is a method of acquiring data on the features above and below (to a depth of approximately 20 metres) sea level from measurements made without coming into physical contact with those features. The sensing is done from approximately 920 km above the ocean's surface in contrast to the lower altitudes of other methods such as aerial photography and airborne radar sensing, and the ocean surface methods of shipborne acoustic and radar profiling. Hydrographic charting by satellite sensing has been used in various parts of the world and has been well documented. This article will concentrate on discussing its appropriateness as a technology for Papua New Guinea.

2. What is meant by appropriate technology? Appropriate is a value judgement and is therefore open to interpretation and difficult to define. The term technology, however, is more definable and can be considered "a technical

method or capability for achieving a practical purpose"; or as a "methodology or system for employment of tools (or process) to accomplish some task or create some product" (Wagner, 1979). Satellite sensing and the processing of its data could be considered a "high technology" and, by inference, inappropriate for Papua New Guinea in its present state of development. To be appropriate, technology must significantly contribute to the national economic development or to the planning and monitoring of such development (Wagner, 1979). Satellite data can be used to achieve these objectives.

THE STATUS OF HYDROGRAPHIC CHARTING IN PAPUA NEW GUINEA

3. The ocean area within Papua New Guinea's EEZ is covered with charts varying from scales of 1:1,700,000 to 1:12,500, the latter for harbours and channel approaches. For general navigation 1:300,000 charts are adequate while 1:100,000 charts are more appropriate for coastal navigation. Table 1 lists the chart covereage within Papua New Guinea's EEZ and the portion of surveyed area on charts of particular scale. Many of the surveyed areas are based on incomplete, erroneous or dated information. Of the 2,339,900 Km ocean area only a 701,970 Km area is covered by a scale suitable for navigation, of which 528,580 Km is surveyed, and much of this area needs to be resurveyed or the existing data verified.

COVERAGE OF PAPUA NEW GUINEA'S EEZ

SCALE	COVERAGE OF OCEAN AREA	% OF SURVEYED AREA OF COVERAGE	OCEAN AREA NOT COVERED BY CHARTS OF LARGER SCALE
1: 12,500 - 1: 75,000	1%	83%	1%
1: 100,000 - 1: 150,000	4%	69%	3%
1: 250,000 - 1: 300,000	25%	76%	21%
1: 750,000 - 1:1,000,000	80%	79%	55%
1:1,700,000 and smaller	100%	N/A	20%

TABLE 1

4. The Royal Australian Navy (RAN) is still the recognised charting authority for Papua New Guinea waters but, since the requirement for updating Australian national waters has become more demanding, has very little time to spend working in Papua New Guinea's ocean area. The Navy's Hydroscheme 80, their planned activities for 1980 - 1984, does not include any surveys in Papua New Guinea's ocean area. Hence the Papua New Guinea Government's Hydrographic section, having an extremely limited surveying capacity, has to rely on expensive foreign private contract surveys to fulfil their charting needs (Lloyd, 1979 a and b). This has meant that the expertise involved with the contract charting is retained by the contractor and lost to Papua New Guinea, and the financial burden to the country is greater than necessary. Consequently there is little prospect of Papua New Guinea being able to achieve adequate up-to-date hydrographic chart coverage in the near future using conventional surveying methods.

SATELLITE SENSING OF HYDROGRAPHIC DETAIL: AN APPROPRIATE TECHNOLOGICAL SOLUTION

5. As a developing country with limited resources, Papua New Guinea needs to benefit economically from the product of an introduced technology as well as technically to contribute to continuous stable national growth. Hence, any new introduced technology must be adaptable to local conditions, be labour intensive and capital saving, provide a useful product, and ultimately benefit the majority of the people.

6. There is no requirement for adaption on satellite technology to local conditions as there is no involvement with the sensing equipment or its operations. Involvement is confined to the data produced from the satellite sensing, and this can be acquired in a usable state in readiness for interpretation or manipulation. The acquisition of some minor equipment and software (for the major existing computers in Papua New Guinea) will further increase the capability to utilise the satellite data. These items are readily available and minimal training is required for their effective use.

7. There are two main labour intensive areas stemming from satellite sensed data. The first is the manipulation and interpretation of the masses of data which is in the form of an image scene or computer compatible tapes (each one containing the data of one scene). Each image is approximately 185 Km x 185 Km with information being detected in every 79m x 79m area. The second area is in the production of charts. Much of the data is available now, except for areas of the data obscured by cloud, complete coverage of the ocean area will be available every 18 days once the Australian Landsat station is fully operational and has extended its acquisitional zone. Labour is required to convert this data into hydrographic charts or use it to check existing information. Once this is done the expertise is retained to continue in hydrographic charting aspects, or to be employed in other endeavours supported by satellite sensing.

8. Satellite charting does not replace the shipborne survey methods but is valuable in reducing the dependence on this slow, hazardous and expensive method. This is done by producing a preliminary survey over a wide area, especially in remote localities, allowing for effective task planning and execution. Sparsely surveyed areas can also be completed using satellite data, reducing the need for intensive surface activities. A third benefit is as a continuous monitor and updating tool, especially in remote areas. This data is also useful for bridging large gaps of featureless water to islands, reefs and shoals, of which there are many around Papua New Guinea. Also, where hydrographic survey ships are unable to navigate close inshore and over reefs and shoals, satellite data is particularly useful in depth detection and deliniation of these below surface features.

9. Using satellite technology to chart in remote areas reduces the considerable costs and lost time involved in transit to and from those regions. Large time and cost savings can also be made in the preparation of coastal charts where it has been estimated that the ratio of data acquisition costs to processing costs with ship borne methods is 5-to-1. Consequently, great savings are realizable in the acquisitional process if cheap satellite data can be used (Warne, 1977).

10. Estimated hydrographic data collection costs for satellite data in the 1974/75 period was approximately K0.40 per square kilometer compared with K5.50 for conventional techniques (Warne, 1977), (Polcyn and Lyzenga, 1975) and (Smith et al, 1975). It was also found that one satellite trial bathymetric map costing K380 was almost as useful as a K38,000 hydrographic chart prepared by orthodox means (CSIRO, 1977).

11. In assessing satellite charting as appropriate technology the raw costs cannot be considered alone as the 'economics' of the information is in two parts, namely costs and benefits. The broad benefits can be readily stated but are more difficult to determine in terms of direct economic and social advantages for the majority of the people. The difficulty causes the justification of a technology by comparing the costs of alternative methods of achieving the same results (Watkins, 1978). This is a cost-effective analysis whereas an appropriate technology should be assessed on a cost-benefit analysis, at least in the initial stage in a developing country. If the satellite sensed data is used wisely, and not as data for automated cartography, then satellite technology can be cost-beneficial in Papua New Guinea's situation.

12. As with any "high technology" there are of course aspects which limit their usefulness. Satellite data suffers from a limited spatial resolution, cannot be used to achieve a stereoscopic image, is susceptible to cloud cover, and is not as accurate as conventional charting methods. Progress is being made to improve the spatial resolution and other problems. For example, the U.S. Geological Survey has retained consultants to perform a conceptual design study for a mapping satellite (Mapsat) capable of acquiring stereo multispectral Earth images (NASA, 1980).

THE PRESENT AND THE FUTURE

13. For developing countries such as Papua New Guinea there is an AID grant programme to provide assistance in purchasing equipment and for travel to

improve their remote sensing skills. Funds are also available for training resource managers, developing a training centre, and conducting a demonstration project to show how the technology works (Paul, 1978).

14. With the launching of Landsat D in 1981 (with the anticipated production of its 'improved' data) and improved data handling capabilities, it is anticipated there will be a greater demand for satellite products (Spann, 1979). In 1977 more than 110 countries were participating in satellite sensing activities, and it was found that "many developing countires are using remote sensing data in a much wider range of problem areas than those of the more developed countries" (Spann, 1979). With continued improvements in data usefulness many more diciplines will be able to utilize the satellite products improving the useful effectiveness of this technology, especially in relation to cost. This alone may demonstrate that satellite sensing may be an appropriate technology for Papua New Guinea.

CONCLUSIONS

15. Papua New Guinea is faced with a rather grim outloook as huge areas await modern and consistent survey by, unfortunately, a large amount of surveying years. There must be a solution based on a cost/time/reliability basis. In the short term the cost and time factors are important to obtain complete up-to-date chart coverage. Economically planned more accurate shipborne surveys of specific areas can be conducted when economically feasible or necessary. As a developing country there is great potential for any cheap but suitably reliable hydrographic information such as that provided by satellite sensing. The need for up-to-date data, the cost-benefit aspects, and the level of the technology, makes the utilisation of satellite sensed data both timely and appropriate.

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THE ASSOCIATION OF SURVEYORS OF PAPUA NEW GUINEA

16TH SURVEY CONGRESS

SURVEY TRAINING AND TECHNOLOGY IN THE SOUTH PACIFIC

LAE 7TH - 11TH SEPTEMBER 1981

PROGRAMME

Monday 7th
- Day - Arrival of delegates and registration
- Evening - Opening ceremony and President's Cocktail Party

Tuesday 8th
- Day - Technical sessions all day
- Evening - Home entertainment

Wednesday 9th
- Day - AM Technical sessions. PM Technical Tours
- Evening - Annual Dinner

Thursday 10th
- Day - Technical sessions all day
- Evening - Free

Friday 11th
- Day - Annual General Meeting for members (Tour for visitors)
- Evening - Farewell Mu-Mu

LADIES

A full ladies programme is planned to compliment the evening social events.

FEES

Double	K100	Single	K70
Technical sessions	K 25	Students	K10

Guests to any social function K20 per function

ACCOMMODATION

Double	K 47	Single	K34
Continental Breakfast	K 3.75	Full Breakfast	K 4.75

It would be appreciated if intending delegates would return the attached Registration Form to the Congress Secretary as soon as possible.

Congress Secretary
P.O. Box 1896
LAE
PAPUA NEW GUINEA

16th Survey Congress Lae 7th - 11th September 1981

REGISTRATION FORM

Name..Accompanying............

Address...

....Telephone...............

Type of Registration:

Double..........Single...........Technical..........Student.............

Accommodation Requirements:

Double.............Single.............

When arriving in Lae:

Date.................Time.............

Departure:

Date.................Time.............

PERSONAL NOTES

Ian Sparkes has gone finish to Sydney where he has joined that well known aerobatics group QASCO. Ian had a tear in his eye as he left, but he has a son Jeremy in his formative years and Ian reckoned he should be close by for a few years.

Selan Panbuai bought a new colt (the motor vehicle variety) last year and really gets his moneys worth out of it. Despite frequent bush trips he still manages to log up more kilometres when in Port Moresby than the rest of the A & L fleet combined.

Kila Obaha is just the reverse. He gets a PMV to work these days, as since he got into the transport business 3 or 4 years ago he realizes that there is more money in hiring vehicles out than driving them yourself.

Des McNee and family only had about six months in Lae and were barely unpacked when Des was transferred to Port Moresby to fill the gap left by the Sparkler. Its even been wet for them to remind them of Lae.

Mick Larmer still gives his address as Tonaguba Hill but is now in his third different abode on that once barren rock. Watkins are building him another house a few hundred metres around from where he is now but Dianne assures us that this will be the fourth and last move.

Seen at the Congress in Sydney - Roger Machin sporting a HP9835 computer AND a wife of 6 months. Says he will be back for a visit in August/September.

Norm Leet's computer programs worked very well at the Post Graduate Diploma Course on Survey Examination. Are Cannon secretly negotiating with him as his contract draws to a close?

In his typical unselfish fashion, Mick Larmer donated the use of his MRA101's to Unitech for the 5th Year Survey Camp.

An old campaigner from PNG, Bruce Forster gave a paper at the Sydney Congress on the use of Landsat in determining land values. Raised a few eyebrows and a few hackles too.

Annual Subscriptions Due

All members are reminded that the fees for the current year are now due. Prompt payment ensures that your interests can be protected.

Scale of Fees

In line with the latest movement in the C.P.I., the multiplying factor to the Scale of Fees is now altered to 1.90. Effective 1.3.81.

New Fellow of the Association

In accordance with Clause 17 of the Association's Constitution, Mr. M.J. Larmer has been elevated to the position of Fellow of the Association. All members will join us in sending their hearty congratulations to Mick. No one works harder for the Association and the profession, no one is a keener supporter of young graduate surveyors.

Nice to see hard work rewarded.

SLOPE EVALUATION ON AERIAL PHOTOGRAPHS

by

G.S. Vatasan, R.N. Vatasan and Y Bun

1. INTRODUCTION

For the land manager the slope of the terrain represents one of the most important criteria in deciding on the future land use as well as on the technical measures necessary to sustain that use.

Certain slopes limit the use of particular agricultural machinery, increased slope makes forest logging difficult or downright dangerous, the risk of landslides depends to a large extent on the slope of the terrain.

Aerial photographs provide a wealth of information for land management purposes, as for instance the present land use pattern, vegetation types and state of the vegetation cover, human activities in the past and present, etc.

It is only natural then for the persons using aerial photographs to try and measure the slope of the ground using the same photographs from which so much information can be gathered.

However, the determination, even approximate of the terrain slope from aerial photographs using simple and cheap instruments is not easy and the examination of stereoscopic pairs of aerial photographs can be very misleading with regard to the slope for the unwary observer, due to the exaggeration of relief caused by the very large base line.

While the measurement of ground slope can readily be done with the help of 1st or 2nd order plotters, its determination or even its estimation with reasonable accuracy using simpler instruments, poses quite a few problems, proof the large number of solutions, apparatus and templets which have been devised over the years.

2. THE GROUND SLOPE ON AERIAL PHOTOGRAPHS

While some information about the terrain slope can be gathered under certain circumstances, from single aerial photographs, only the stereoscopic examination of pairs of photographs provides the necessary optical model on which the slopes can actually be measured.

The apparent terrain slope on the stereoscopic model depends on the following parameters:

- The actual slope of the terrain
- The focal length of the camera lens
- The distance "B" between the two camera stations
- The height of flight above the ground.

The effect of all these factors contribute to make that terrain slope in one place appear totally different on pairs of photographs taken at different times. Also, the terrain slope is always exaggerated on aerial photographs compared with what one perceives with the naked eye from an aircraft.

Obviously these factors have to be taken into account when measuring the ground slope on aerial photographs.

In fact, the exaggeration of relief on sterescopic pairs of aerial photographs helps in increasing the accuracy of slope measurement, making it possible to use with reasonable confidence some very simple methods.

3. METHODS OF SLOPE MEASUREMENTS FROM AERIAL PHOTOGRAPHS

The methods of slope measurements from aerial photographs can be divided in three classes (Turner 1977):

- Methods based on parallax measurement
- Graphical methods
- Comparative methods.

As it is not the objective of this paper to evaluate all the methods, only an outline of their principles will be given.

3.1 Methods Based on Direct Parallax Measurement:

These methods represent the standard approach to slope determination. With the help of parallax measurement, the level difference between two points on the slope is determined.

This level difference divided by the horizontal distance between the two points gives the tangent of the slope angle.

The parallax differences can be measured with the help of the stereometric bar or of various templets like the "ITC Templet" or the "Hand Templet".

3.2 Graphical Methods:

In these methods the slope is obtained with the help of geometric constructions, usually done on tracing paper over the photographs. They do not involve any apparatus except the usual drawing utensils. Generally, these methods are quite inaccurate with the exception of the Eliott Method, which could be used by people with impaired stereoscopic vision (Turner, 1977).

3.3 Comparative Methods:

These methods are based on the comparison of the apparent ground slope seen on the stereoscopic model, with a sloping plane or line artificially created by the instrument.

There are a number of instruments based on comparative methods, from the fairly sophisticated "Stereo Slope Comparator" and the "Stereo Slope Meter" to simple "estimators" like the "Brundal and Harder Estimator" and the "ITC Estimator" (Turner, 1977).

3.4 The Inclinometer Templates:

Of particular interest for their simplicity and ease of use are the "Inclinometer Templates" supplied with the "Twin Stereoscope T-22 Condor" by the Ushikata Mfg. Ltd. Japan.

These templets, one for the left and one for the right eye, consist of a series of circles, each divided by "radii" in eight equal sectors. On each templet the radii of successive circles intersect in points progressively more offset from their centres. When viewed stereoscopically, each templet under one eye, the circle pairs appear as inverted cones, with the "radii" now sides, progressively steeper from pair to pair, as the eccentricity of the circles increases.

The circles are calibrated for ground slopes corresponding to the apparent slope on the stereoscopic model for a given focal length of the camera lens (210mm and 150mm), and a given base length (55mm). Correction tables and/or graphs must be used to find the ground slope for other base lengths.

The practical use of the templets is extremely simple and the procedure very quick. The pair of circles producing the cone best fitting the ground slope (one of the sides "laying" on the ground) gives the slope inclination in degrees for 55mm base length and the corrected slope for the actual base length is read off the graph.

While the optical comparison between cones and ground was found to be extremely easy under the stereoscope, the correction of the measured slope angle to the angle corresponding to the actual base length was somewhat cumbersome and prone to mistakes.

In consequence a new design of the templets was adopted, whereby the actual offset of the circles is given, the left and right circles can be combined in a number of ways. The ground slope, corresponding to the sum of the left and right offsets ("dP") is then read off the graph in which the other entry is the base length of the stereoscopic pair of photographs (distance "P"). In this way any confusion and ambiguity are eliminated.

4. COMPUTATION AND DESIGN OF SLOPE CONES

The "cones" have been redesigned to provide centre offset increments, dP, of 0.5mm through different combinations of the left and right circles templates. The "cones" have a radius, l', of 10mm.

On the ground, to the distance l' on the stereo model corresponds the horizontal distance $l = l'\frac{H}{f}$, where H is the height of the camera above ground level and f is the focal distance of the lens.

5. THE SLOPE ESTIMATION WITH THE HELP OF SLOPE CONES

The procedure is as follows:

- Arrange the photographs for good stereoscopic viewing and affix them with sellotape on the desk.
- Determine "P", the distance between the two principal points of the two photographs.
- Place the RH slope cone sheet on the right hand photograph with the top pointing away from you and the LH sheet on the left hand side photograph.
- Position the "O" circle of the "Left" sheet on the area whose slope is to be measured on the left hand side photograph and the circle "1" of the "Right" sheet on the same area of the right hand side photograph. Looking through the stereoscope, an inverted cone will appear. Compare the slope of the ground on the three dimensional photographic image with the slope of the inverted cone side. If the ground appears steeper, move the Left sheet away from you to bring the circle "0.5" level with the circle "1" on the "Right" sheet. By trying a few combinations of left and right circles, the inverted cone with the sides at a slope closest to that of the ground is found.
- Add the figures opposite the left and opposite the right circles corresponding to the best fitting cone. This is the "dP" value.
- On the graph for the appropriate focal length of the camera lens, find the curve corresponding to the "dP" value for the best fitting cone. Enter the determined distance "P" on the abscise of the graph, raise a perpendicular to the selected curve and find the slope on the ordinate, opposite the curve. Note that for a pair of photographs, the distance "P" is considered constant, and can be used for a number of slope measurements. See example in Fig. 2 and graph "dP to Slope Conversion".

On the ground the slope is defined as $\tan \alpha = \frac{h}{l}$, where α is the vertical angle between the terrain and the horizontal and h is the level difference corresponding to the distance l, as in Fig. 1.

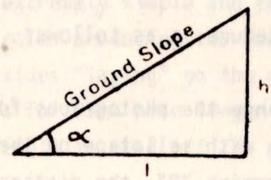


Fig. 1. Slope definition

Substituting l' for l, the slope can be expressed as $\tan \alpha = \frac{hf}{Hl'}$,

But $h = \frac{dP}{(P+dP)} H$, where dP is the parallax difference (in this case the centre offset of the "cone" equal with the sume of the left and right circles offsets) and P is the absolute parallax.

$$\text{Therefore } \tan \alpha = \frac{f\ dP}{l'(P + dP)}$$

For l'= 10mm and expressing the slope in %

$$100 \tan \alpha = \frac{10\ f\ dP}{(P + dP)}$$

On the basis of the above formula, a graph has been prepared for f = 152 mm (wide angle lens) and f = 210 mm (normal lens) and for P from 50 mm to 80 mm.

It is to be noted that the photographs taken on 70 mm film with 50 mm lens and enlarged to 230 mm x 230 mm (9" x 9") can be assimilated with those taken directly with a 210 mm lens.

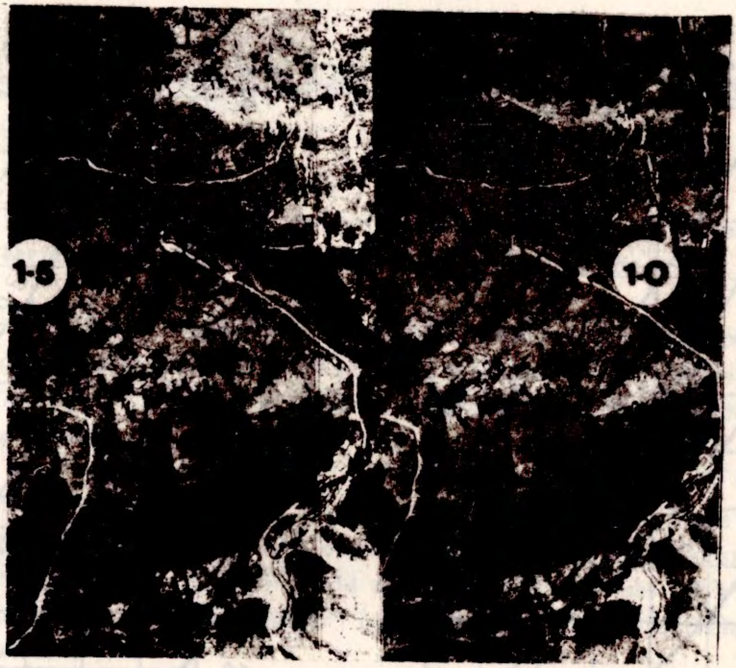
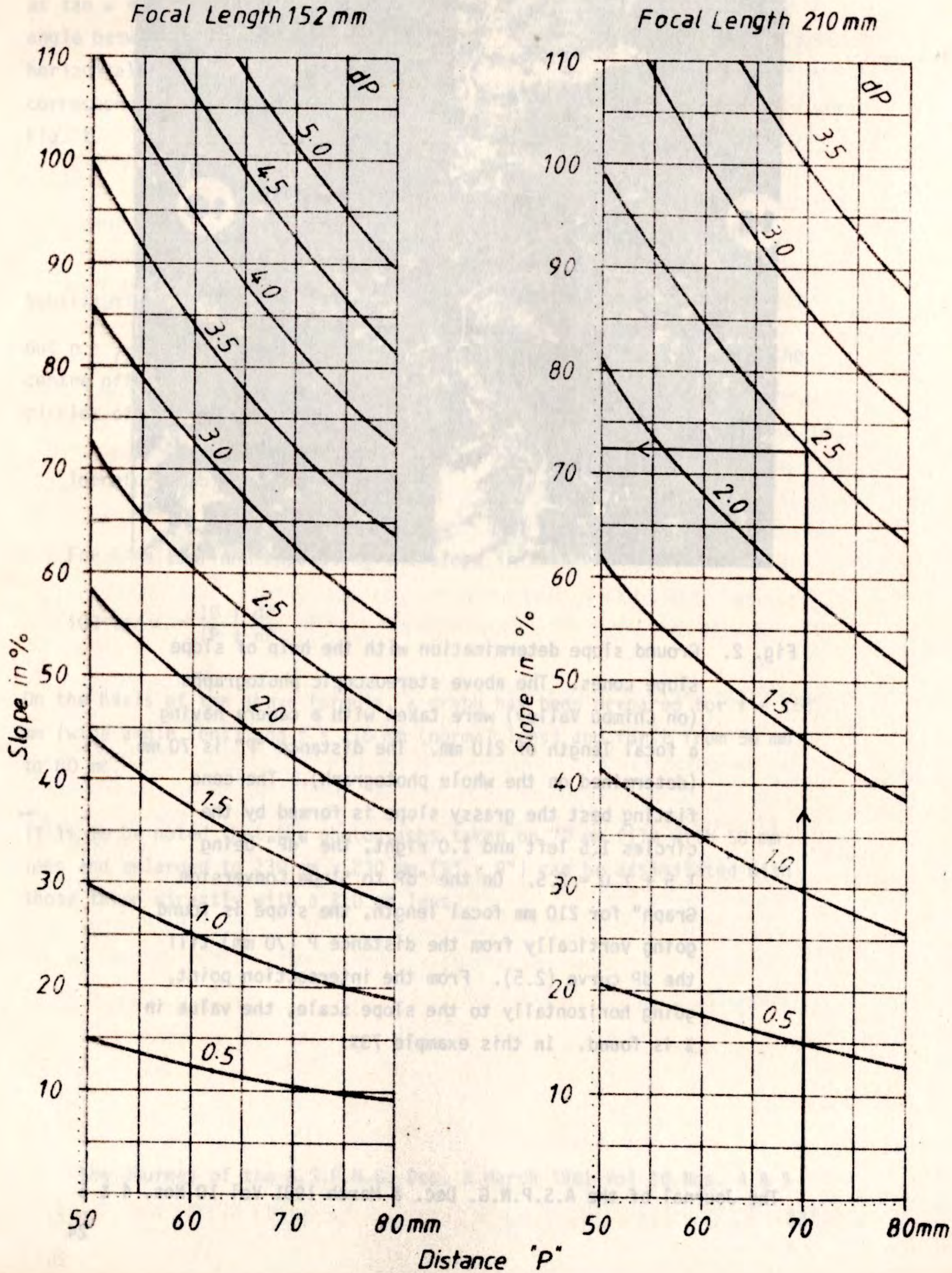


Fig. 2. Ground slope determination with the help of slope slope cones. The above stereoscopic photographs (on Chimbu Valley) were taken with a camera having a focal length of 210 mm. The distance "P" is 70 mm (determined on the whole photograph). The cone fitting best the grassy slope is formed by the circles 1.5 left and 1.0 right, the "dP" being 1.5 + 1.0 = 2.5. On the "dP to Slope Conversion Graph" for 210 mm focal length, the slope is found going vertically from the distance P (70 mm) till the dP curve (2.5). From the intersection point, going horizontally to the slope scale, the value in % is found. In this example 73%.

dP to Slope Conversion



6. LIMITATIONS AND PRECISION OF SLOPE ESTIMATION WITH THE "SLOPE CONE"

6.1 Testing the Method:

Tests were conducted to determine the ground slope in field and from aerial photographs with the purpose of evaluating the method.

Eleven lines in open land were selected on a pair of aerial photographs taken near Lae on 70 mm film, enlarged to an equivalent focal length of 210 mm with a somewhat large base distance "P" of 90 mm, and an approximate scale of 1 : 10,000.

The slope of each of the lines was estimated, using the slope cones by an experienced and by a beginner photo-interpreter. The same lines were identified in field and their slope was measured with the help of a "Suunto clinometer" (one line could not be identified and measured).

The mean square deviation between the estimation of the slope on photographs and in field expressed in % of slope was 13.2 for the beginner and 5.1 for the more experienced operator. The worst difference was 22%, under-estimation of a road cutting slope, appearing very short on the photograph.

6.2 Limitations:

The most difficult to estimate were the slopes parallel with the line of flight, on which direction the shape of the "cone" is less well defined.

On the other hand, the slope of the ground under forest cover is much easier determined on the photographs than on the ground.

Trials on smaller scale photographs have shown that it is difficult to estimate the slope of the ground using the "cones" if the scale of the photograph is below 1 : 25,000, particularly because there are few uniform slopes long enough to be compared with the cones.

7. CONCLUSIONS

The large number of methods and apparatus devised by various users of photogrammes for the purpose of slope determination (Turner, 1977), shows that there is no quick and precise solution to the problem.

However, the "slope cones" templets can provide a quick and simple method of slope estimation from large and medium scale aerial photographs if the precision of ± 5% of slope is considered sufficient, as it is generally in the case of land classification for future use, for erosion prevention or logging planning in forestry.

Note: Sets of Slope Cone Templets and "dP to Slope Concersion Graphs" can be ordered from:

The Manager
National Testing Laboratory
P.O. Box 793
LAE.

The cost (prepayment is necessary) is K2.00, and it includes postage in Papua New Guinea.

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