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OF THE

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AN ANALYSIS OF THE EFFECTS OF TEMPERATURE AND HUMIDITY ON A VARIETY OF DRAWING MEDIA

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Introduction: The need for accuracy in map production cannot be over-emphasised. Detail must be drawn in its correct planimetric position, the grid and the associated co-ordinates must be precisely plotted and colour and detail should be in perfect register if the map is to be successful as a means of graphic communication.

Achieving this type of accuracy in the tropics is made all the more difficult by the nature of the climate. High temperatures and fluctuating humidity, even inside buildings, often make working conditions uncomfortable and the effects of these conditions on different media is readily seen. Paper, in the form of maps attached to the wall for teaching purposes, starts to buckle and stretch after a very short period of time and student exercises, involving the registration of several different plates, have been rendered obsolete following distortion of one or more of the plates.

The purpose of this analysis is to investigate the effects of varying temperature and humidity, under controlled and measureable conditions, on a wide variety of media that are readily available to drawing offices throughout the tropics.

Method of Analysis: A variety of media was obtained from different manufacturers (see Appendix A): 3 samples of each medium were placed in a room (room 3) in which air conditioning was continually provided. On each sample an ink line of approximately 150 mm was drawn and all samples were left in room 3 for a period of 8 weeks: this period was intended as the standardisation period, during which all the samples would adopt a stable condition. Following this 8-week period the samples were subjected to differing environmental characteristics. One set of samples remained in room 3, one set was removed to room 2 and the third set removed to room 1. Over the next 24 days measurements were taken in each of the rooms and the length of each line recorded: all samples were then moved back to room 3, left for 7 days and a final length observed for each line. In addition to the initial and final measurement the samples in room 1 were measured twice, those in room 2 twice and those in room 3 once only.

Description of the Rooms

Room 1: This room was not equipped with an air conditioner, the windows were secured at all times and the door opened only to gain access for measurement purposes. Graph 1 shows the temperature and humidity levels measured in this room over a 5-day period.

Room 2: This room was equipped with an air conditioner which was switched on when the room was in use for normal working purposes. All windows were secured and the door opened and closed frequently through continual use of the room. Of the three rooms, room 2 was judged to be most representative of drawing offices in Papua New Guinea. Graph 2 shows the temperature and humidity levels recorded in this room over a 24-day period.

Room 3: This room was equipped with an air conditioner which was left switched on throughout the whole testing period. Windows were secured at all times and the door opened only for access for measurement purposes and for infrequent use of the room. Graph 3 shows the temperature and humidity levels recorded over a 7-day period. Room 3 was used to standardise all the samples before further measurement was undertaken.

Apparatus used: A Darton thermo-hygrograph was used to record the temperature and humidity: a central drum is rotated by a clockwork mechanism and has wrapped around it a strip of graph paper, graduated into time units. Any fluctuation in temperature or humidity is transmitted to the graph paper by means of marker points. A continuous graph can therefore be obtained for any 24 hour period. (See Figure 1). A Beck vernier microscope was used to measure the lengths of the lines. Provided with a vernier attachment, this instrument made it possible to measure lengths to 0.01 mm.

Medium	Initial measurement in room 3 under standardised conditions (1)	1st measurement in room 1 (2)	% change 1 - 2	2nd measurement in room 1 (3)	% change 1 - 3	final measurement in room 3 (4)	% change 1 - 4
DEP drafting foil 0.007 MP	150.86	151.09	+0.152	151.11	+0.166	151.06	+0.133
Cronaflex UC - 4/7	151.57	151.67	+0.066	151.63	+0.040	151.40	-0.112
Cronaflex UC4	151.62	151.71	+0.059	151.68	+0.040	151.58	-0.026
Cronaflex M - IDF	151.70	151.95	+0.165	151.87	+0.112	151.79	+0.059
Cronaflex UC - 7	152.08	151.08	-	152.10	+0.013	152.06	-0.013
Dupont Crovex MI - DF	151.92	152.08	+0.105	152.14	+0.154	151.95	+0.020
Dupont Crovex M2 - DF	151.21	151.37	+0.106	151.38	+0.112	151.21	-
Albanene tracing paper	150.88	151.34	+0.305	151.44	+0.371	150.81	-0.046
Crystalene tracing paper 109155	151.24	151.89	+0.430	151.82	+0.383	151.24	-
K and E 441077	151.86	151.94	+0.053	151.89	+0.020	151.93	+0.046
Croves	151.74	151.76.	+0.013	151.72	-0.013	151.69	-0.033
Velvetex 0.003 double matt	150.95	151.09	+0.093	151.13	+0.119	150.98	+0.020
Ethulon	152.14	152.74	+0.394	152.70	+0.368	152.18	+0.026
Cobex	151.86	151.94	+0.053	151.90	+0.026	151.86	-

TABLE 2 MEASUREMENTS RECORDED FROM SAMPLES IN ROOM 2. THIS ROOM CONTAINED AN AIR CONDITIONER WHICH WAS IN OPERATION DURING WORKING HOURS. WINDOWS WERE KEPT CLOSED AND DOOR OPENED FREQUENTLY THROUGH CONTINUAL USE OF THE ROOM. ALL LENGTHS ARE EXPRESSED IN MM.

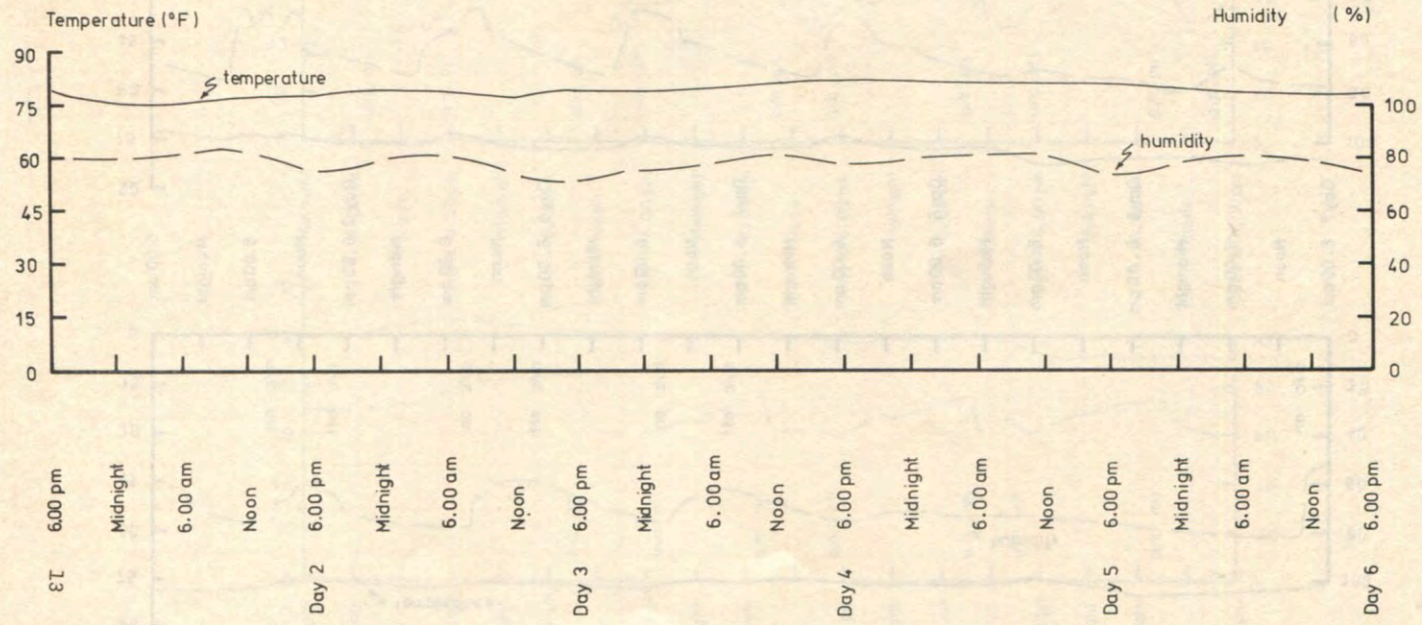
Medium	Initial measurement in room 3 under standardised conditions (1)	1st measurement in room 2 (2)	% change 1 - 2	2nd measurement in room 2 (3)	% change 1 - 3	final measurement in room 3 (4)	% change 1 - 4
GAF Polyester drafting film UF 1003	151.18	151.32	+0.093	151.28	+0.066	151.29	+0.073
GAF UF 2002 0.002	151.64	151.76	+0.079	151.59	-0.033	151.59	-0.033
GAF UF 2003 0.08MM	151.66	151.68	+0.013	151.68	+0.013	151.54	-0.079
GAF UF 2005	151.51	151.62	+0.073	151.50	-0.007	151.56	+0.033
GAF Tracing paper No.110 S	151.00	151.50	+0.331	151.33	+0.219	151.18	+0.119
GAF Tracing paper No.309 M	151.35	151.66	+0.205	151.38	+0.020	151.26	-0.059
GAF Detail paper No. 300	150.95	151.20	+0.166	151.09	+0.093	150.94	-0.007
GAF Tracing paper No.520 S	150.93	152.00	+0.709	151.34	+0.272	150.96	+0.020
GAF Tracing paper No.307 S	150.79	151.13	+0.225	150.93	+0.093	150.80	+0.007
GAF Tracing paper No.309 S	152.67	153.00	+0.216	152.77	+0.066	152.58	-0.059
GAF Cartridge paper No.475 K	150.83	151.30	+0.312	151.08	+0.166	151.06	+0.152
GAF, Alphadraft	151.00	151.29	+0.192	151.16	+0.106	151.08	+0.053
GAF imperial tracing cloth (ink)	151.14	151.29	+0.099	151.18	+0.026	151.15	+0.007
Ozalar D drafting film: double matt 0.002 H 0322	151.45	151.67	+0.145	151.57	+0.079	151.56	+0.073
Ozalar thru-matt 0.002 H 03F2	151.24	151.33	+0.060	151.28	+0.026	151.22	-0.013

Medium	Initial measurement in room 3 under standardised conditions (1)	1st measurement in room 2 (2)	% change 1 - 2	2nd measurement in room 2 (3)	% change 1 - 3	final measurement in room 3 (4)	% change 1 - 4
Reprolar D drafting film: double matt 0.0015 H 092B	150.60	150.78	+0.120	150.75	+0.100	150.68	+0.053
Ozalid thru-matt 0.002" H 0cF2	151.59	151.74	+0.099	151.68	+0.059	151.68	+0.059
Ozalid thru-matt 0.005" H 0cF5	152.23	152.32	+0.059	151.23	-	152.25	+0.013
Ozatex drafting film: double matt 0.003" H 0023	151.50	151.67	+0.112	151.60	+0.066	151.56	+0.040
Ozatex drafting film: 'p' adhesive backed opaque white 0.005" H 0615	150.95	151.08	+0.086	150.97	+0.013	150.97	+0.013
Ozatex drafting film: double matt 0.002" H 0022	150.61	150.68	+0.046	150.60	-0.007	150.58	-0.020
Ozatex drafting film: single matt 0.0075" H 0017	151.33	151.49	+0.106	151.38	+0.033	151.39	+0.040
Ozatex drafting film: double matt 0.0075" H 0027	151.45	151.50	+0.033	151.42	-0.020	151.38	-0.046
Ozatex drafting film: single matt 0.005" H 0015	150.50	150.65	+0.100	150.44	-0.040	150.42	-0.053
Ozatex thru-matt 0.005" H 0FF5	150.86	151.02	+0.106	150.95	+0.060	150.88	+0.013
Ozatex thru-matt 0.003" H 0FF3	151.50	151.67	+0.112	151.55	+0.033	151.49	-0.007
Ozatex opaque white film: 0.003" H 0513	151.36	151.44	+0.053	151.40	+0.026	151.44	+0.053
Ozatex double clear 0.004"	151.33	151.49	+0.106	151.43	+0.066	151.29	-0.026

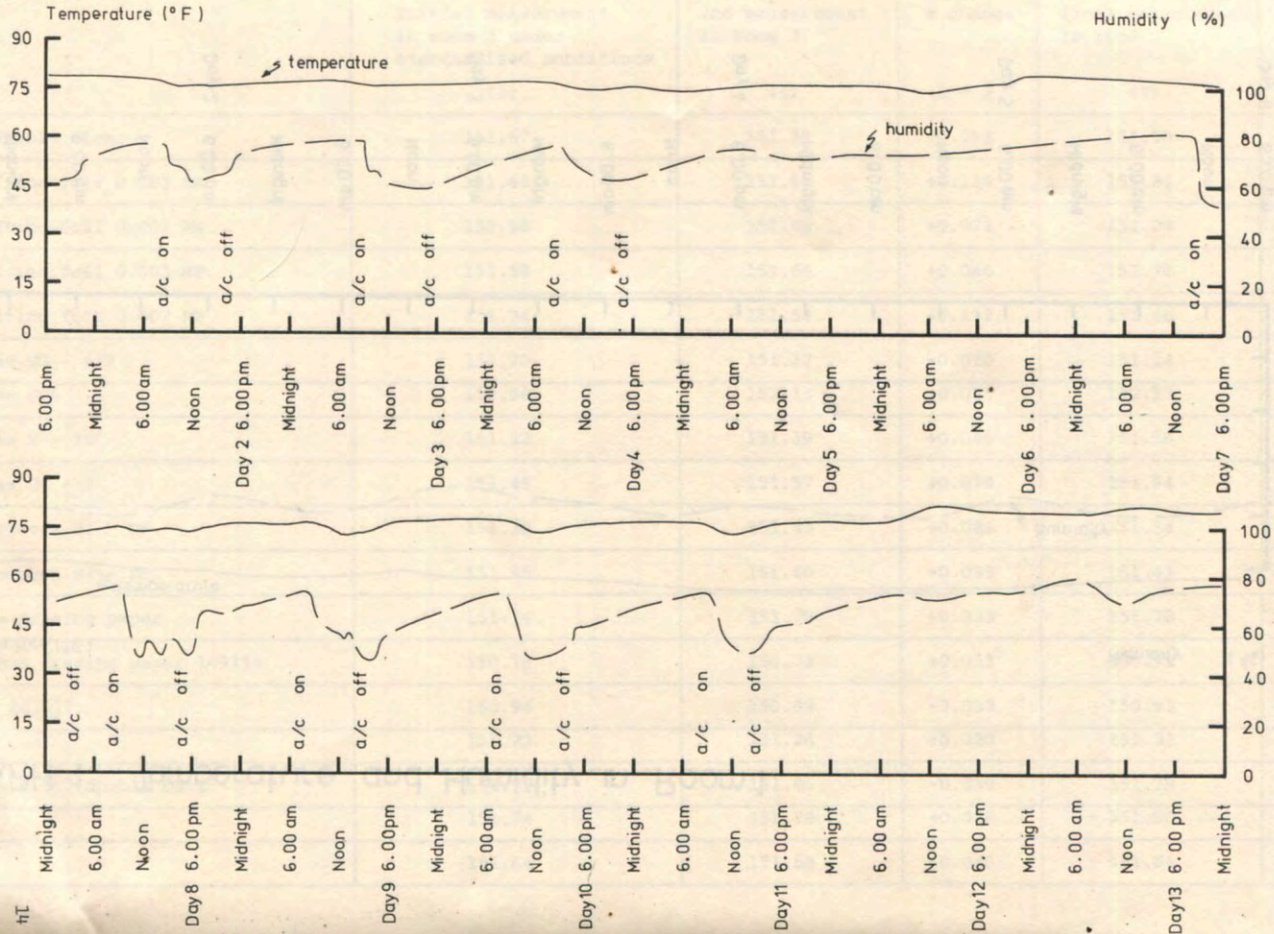
Medium	Initial measurement in room 3 under standardised conditions (1)	1st measurement in room 2 (2)	% change 1 - 2	2nd measurement in room 2 (3)	% change 1 - 3	final measurement in room 3 (4)	% change 1 - 4
DEP drafting foil 0.002 MM	151.43	151.62	+0.125	151.55	+0.079	151.43	-
DEP drafting fil 0.005 MM	151.20	151.37	+0.112	151.25	+0.033	151.29	+0.060
DEP drafting foil 0.003 MP	151.25	151.43	+0.119	151.36	+0.073	151.39	+0.093
DEP drafting foil 0.007 MP	151.10	151.29	+0.126	151.31	+0.139	151.29	+0.126
Cronaflex UC - 4/7	152.20	152.37	+0.112	152.28	+0.053	152.20	-
Cronaflex UC4	152.06	152.22	+0.105	152.07	+0.007	152.06	-
Cronaflex M - 1DF	151.44	151.59	+0.099	151.58	+0.092	151.53	+0.059
Cronaflex UC-7	152.28	152.43	+0.099	152.35	+0.046	152.30	+0.013
Dupont Crovex M1 - DF	151.76	151.94	+0.119	151.85	+0.059	151.82	+0.040
Dupont crovex M2 - DF	151.05	151.13	+0.053	151.11	+0.040	151.09	+0.026
Albanene tracing paper	152.20	152.75	+0.361	152.43	+0.151	152.24	+0.026
Crystalene tracing paper 109155	151.56	152.04	+0.317	151.84	+0.185	151.62	+0.040
K and E 441077	152.95	152.94	-0.007	152.97	+0.013	152.88	-0.046
Crovex	153.92	154.06	+0.091	153.86	-0.039	153.97	+0.032
Velvetex 0.003 double matt	152.21	152.26	+0.033	152.23	+0.013	152.18	-0.020
Ethulon	152.34	152.83	+0.322	152.57	+0.151	152.46	+0.079
Cobex	150.90	150.94	+0.027	150.94	+0.027	150.94	+0.027

Medium	Initial measurement in room 3 under standardised conditions (1)	2nd measurement in room 3 (2)	% change 1 - 2	final measurement in room 3 (3)	% change 1 - 3
Ozatex double clear	151.67	151.59	+0.053	151.59	-0.053
DEP drafting foil 0.002 MM	151.65	151.86	+0.138	151.81	+0.106
DEP drafting foil 0.005 MM	150.98	151.09	+0.073	151.09	+0.073
DEP drafting foil 0.003 MP	151.59	151.66	+0.046	151.70	+0.073
DEP drafting foil 0.007 MP	151.34	151.54	+0.132	151.48	+0.093
Cronaflex UC - 4/7	151.20	151.17	-0.020	151.14	-0.040
Cronaflex UC4	152.08	152.13	+0.033	152.13	+0.033
Cronaflex M - IDF	151.32	151.39	+0.046	151.36	+0.026
Cronaflex UC - 7	151.45	151.57	+0.079	151.54	+0.059
Dupont crovex MI - DF	151.30	151.43	+0.086	151.34	+0.026
Dupont crovex M2 - DF	151.45	151.40	-0.033	151.43	-0.013
Albanene tracing paper	151.74	151.79	+0.033	151.78	+0.026
Crystalene tracing paper 109155	150.73	150.78	+0.033	150.71	-0.013
K and E 441077	150.94	150.89	-0.033	150.91	-0.020
Crovex	151.23	151.26	+0.020	151.32	+0.060
Velvetex 0.003 double matt	151.92	151.86	-0.039	151.78	-0.092
Ethulon	151.74	151.78	+0.026	151.80	+0.040
Cobex	151.64	151.58	-0.040	151.65	+0.007

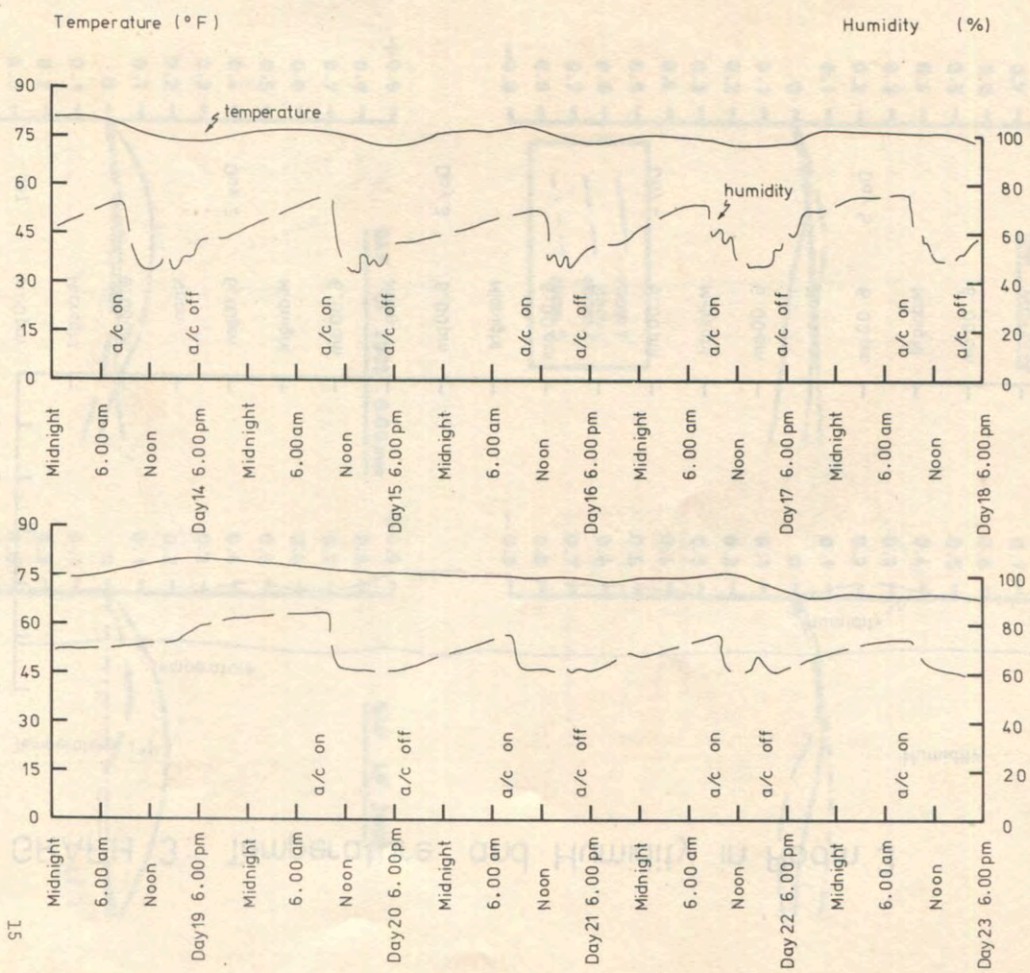
GRAPH 1: Temperature and Humidity in Room 1



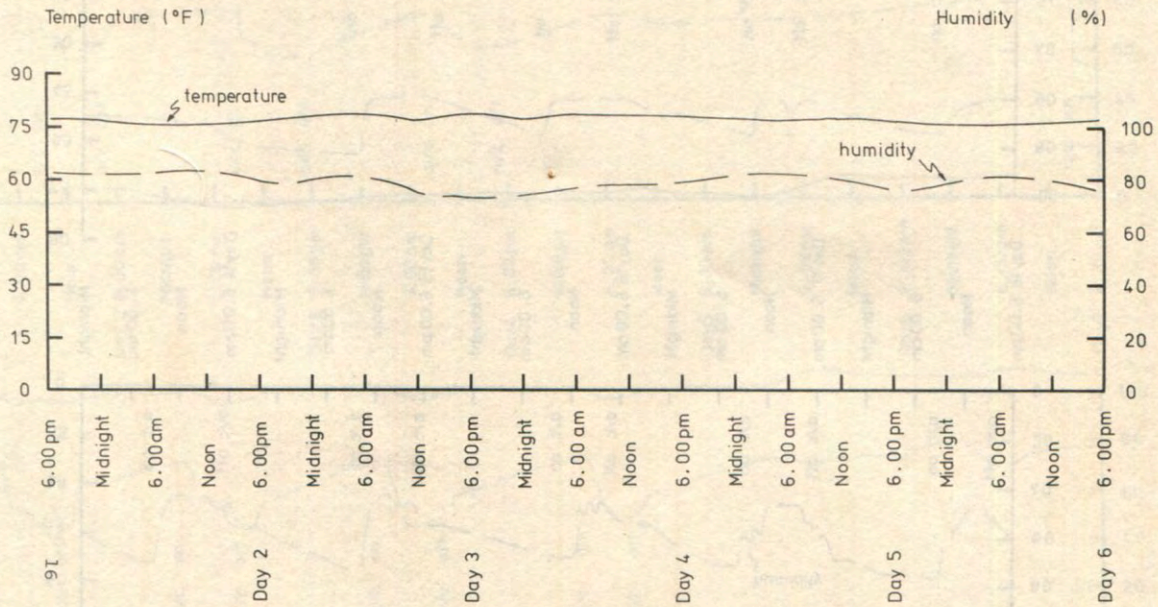
GRAPH 2: Temperature and Humidity in Room 2



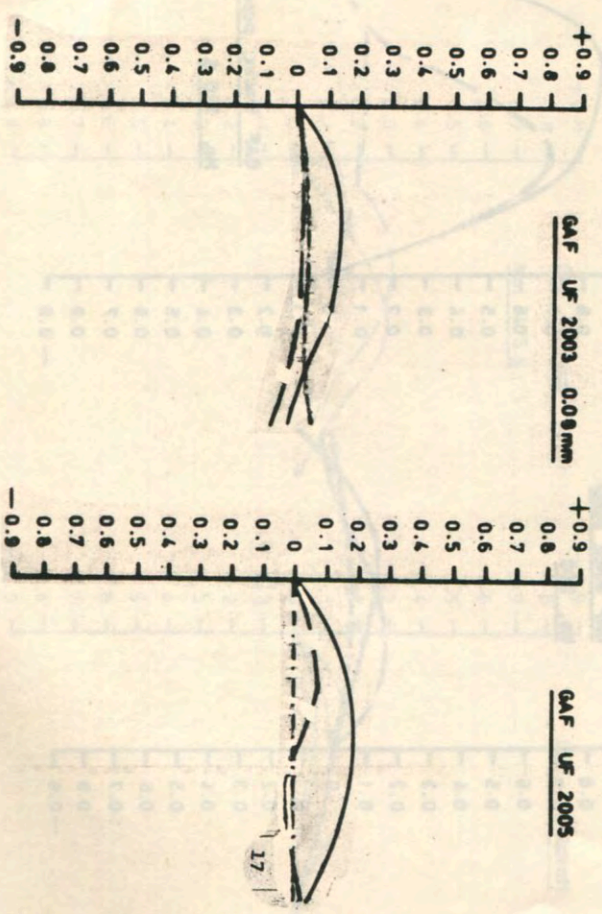
GRAPH 2: continued

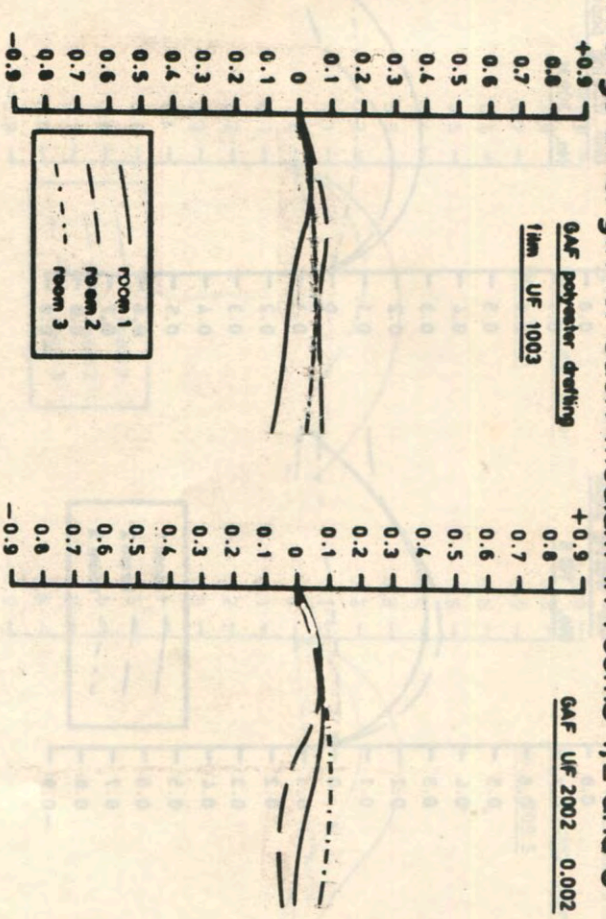


GRAPH 3: Temperature and Humidity in Room 3

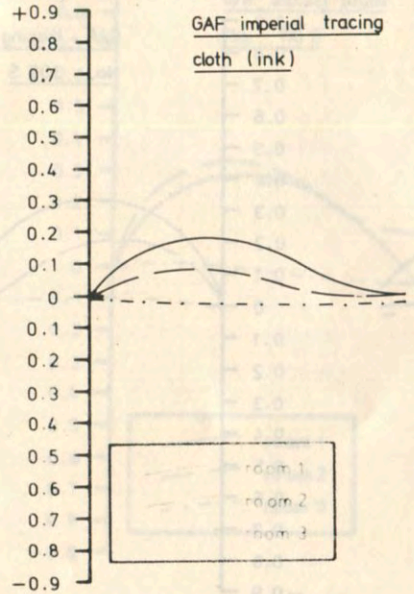


% change in length for each medium in rooms 1, 2 and 3

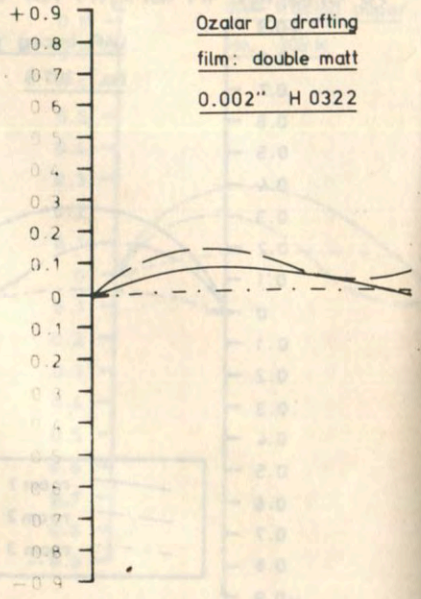




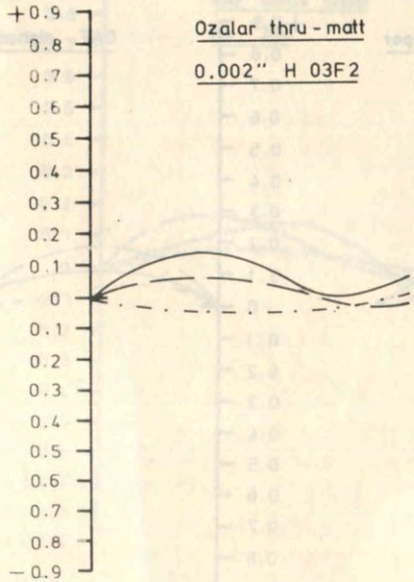
% change in length for each medium in rooms 1,2 and 3



GAF imperial tracing cloth (ink)



Ozalar D drafting film: double matt 0.002" H 0322



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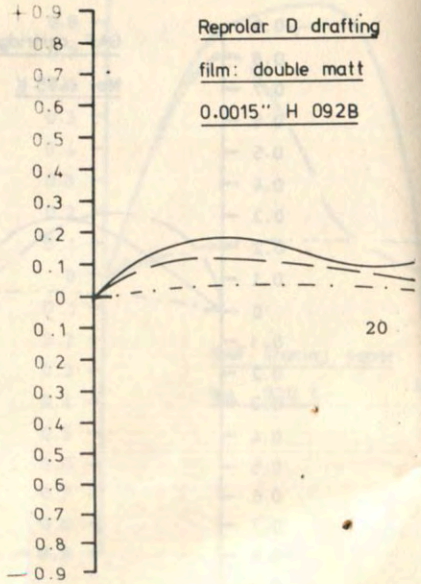

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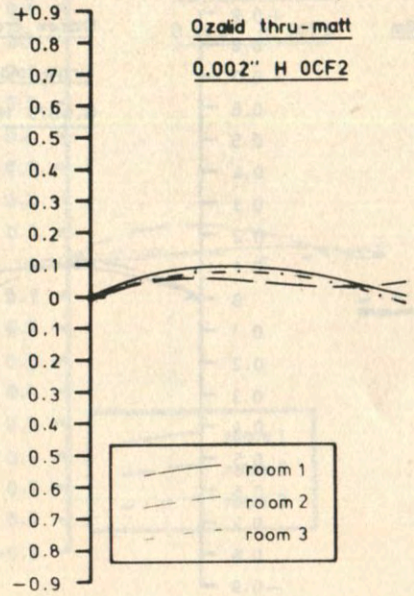
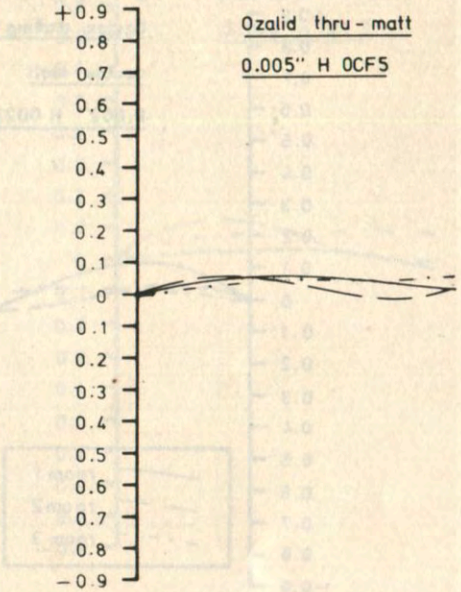
% change in length for each medium in rooms 1,2 and 3



Ozalid thru-matt 0.002" H 0CF2



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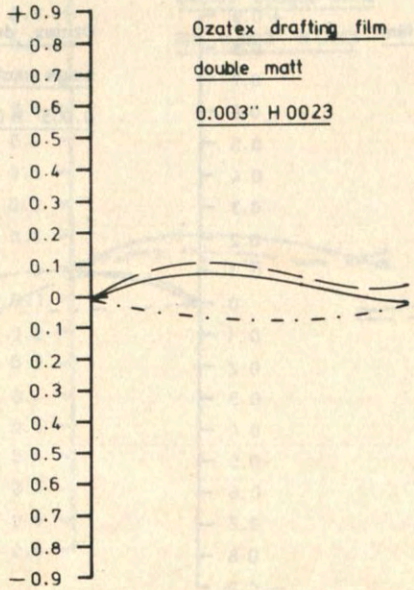

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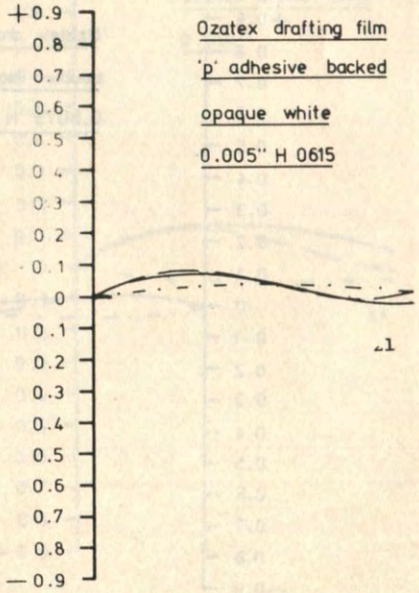
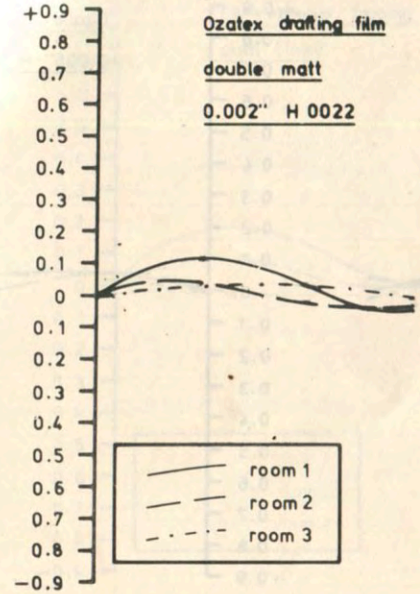


Ozatex drafting film 'p' adhesive backed opaque white 0.005" H 0615

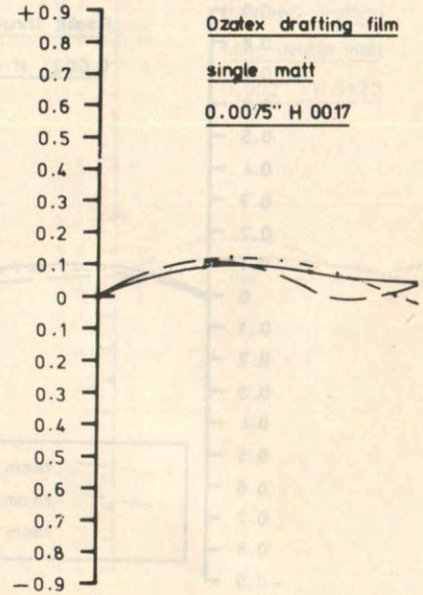
% change in length for each medium in rooms 1,2 and 3



Ozatex drafting film

double matt

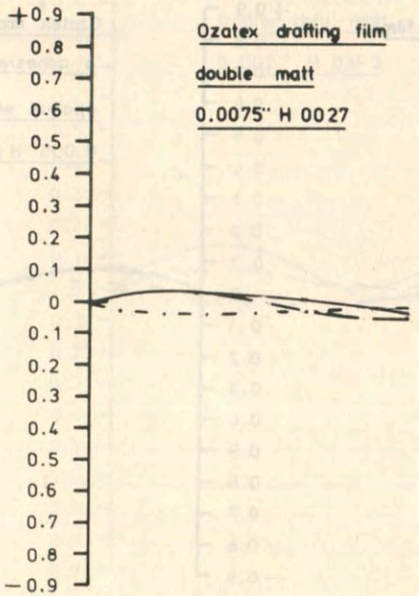
0.002" H 0022



Ozatex drafting film

single matt

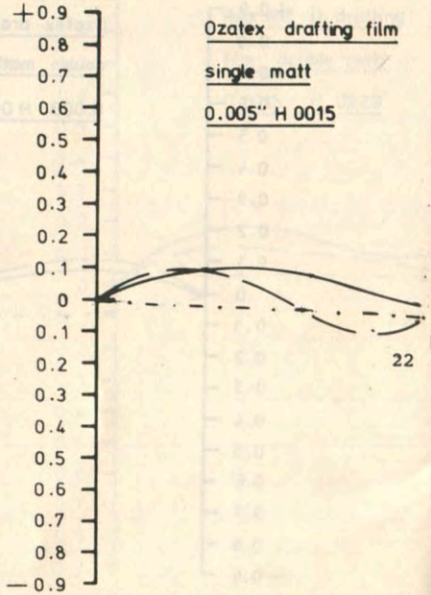
0.0075" H 0017



Ozatex drafting film

double matt

0.0075" H 0027

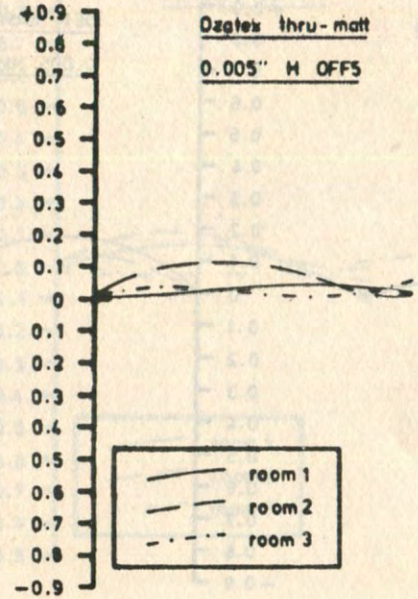


Ozatex drafting film

single matt

0.005" H 0015

% change in length for each medium in rooms 1,2 and 3



Ozatex thru-matt

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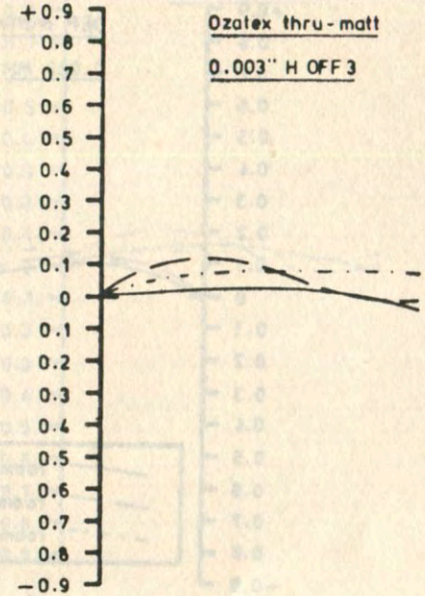

Ozatex thru-matt

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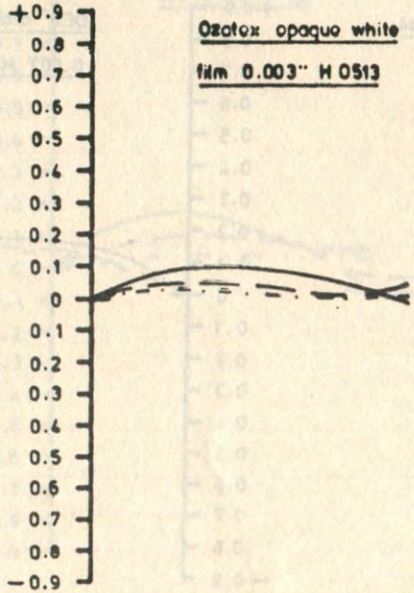
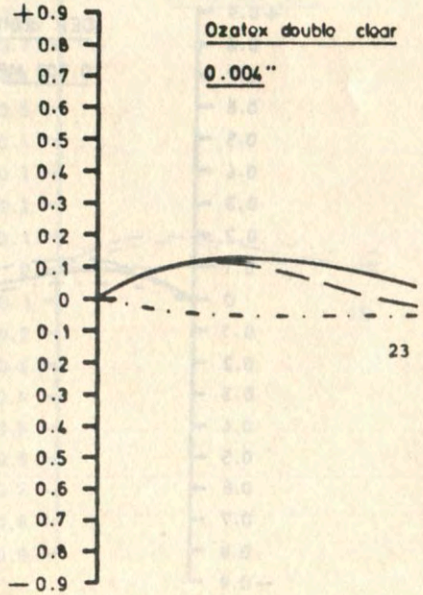


Ozatex opaque white

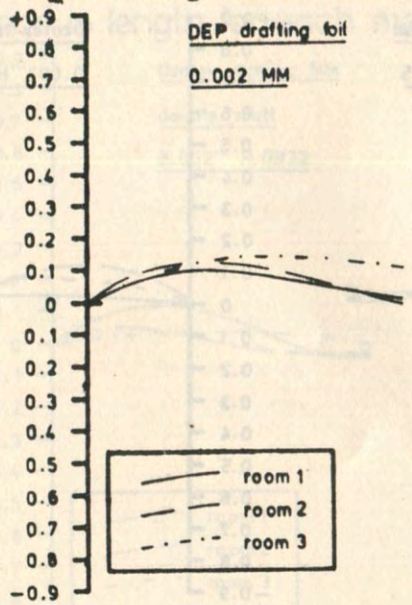
film 0.003" H 0513

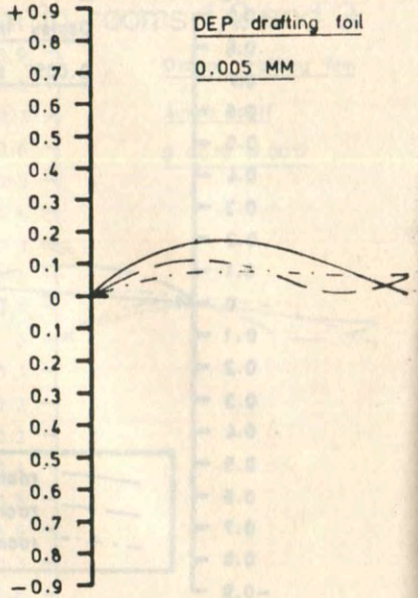


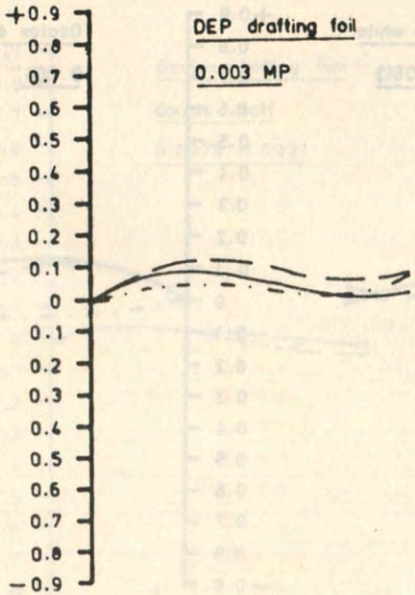
Ozatex double clear

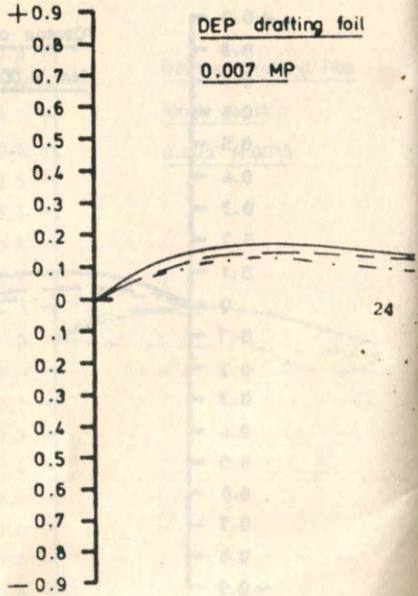
0.004"

% change in length for each medium in rooms 1, 2 and 3

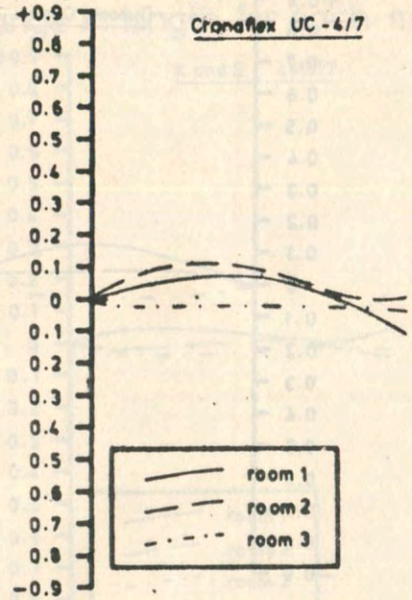


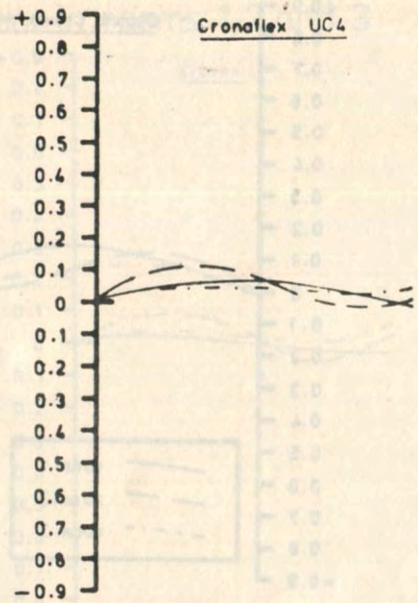


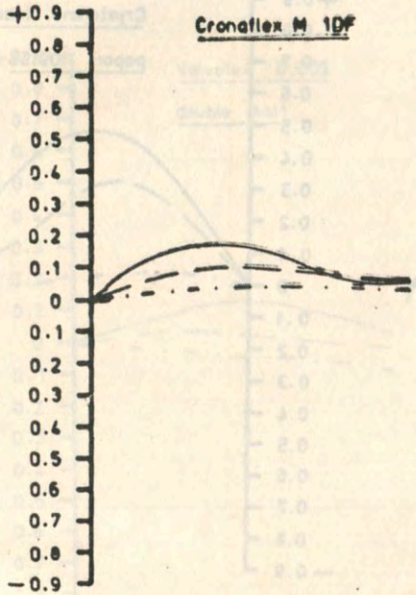


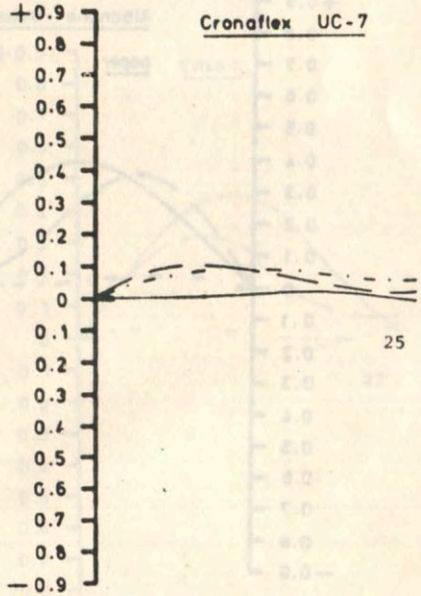


% change in length for each medium in rooms 1, 2 and 3

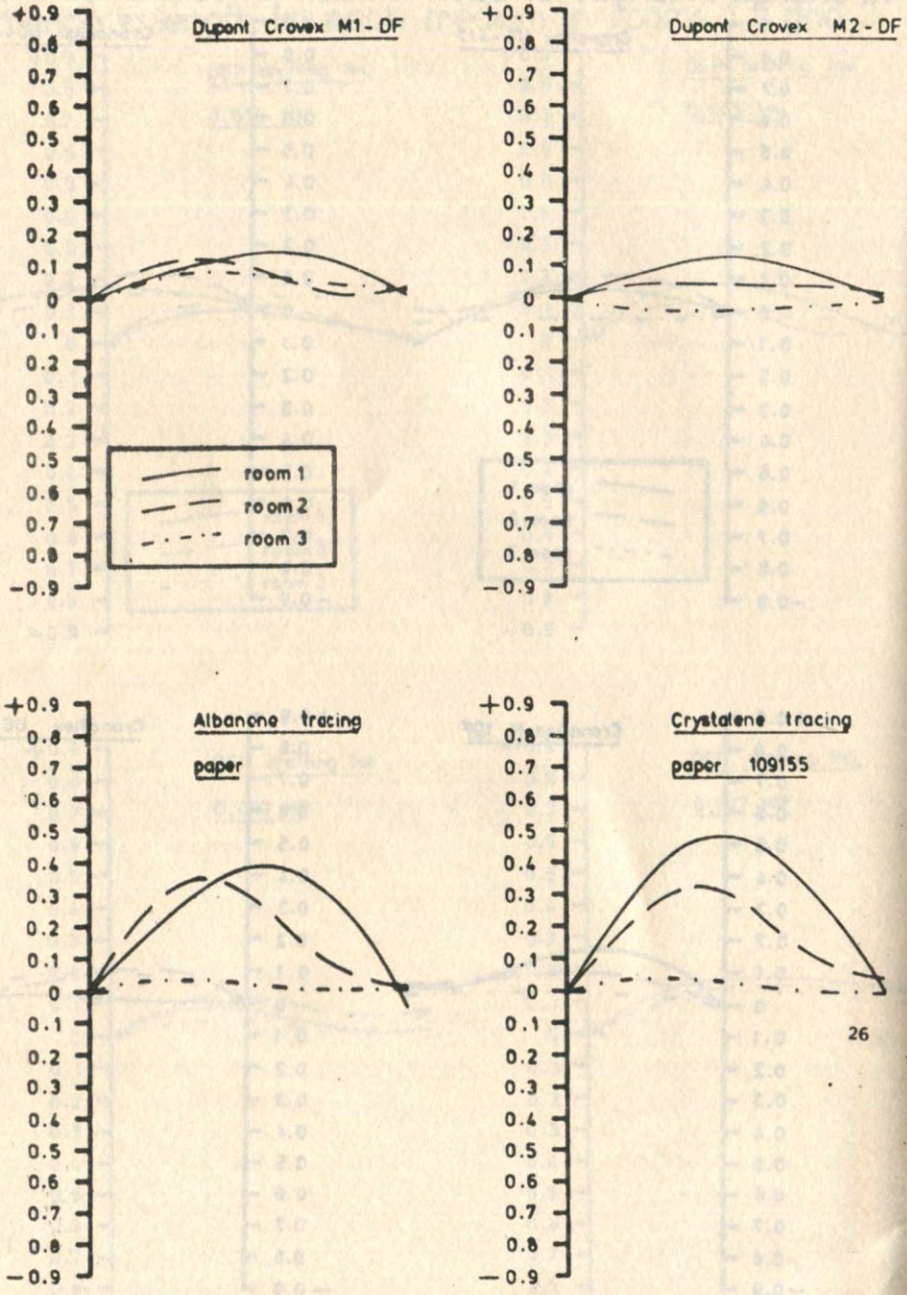




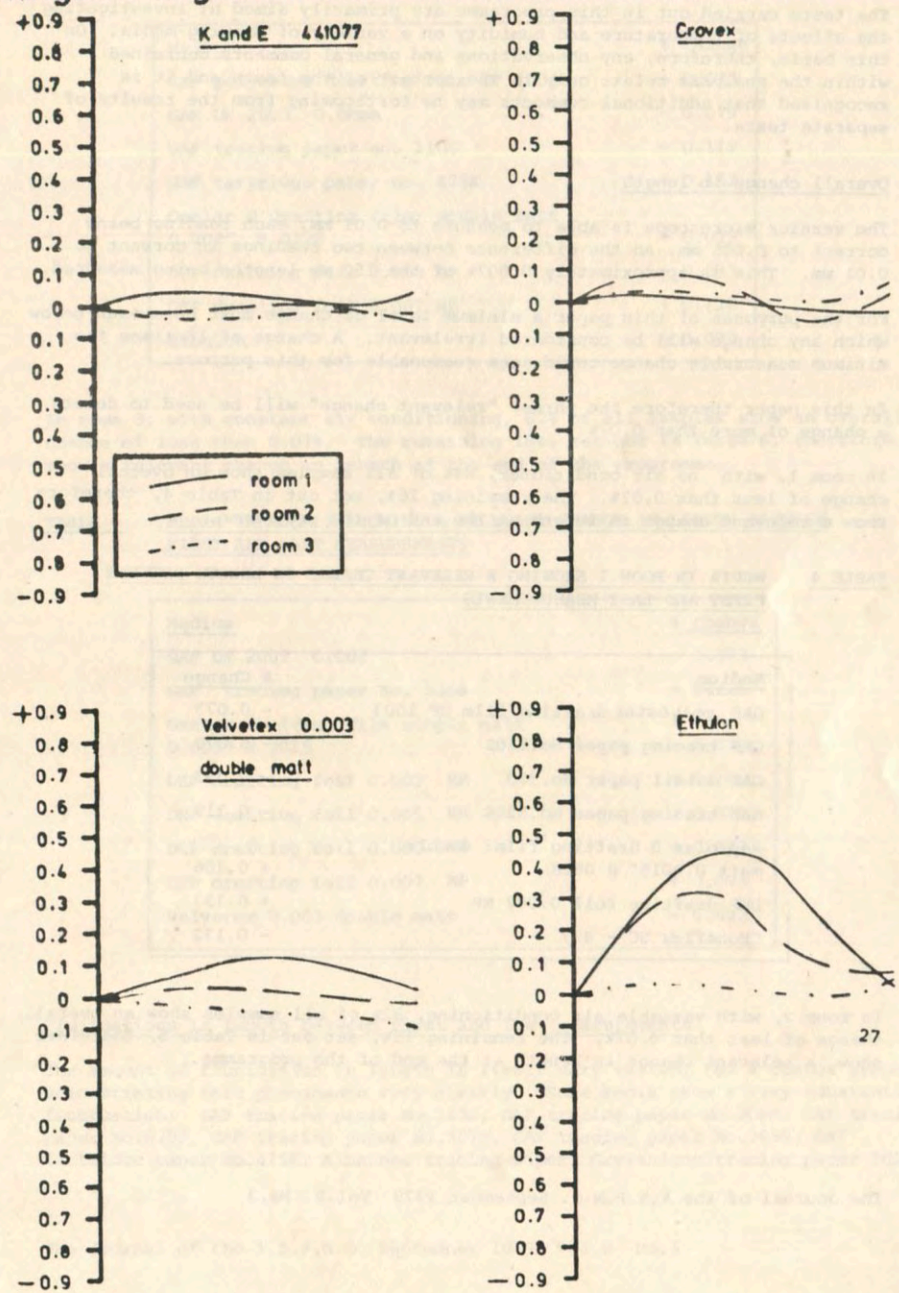




% change in length for each medium in rooms 1, 2 and 3



% change in length for each medium in rooms 1, 2 and 3



Analysis of the graphs showing the % change for each medium

The tests carried out in this programme are primarily aimed at investigating the effects of temperature and humidity on a variety of drawing media. On this basis, therefore, any observations and general comments contained within the analysis relate only to the context of the tests and it is recognised that additional comments may be forthcoming from the results of separate tests.

Overall change in length

The vernier microscope is able to measure to 0.01 mm, each reading being correct to 0.005 mm, so the difference between two readings is correct to 0.01 mm. This is approximately 0.007% of the 150 mm lengths being measured.

For the purposes of this paper a minimum level of change must be chosen below which any change will be considered irrelevant. A change of 10 times the minimum measurable change could seem reasonable for this purpose.

In this paper therefore the phrase "relevant change" will be used to denote a change of more than 0.07%.

In room 1, with no air conditioner, 84% of all samples show an overall change of less than 0.07%. The remaining 16%, set out in Table 4, therefore show a relevant change in length at the end of the programme.

TABLE 4 MEDIA IN ROOM 1 SHOWING A RELEVANT CHANGE IN LENGTH BETWEEN FIRST AND LAST MEASUREMENTS

Medium	% Change
GAF polyester drafting film UF 1003	- 0.073
GAF tracing paper No.110S	- 0.079
GAF detail paper No.300	- 0.093
GAF tracing paper No.520S	- 0.119
Reprolar D drafting film: double matt 0.0015" H 092B	+ 0.106
DEP drafting foil 0.007 MP	+ 0.133
Cronaflex UC - 4/7	- 0.112

In room 2, with variable air conditioning, 82% of all samples show an overall change of less than 0.07%. The remaining 18%, set out in Table 5, therefore show a relevant change in length at the end of the programme.

TABLE 5 MEDIA IN ROOM 2 SHOWING A RELEVANT CHANGE IN LENGTH BETWEEN FIRST AND LAST MEASUREMENTS

Medium	% change
GAF polyester drafting film UF 1003	+ 0.073
GAF UF 2003 0.08mm	- 0.079
GAF tracing paper no. 110S	+ 0.119
GAF cartridge paper no. 475K	+ 0.152
Ozalar D drafting film: double matt 0.002" H 0322	+ 0.073
DEP drafting foil 0.003 MP	+ 0.093
DEP drafting foil 0.007 MP	+ 0.126
Ethulon	+ 0.079

In room 3, with constant air conditioning, 82% of all samples show an overall change of less than 0.07%. The remaining 18%, set out in Table 6, therefore show a relevant change in length at the end of the programme.

TABLE 6 MEDIA IN ROOM 3 SHOWING A RELEVANT CHANGE IN LENGTH BETWEEN FIRST AND LAST MEASUREMENTS

Medium	% change
GAF UF 2002 0.002	+ 0.073
GAF tracing paper No. 520S	+ 0.125
Ozatex drafting film single matt 0.005" H 0015	- 0.073
DEP drafting foil 0.002 MM	+ 0.106
DEP drafting foil 0.005 MM	+ 0.073
DEP drafting foil 0.003 MP	+ 0.073
DEP drafting foil 0.007 MP	+ 0.093
Velvetex 0.003 double matt	- 0.092

Fluctuations in length between first and last measurements

The amount of fluctuation in length is itself very varied, the % change graphs demonstrating this phenomenon very clearly. Some media show a very substantial fluctuation: GAF tracing paper No.110S, GAF tracing paper No.309M, GAF tracing paper No.520S, GAF tracing paper No.307S, GAF tracing paper No.309S, GAF cartridge paper No.475K, Albanene tracing paper, Crystalene tracing paper 109155

and Ethulon. Other media, however, reveal a very small fluctuation: Ozalid thru-matt 0.002" H OCF2, GAF UF 2005, Ozalid thru-matt 0.005" H OCF5, Ozatex drafting film 'p' adhesive backed opaque white 0.005" H 0615, Ozatex drafting film double matt 0.0075" H 0027, Ozatex opaque white film 0.003" H 0513, DEP drafting foil 0.002 MM, DEP drafting foil 0.003 MP, DEP drafting foil 0.007 MP, Cronaflex UC - 7 and K & E 441077. The largest fluctuation is offered by GAF tracing paper No.520S, with an increase of + 0.863% following the second measurement in room 1. The smallest fluctuation is offered by three different media, all recording no change in length: in room 1, Cronaflex UC - 7 after the first measurement; in room 2, Ozalid thru-matt 0.005" H OCF2 after the second measurement and in room 3, GAF UF 2005 after the second measurement.

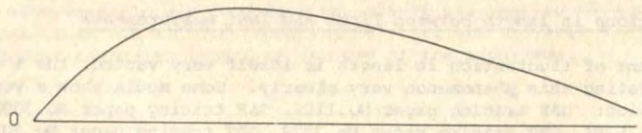
The greatest fluctuation in length would appear to be present in room 2, a room where the air conditioner was continually turned on and off: graph 2 shows very clearly how both the temperature and especially the humidity have been affected by the turning on and off of the air conditioner. The smallest fluctuation would appear to be present in room 3, in which both the air conditioner was in continual operation and the media were standardised. Graph 3 shows how both temperature and humidity were fairly constant.

While rooms 2 and 3 may account for the greatest and least fluctuations respectively, it is in room 1, with no air conditioning, where the most abrupt changes in length are to be found. Many, though not all, media reveal a rapid increase in length after being moved from the standardisation conditions in room 3: GAF tracing paper No.520S offers an extremely good example. Many media also show a significant increase in length when moved to room 2. While an air conditioner was operating irregularly in this room it must be recognised that the temperature control was not necessarily exactly the same as that on the air conditioner in room 3.

Patterns of behaviour

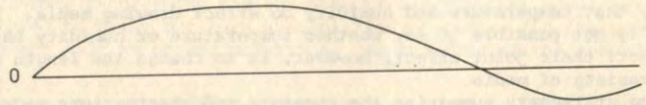
In room 1, 82% of the media show a distinct pattern of an initial rise in the % change in length followed by a falling-off in value. This pattern is shown in diagram 1.

DIAGRAM 1: Behaviour pattern for room 1



In room 2, a distinct pattern is more difficult to determine because of the greater fluctuation of the values. However, some 50% of samples tend towards a pattern showing an initial rise, followed by a fall in value and finishing with a second rise towards the time of the final reading in room 3. Of the remaining 50% of samples, several show a similar pattern to the samples in room 1. Diagram 2 shows the most common behaviour pattern in room 2.

DIAGRAM 2: Behaviour pattern for room 2



In room 3, some 36% of samples show a tendency towards the pattern of room 1, while the remainder show a variety of patterns, some the reverse of that for room 1, with an initial fall in value followed by a rise, and others approximating to a straight line, following the horizontal zero axis of the graph. While it is to be expected that all samples in room 3 should not change significantly in length, the effects of human error, power failure to the air conditioner (unfortunately a not - uncommon occurence in Lae) and fluctuation within the air conditioner itself must not be discounted.

The effects of temperature and humidity

Of graphs 1, 2 and 3, showing the temperature and humidity in rooms 1, 2 and 3, graph 2 best shows the way in which the air conditioner controls the temperature and humidity in that particular room. Turning the air conditioner on, for example, has the immediate effect of lowering the humidity and, to a lesser extent, the temperature.
A comparison between these three graphs and the individual % change graphs for each drawing medium will show to a great extent how the behaviour pattern is related to the temperature and humidity.

In room 3, where temperature and humidity are fairly constant, the reaction of each medium is to tend towards a constant length. Fluctuations in length are minimal and any deviation away from a horizontal line on the graph can be accounted for by the limitations of the methods of observation and by the difficulties of maintaining strictly constant conditions in the room.

The temperature and humidity graph for room 2 shows a great variation in both components and this variation is reflected in the several behaviour patterns for this room.

Moving the media from room 3 to room 1 has produced an immediate reaction: once in an environment free of the effects of the air conditioner, and where temperature and humidity are much higher, the length of the sample, in most cases, increases. This increase is not constant between all media, of course, because of their differing degrees of dimensional stability.
Many samples in room 1 show a further distinctive characteristic: on being returned to the lower temperature and humidity of room 3 they immediately reflect a decrease in length, though not necessarily back to the initial length.

Conclusions

It can be seen, from the individual graphs showing the behaviour patterns of each medium, that temperature and humidity do affect drawing media. From this analysis it is not possible to say whether temperature or humidity has the greater effect: their joint effect, however, is to change the length of a line drawn on a variety of media.
The following statements summarise the comments and observations made in the previous sections of this report:

1. Moving a medium from one environment to another causes a change to take place in the length of a line drawn on that medium
2. An increase in the temperature and humidity of an environment tends to increase the length of such lines
3. Fluctuating temperature and humidity tends to produce fluctuations in the behaviour pattern of a medium
4. Uniform conditions of temperature and humidity tend to produce minimal changes to the length of lines drawn on the media
5. On being returned to standardised conditions, many media tend towards their initial dimension

To be continued in the next issue.

GRAPHICAL EVALUATION OF ROTATIONAL ELEMENTS OF ANALOGUE ABSOLUTE ORIENTATION

BY: S. Balasubramanian, B.E., M.E., A.M.I.S. (India) M.A.S.P.N.G.
and
G.I. Taduran, B.Sc. Geod. Eng(Phil), B.Sc. Photogram. Eng. (Neth.), M.B.M.(Phil), M.A.S.P.N.G.

Introduction: This paper presents a suitable procedure for determining the amounts of $\Delta\Phi$ and $\Delta\Phi$ rotations needed to level relatively oriented models on analogue instruments. The authors have noted the difficulties experienced by beginners in grasping the concepts of carrying out model levelling, and have tried to bring out here a simplified procedure for the purpose. No claims are made as to any novelty or superiority of the procedure.

Preparatory Work: After carrying out relative orientation, the model is brought to the desired scale and the map sheet adjusted in azimuth. A graph paper (preferably tracing) is super-imposed on the map sheet with its lines parallel to model axes.

The positions of the principal points on the model are plotted on the graph paper. The positions of three suitably located height control points appearing in the model are also plotted. Recording the model heights of the control points and evaluating the height errors at these points complete the preparatory work.

Figure 1 shows a typical graph. This graph drawn to a scale of 1/50,000 (same as the plotting scale) shows the positions of the principal points, and the height control points 9, 4001, and 4004.

Evaluation of $\Delta\Phi$: Figure 2 illustrates the graphical constructions needed for evaluation of $\Delta\Phi$. Since $\Delta\Phi$ is a rotation about the model Y axis, a line parallel to model X axis is needed. The obvious choice is a line through point 4004 parallel to the X axis. This line meets the line joining the other two control points at D. To evaluate $\Delta\Phi$, the height error at D has to be interpolated.

For this, the height errors at 4001 and 9 are plotted at an exaggerated scale (in this case at 1/5000) as shown in figure 2, along lines parallel to X axis. (This direction is chosen for obtaining an accurate interpolation). The height errors at 4001 and 9 are represented by the lines (4001 -a) and (9 - b) respectively. A line parallel to the X axis is drawn through D, intersecting the line joining a and b at d. The line (D - d) represents the height error at D.

The height error at point 4004 is plotted, but now along a direction parallel tothe Y axis. The line (4004 - c) represents this error. Also the previously interpolated height error (D -d) for point D is transposed through 90 degrees and shown along the Y - direction by the line (D - d'). c and d' are joined and the inclination of this line with the X axis represents the amount of $\Delta\Phi$ rotation needed to the model. Due to the exaggerated vertical scale used to represent the height errors, the amount of

rotation represented by this angle is also exaggerated. The correct rotation to be applied on the plotter is worked out as follows:

$$\Delta\Phi = \tan^{-1}\left(\frac{\tan \Delta\Phi f}{\text{vertical exaggeration}}\right)$$

Evaluation of $\Delta\Omega$: For evaluation of $\Delta\Omega$, a line parallel to Y axis is needed, and as shown in figure 3, the line (9 - E) is suitable. The height error at E is to be interpolated. This is done as in the previous case (interpolation for D), but now using the height errors at 4001 and 4004, which are plotted along the Y direction to facilitate better interpolation. (E -e) represents the interpolation height error at E.

Also since $\Delta\Omega$ takes place about X axis, the height errors at 9 and E are transposed through 90 degrees to be along the X direction. (E - e') and (9 - b') are the errors to be used in evaluation $\Delta\Omega$. The inclination of b' e' with the model Y axis represents this angle, and the rotation to be applied to the plotter is worked out as follows:

$$\Delta\Omega = \tan^{-1}\left(\frac{\tan \Delta\Omega f}{\text{vertical exaggeration}}\right)$$

The angles $\Delta\Phi f$ and $\Delta\Omega f$ appearing in figures 2 and 3 respectively can be measured using a protractor to the nearest 15 minutes of arc.

Conclusion: The procedure outlined can be used for any configuration of control points easily. Interpolation of height errors, and evaluating the rotations using this procedure has been found to be more easily comprehensible by beginners.

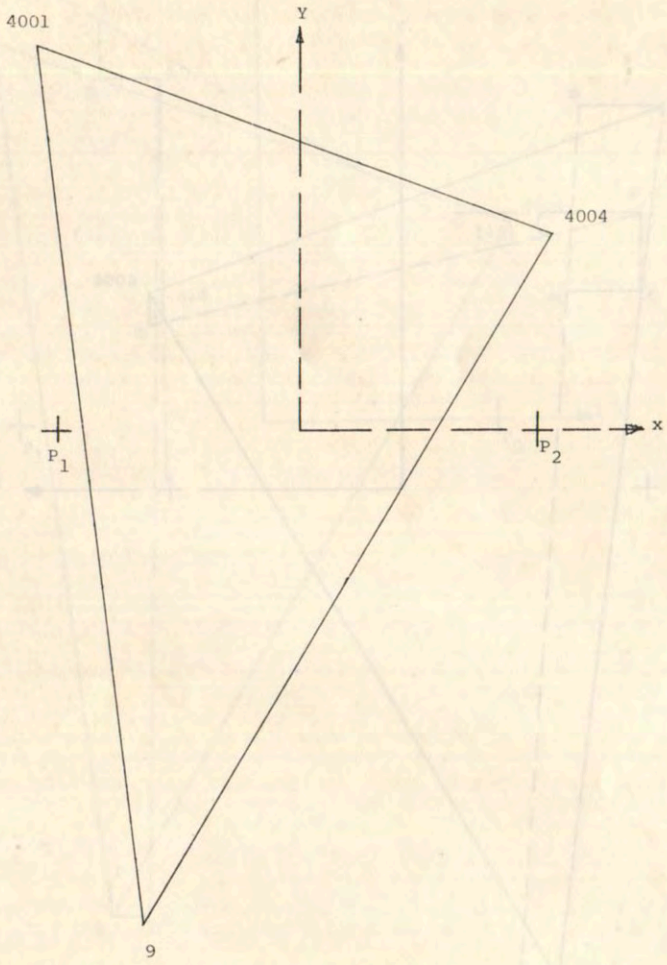


Figure 1

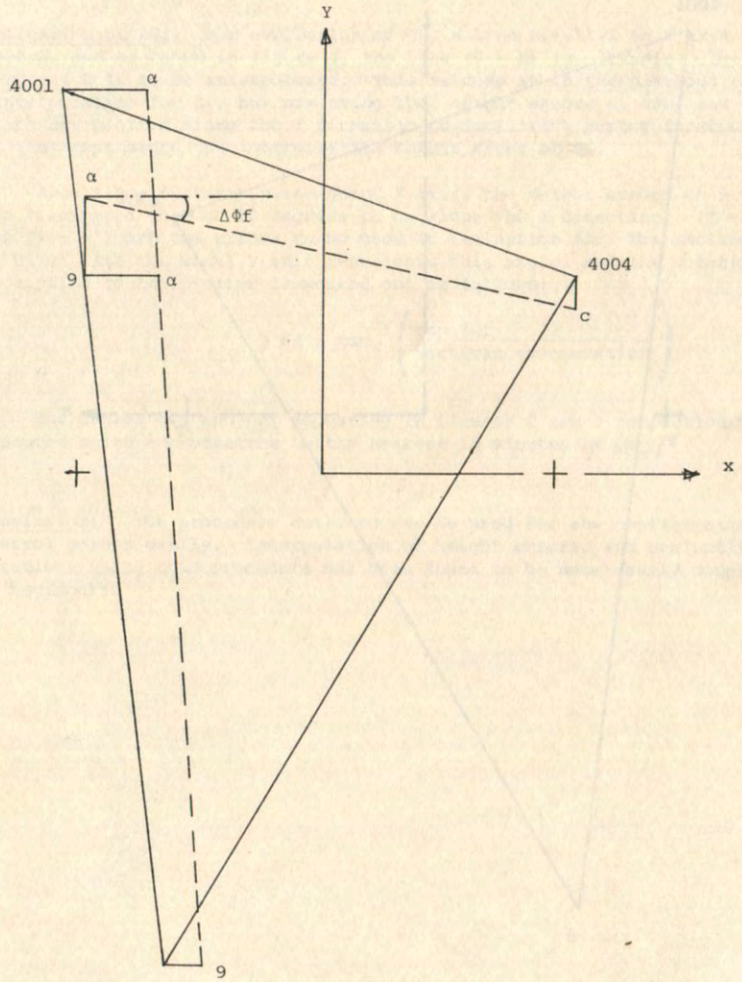


Figure 2

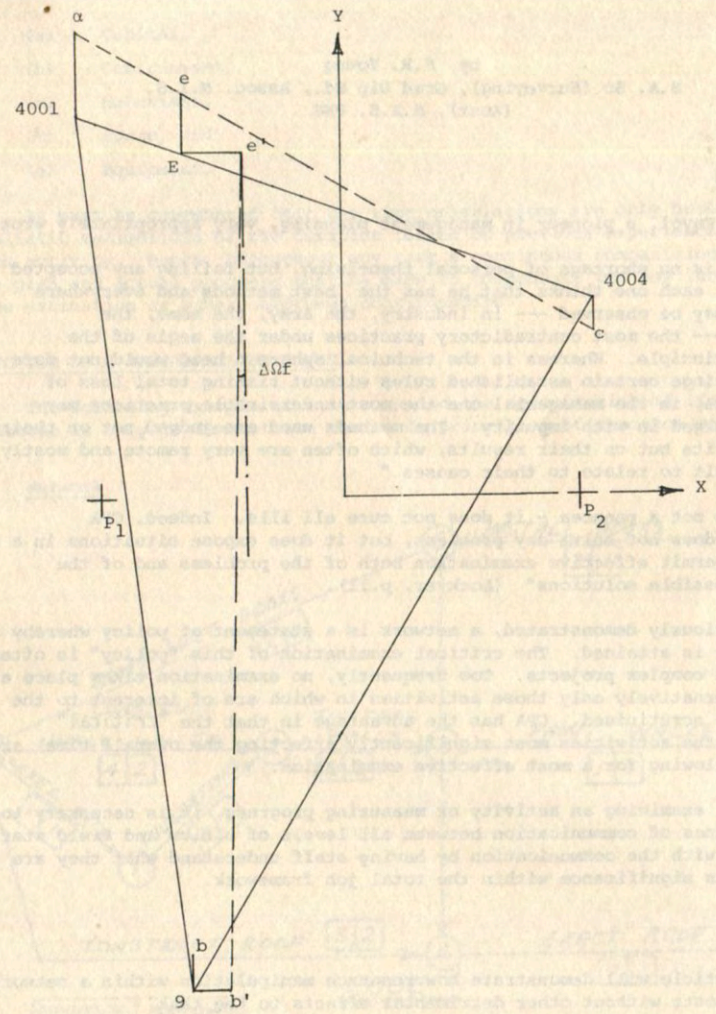


Figure 3

CRITICAL PATH ANALYSIS AND RESOURCE MANIPULATION

by F.R. Young
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(Aust), M.A.S. PNG

INTRODUCTION

1. Mr. H. Fayol, a pioneer in management planning, very appropriately wrote:

> "There is no shortage of personal theorising, but failing any accepted theory, each one thinks that he has the best methods and everywhere there may be observed --- in industry, the army, the home, the state --- the most contradictory practices under the aegis of the same principle. Whereas in the technical sphere a head would not dare to infringe certain established rules without risking total loss of prestige, in the managerial one the most undersirable practices may be indulged in with impunity. The methods used are judged not on their own merits but on their results, which often are very remote and mostly difficult to relate to their causes."

"CPA is not a panacea - it does not cure all ills. Indeed, CPA "in itself" does not solve any problems, but it does expose situations in a way which will permit effective examination both of the problems and of the effective possible solutions" (Lockyer, p.11).

As previously demonstrated, a network is a statement of policy whereby an objective is attained. The critical examination of this "policy" is often difficult in complex projects. Too frequently, no examination takes place at all, or alternatively only those activities in which are of interest to the examinar are scrutinised. CPA has the advantage in that the "critical" activities (the activities most significantly affecting the overall time) are isolated, allowing for a most effective examination.

Whether examining an activity or measuring progress, it is necessary to have good lines of communication between all levels of office and field staff. CPA assists with the communication by having staff understand what they are doing and its significance within the total job framework.

AIM

This article will demonstrate how resource manipulation within a network can reduce costs without other detrimental effects to the task.

1. Fayol's Original: Administration Industrielle et Generale

The manpower resource only will be considered in this instance. Other resources categories that could also be considered are:

(a) Capital,
(b) Environment,
(c) Materials,
(d) Space, and
(e) Equipment.

It must be remembered that the time calculations are only based on realistic estimations of the duration (based on previous experiences) of each activity. Hence, throughout any task a continuous comparision between the plan and actual progress must be made to compensate for any incorrect time estimation or other unforseen contingencies.

ERECTION OF A PREFABRICATED HOUSE.

The following example of a network and the optimisation of its manpower resource is only to demonstrate the basic principles of resource manipulation.

Network

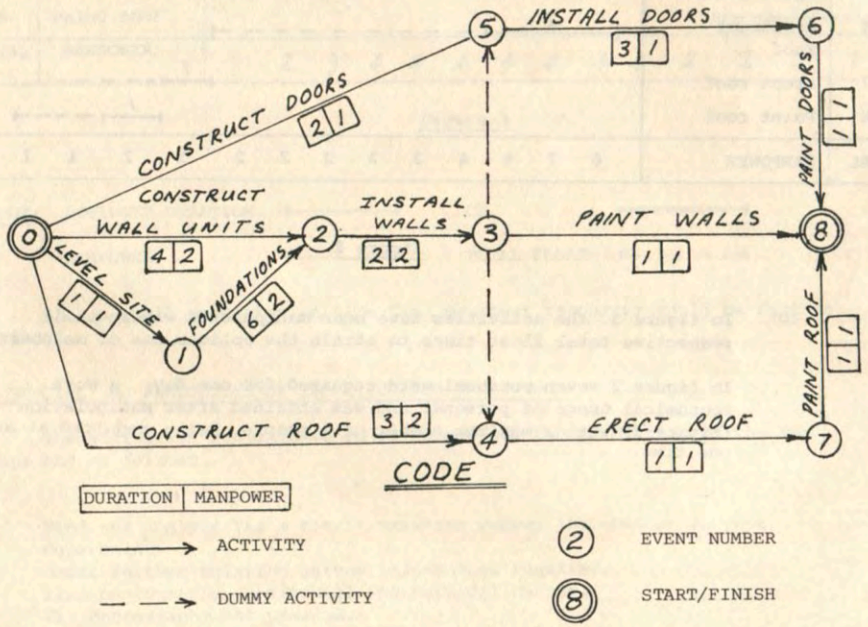


Figure 1: (Basic network from Armstrong-Wright, p.43)

Resources Levelling

(a) This chart depicts each activity commencing at its EST and the manpower allocated to each activity.

DAYS		0	1	2	3	4	5	6	7	8	9	10	11	12	13
CODE	ACTIVITY														
0-2	Construct wall units			2											
0-1	Level site		1												
1-2	Construct foundation's				2										
2-3	Install walls									2					
0-5	Construct doors		1												
5-6	Install doors											1			
6-8	Paint doors													1	
3-8	Paint walls											1			
0-4	Construct roof			2											
4-7	Erect roof											1			
7-8	Paint roof												1		
TOTAL	MANPOWER	6	7	6	4	2	2	2	2	2	3	2	1	1	

Figure 2

(b) In figure 3. the activities have been manipulated within their respective total float times to attain the optimum use of manpower.

In figure 2 seven personal were required for one day; a more economical usage of personal and was attained after manipulation (figure 3) with a maximum number of 4 people being required at any one time.

DAYS		0	1	2	3	4	5	6	7	8	9	10	11	12	13
CODE	ACTIVITY														
0-2	Construct wall units			2											
0-1	Level site		1												
1-2	Construct foundations				2										
2-3	Install walls									2					
0-5	Construct doors		1												
5-6	Install doors											1			
6-8	Paint dorrs													1	
3-8	Pain walls											1			
0-4	Construct roof			2											
4-7	Erect roof											1			
7-8	Paint roof												1		
TOTAL	MANPOWER	2	3	4	4	4	4	4	4	4	2	2	2	1	

Figure 3

CODE: ACTIVITY DURATION — CP

MANPOWER (3) — TOTAL FLOAT

With a small extension in time the manpower resources could be further reduced.

A SPECIAL MAP PRODUCTION OF TWO 1:100,000 MAP AREAS.

The activities required to be performed for the production of the two maps are as follows.

. Find and analyse (as a total) existing survey information in your department
. Order further existing survey information required.
. Plan photography, horizontal and vertical control.
. Fly photography and process.
. Administration procedures before going to field (for each field trip).
. Get horizontal (plus trip heighting) control of new stations.

. Get vertical control (altimeter) of new stations.
. Compute horizontal control.
. Compute vertical control (altimeter)
. Check horizontal PCP's for new stations.
. Check vertical PCP's for new stations.
. Prepare station summaries for all new trigs.
. Obtain reference material for compilation (existing maps, photos).
. Area familiarisation for plotting section boss.
. Arrange data for aerotriangulation.
. Order compilation sheets, photo sheet corners and marginal information.
. Aerotriangulation observation, computation, adjustment.
. Assess result of aerotriangulation.
. Prepare trig records (station summaries) of existing trigs.
. Plot minor control on compilation sheets.
. Plot cultural detail
. Plot hydrography
. Plot contours
. Plot vegetation
. Spot check on plotting

} each activity for sheet 1 and 2

. Visit existing trigs to check condition for records (station summaries).
. Edit black compilation sheets.
. Edit blue compilation sheets.
. Edit green compilation sheets.
. Edit brown compilation sheets.
. Composite edit of compilation sheets (for both sheet 1 & 2).
. Full edit of compilation sheets and prepare field check sheets.
. Field check.
. Final edit.
. Report on control and compilation.
. Check data for despatch.

Table 1

Network Diagram

Having determined the activities for the task the next step is to construct a network diagram (Annex 1).

The newtwork is the logical sequence of all the activities within the task and can not be altered. The dummy activities produced by the logical sequencing of activities must now be added to the list of activities.

Network Calculations

From the network diagram list the activities and their code and assign resources and estimated durations to each activity. This is necessary before the calculations step can commence.

CODE	ACTIVITY	DURATION (DAYS)	RESOURCES
0-1	Find Survey Information	3	1 x S
1-2	Order and get Survey Information	3	1 x S

CODE	ACTIVITY	DURATION (DAYS)	RESOURCES
1-3	Plan control and photos	1	2 x S
2-3	Dummy	0	1 x Clerk
3-7	Admin for Field Trip - Horizontal control	5	1 x Clerk
3-4	Admin for Field Trip - Vertical control	5	1 x Clerk
2-17	Admin for Field Trip - Visit trigs	5	1 x Clerk
4-5	Get vertical control	10	2 x S, 2 x A
5-6	Check vertical PCP's	1	2 x S
6-10	Compute vertical control	3	1 x S, 6 x A
3-10	Fly photos and process	30	
7-8	Get horizontal control	18	1 x S, 6 x A
8-9	Check horizontal PCP's	1	2 x S
9-10	Compute horizontal control	5	1 x S, 8 x A
1-13	Order compilation sheets	15	
10-11	Arrange data for aerotriangulation	2	1 x S
11-12	Aerotriangulation	14	
12-13	Assess aerotriangulation results	1	2 x S
13-16	Plot minor control on compilation sheets	2	1 x A
1-16	Obtain reference material for compilation	7	1 x S
1-15	Admin for Field Trip	5	1 x Clerk
15-16	Area familiarisation	5	1 x S
17-30	Inspect trig station	10	2 x S, 2 x A
30-31	Prepare station summaries	5	6 x A
10-31	Prepare station summaries	5	4 x A
16-18	Plot, ink and check compilation sheet 1	20	1 x S, 4 x A
16-23	Plot, ink and check compilation sheet 2	25	1 x S, 4 x A
18-19	Edit black compilation sheet 1	1	1 x S
18-20	Edit blue compilation sheet 1	1	1 x S
18-22	Edit green compilation sheet 1	1	1 x S
18-21	Edit brown compilation sheet 1	1	1 x S
23-24	Edit black compilation sheet 2	1	1 x S
23-25	Edit blue compilation sheet 2	1	1 x S
23-27	Edit green compilation sheet 2	1	1 x S
23-26	Edit blue compilation sheet 2	1	1 x S
22-28	Composite edit sheet 1	2	1 x S
27-28	Composite edit sheet 2	2	1 x S

CODE	ACTIVITY	DURATION (DAYS)	RESOURCES
28-29	Full edit and prep of dyelines	3	1 x S, 1 x A
16-14	Admin for Field trip	5	1 x Clerk
29-31	Field check	5	2 x S, 2 x A
31-33	Final Edit	2	2 x S
31-32	Prepare report	1	2 x S
33-34	Check data for despatch	1	1 x S
19-22	Dummy	0	
20-22	Dummy	0	
21-22	Dummy	0	
24-27	Dummy	0	
25-27	Dummy	0	
26-27	Dummy	0	
32-33	Dummy	0	
14-29	Dummy	0	

Note: (1) S is qualified Surveyor/Photogrammetist.

(2) A is Assistant/technician.

Table 2

Using C.P.A. formulae (YOUNG, 1979) the following results are obtain from the information so far given.

CODE	ACTIVITY OPERATION	DURATION	EST	EFT	LST	LFT	FLOAT FF	FLOAT TF	FLOAT IF	CRITICAL ACTIVITY
00-01	Find Survey Information	3	0	3	0	3	0	0		****
01-02	Order and get Survey Information	3	3	6	3	6	0	0		****
01-03	Plan Control and Photos	1	3	4	5	6	2	2		
01-16	Obtain Ref Material for Comp	7	3	10	48	55	0	45		
02-03	Dummy	0	6	6	6	6	0	0		****
03-07	Admin for Horizontal Control	5	6	11	7	12	0	1		
03-04	Admin for Vertical Control	5	6	11	17	22	0	11		
02-17	Admin - Visit Trigs	5	6	11	71	76	0	65		
03-10	Fly photos and Process	30	6	36	6	36	0	0		****
01-13	Order and Get Compilation Sheets	15	3	18	38	53	35	35		
11-15	Admin - Area Familiarisation	5	3	8	45	50	35	42		

CODE	ACTIVITY OPERATION	DURATION	EST	EFT	LST	LFT	FLOAT FF	FLOAT TF	FLOAT LF	CRITICAL ACTIVITY
04-05	Get Vertical Control	10	11	21	22	32	0	11		
07-08	Get Horizontal Control	18	11	29	12	30	0	1		
17-30	Inspect Trig Stations	10	11	21	76	86	0	65		
15-16	Area Familiarization	5	15	20	50	55	35	35		
05-06	Check Vertical PCP's	1	21	22	32	33	0	11		
30-31	Prep. Stn. Summaries from Fd Visit	5	21	26	86	91	65	65		
06-10	Compute Vertical Control	3	22	25	33	36	11	11		
08-09	Check Horizontal PCP's	1	29	30	30	31	0	1		
09-10	Compute Horizontal Control	5	30	35	31	36	1	1		
10-11	Arrange Data for Aerotriangulation	2	36	38	36	38	0	0		****
10-31	Prep. Stn. Summaries of Trig Estb.	5	36	41	86	91	50	50		
11-12	Aerotriangulation	14	38	52	38	52	0	0		****
12-13	Assess Aerotriangulation Results	1	52	53	52	53	0	0		****
13-16	Plot Minor Control of Comp.	2	53	55	53	55	0	0		****
16-18	Plot, ink, check, sheet 1	20	55	75	60	80	0	5		
16-23	Plot, ink, check, sheet 2	25	55	80	55	80	0	0		****
18-19	Edit black sheet 1	1	75	76	80	81	0	5		
18-20	Edit blue sheet 1	1	75	76	80	81	0	5		
18-22	Edit green sheet 1	1	75	76	80	81	0	5		
18-21	Edit brown sheet 1	1	75	76	80	81	0	5		
22-28	Composite edit sheet 1	2	76	78	81	83	5	5		
19-22	Dummy	0	76	76	81	81	0	5		
20-22	Dummy	0	76	76	81	81	0	5		
21-22	Dummy	0	76	76	81	81	0	5		
23-24	Edit black sheet 2	1	80	81	81	81	0	0		****
23-25	Edit blue sheet 2	1	80	81	81	81	0	0		****
23-27	Edit green sheet 2	1	80	81	81	81	0	0		****
23-26	Edit brown sheet 2	1	80	81	80	81	0	0		****
16-14	Admin for Field Check	5	55	60	81	86	26	26		
14-29	Dummy	0	60	60	86	86	26	26		
27-28	Composite edit sheet 2	2	81	83	81	83	0	0		****
24-27	Dummy	0	81	81	81	81	0	0		****
25-27	Dummy	0	81	81	81	81	0	0		****
26-27	Dummy	0	81	81	81	81	0	0		****

CODE	ACTIVITY OPERATION	DURA-TION	EST	EFT	LST	LFT	FLOAT FF	FLOAT TF	FLOAT LF	CRITICA ACTIVIT
28-29	Full edit - Prep. of Dyelines	3	83	86	83	86	0	0		****
29-31	Field Check	5	86	91	86	91	0	0		****
31-33	Final Edit	2	91	93	91	93	0	1		
31-32	Prepare Report	0	92	92	93	93	1	1		
32-33	Dummy	0	92	92	93	93	1	1		
33-34	Check data for Dispatch	1	93	94	93	94	0	0		****

Table 3

Resources Levelling

The resources levelling in Annex 2 is based on the calculations in table 3 with each activity commencing at their earliest start times.

After manipulating the activities within their respective float times (without effecting logic or task duration) a more desirable resources usage can be obtained (Annex 3).

Further manipulations can reduce the time or resources factors depending on the financing arrangements and availability of resources. It must be remember that, apart from the determination of the logical sequence of activities, a computer can rapidly do all the remaining calculations, diagrams, and charts, and the alterations to them.

GENERAL COMMENTS ON THE C.P.A. METHOD

Reactions

Before the C.P.A. of planning is introduced, it must be accepted and understood by those who will have to use it. It is also beneficial if those who are affected by C.P.A. at least understand it is principle. Difficulties in using C.P.A. are almost always symptoms of some managerial weakness (Lockyer, p12).

To assess different people's knowledge and feeling of the C.P.A., I conducted a small survey of persons in various positions. This was combined with results by a survey conducted in the Engineering profession (Young, 1974).

General Reaction

The general reactions were as follows:

(a) agreement that planning is required;

(b) disagreement on how much planning should be done and the cost involved.

Management

Here, the general reaction is that they get the jobs done with few problems, so why change?

A greater portion of people in this position prefer proven traditional methods that they understand. Management never hears of many problems as they are solved at a lower level where the methods used may not all be particularly efficient. C.P.A. remedies these two points as it is easily understood and, by its design, maintains job involvement with the people at the top.

Middle Management

This group generates plans, schedules, bar graphs and verbal organising, and recognises job and planning potentials. The general complaint here is that the management, although sometimes interested, are not willing to try C.P.A.

Field Personnel of Foreman-type Status

This group has decided that they had to work their way up and have obtained all the required knowledge. They are not enthusiastic to new ideas and appear to see them as a threat to their jobs.

People of this position generally have the idea that there are too many bosses, think there is no planning done anyway, feel they know best no matter what way they were told to do something, and generally believes they know all there is to know for that particular activity.

Users

Most users of C.P.A. generally praise its simplicity, effectiveness, and believe it is the best method available.

Contractor and Other Interested Departments

These groups are impressed as the C.P.A. shows the progress of the project. They can also see it as a tool by which they can understand the steps and keep a close control over more activities, or projects, with more effectiveness.

Others

People with knowledge of the C.P.A. but not able to use it, feel that it would correct the following problems:

(a) Lack of a workable chain of command.

(b) Too many bosses all with differing opinions but all knowing best.

(c) Office personnel out of touch with field workers.

(d) Need for more definite guidelines and better explanations.

(e) Too many group discussions where little of any value is said.

(f) Lack of information passed to worker or back to appropriate higher positions.

Cost and Savings

C.P.A. Cost

ITEM	% of Project Cost	
	Consultant	Computer
Preliminary Planning	0.04	0.01
Working Plan	0.11	0.04
Updating	0.20	0.10
T O T A L	0.35%	0.15%

Table 4

This means that the total cost for C.P.A. is 0.5% of the project's cost when you employ a consultant and hire computer time.

This example of C.P.A. costs (table 4) is typical of large engineering projects, and for this particular example the C.P.A. planning saved 20% of the project's time. Some time savings have been as high as 50% and have all compensated for the cost of the C.P.A. system (Young, 1974).

C.P.A. Cost/Time Cost Savings

C.P.M. Phase	Cost %	Time Cost Savings %		Net
		To Contractor	Owner	
Pre-commencement	0.05	0	1.0	0.95
Preliminary Plan	0.05	1.0	1.0	1.95
Working Schedule	0.45	0	0.5	0.05
T O T A L	0.55	1.0	2.5	2.95

Table 5

Conclusions

The application of the network analysis technique requires the listing of each activity which is necessary for the project. The planning has therefore to be carried out in much greater detail than would be done if other forms of project controls would be used. Thorough planning at this early stage has the advantage that areas of work where special arrangements will be necessary are recognised.

I must also be remembered to avoid excessive and unnecessary detail and not loose sight of the physical realities. Three lines of enquiry can usefully be pursued to minimize these pitfalls. They are:

(a) Can separate resources be shown with separate arrows?

(b) Does any single arrow cover responsibilities assignable to more than one person?

(c) Is the detail greater than that which is usable by the person employing the network?

(Lockyer, P.35)

Other questions which may assist the C.P.A. method of planning, or any method used for organising, are:

(a)	Purpose	What is being done? Why is it being done? What else could be done? What should be done?
(b)	Place	Where is it being done? Why there? Where else could it be done? Where should it be done?
(c)	Sequence	When is it done? Why then? When else could it be done? When should it be done?
(d)	Person	Who does it? Why that person? Who else might do it? Who should do it?
(e)	Means	How is it done? Why that way? How else can it be done? How should it be done?

(Lockyer, P.84-85)

The greatest advantage gained though C.P.A. is with the larger projects. For smaller projects C.P.A. is best retained in management levels with bar charts or other simple methods being used at lower organisational levels.

For repetitious tasks of almost any complexity, where the only changes will be resources or activity durations, C.P.A. offers cost and times savings in both planning and the task.

1. Armstrong - Wright, A.T. Critical Path Method, Longman: Harlow, 1971

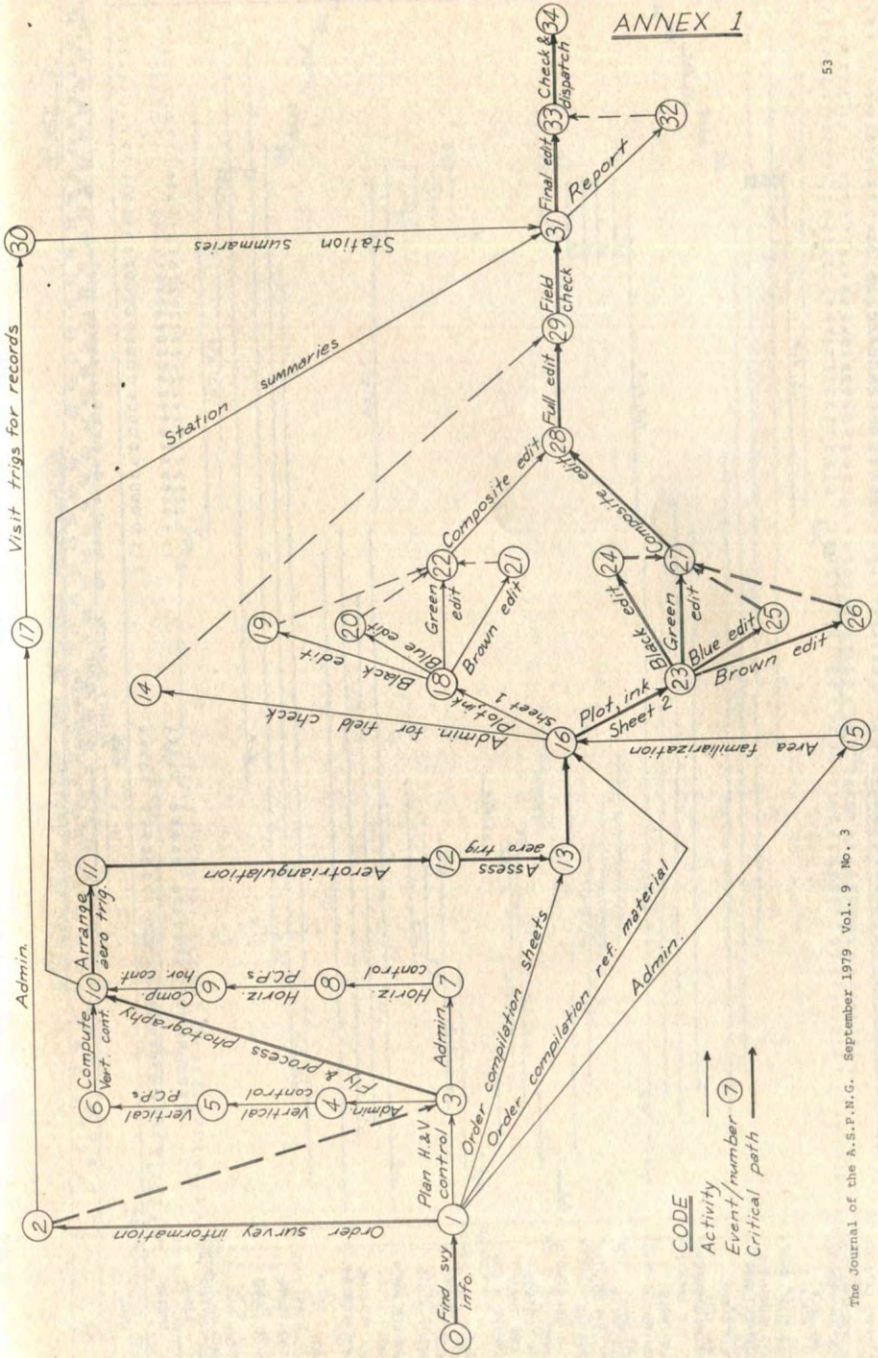
2. Lockyer, K.G. An Introduction to Critical Path Analysis, Pitman: London, 1968

3. School of Military Survey (Australia), Warrent Officers Course Material, 1976

4. Young, F.R. A Critical Path Method of Planning in a Surveying Project, W.A.I.T. 1974

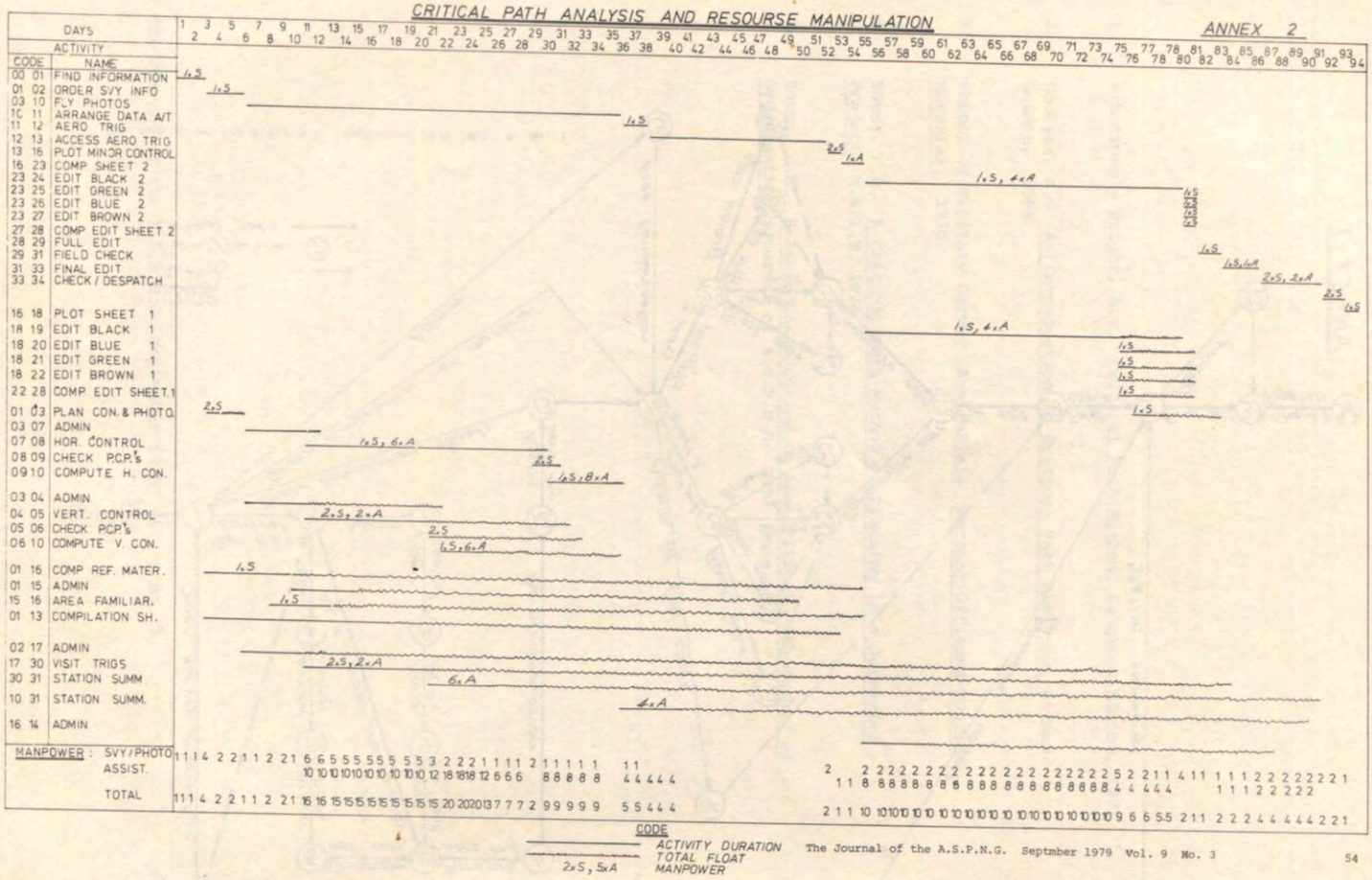
5. Young, F.R. A Basic Introduction to the Critical Path Method of Organisation, Journal of A.S.P.N.G: PNG, June 1979

ANNEX 1



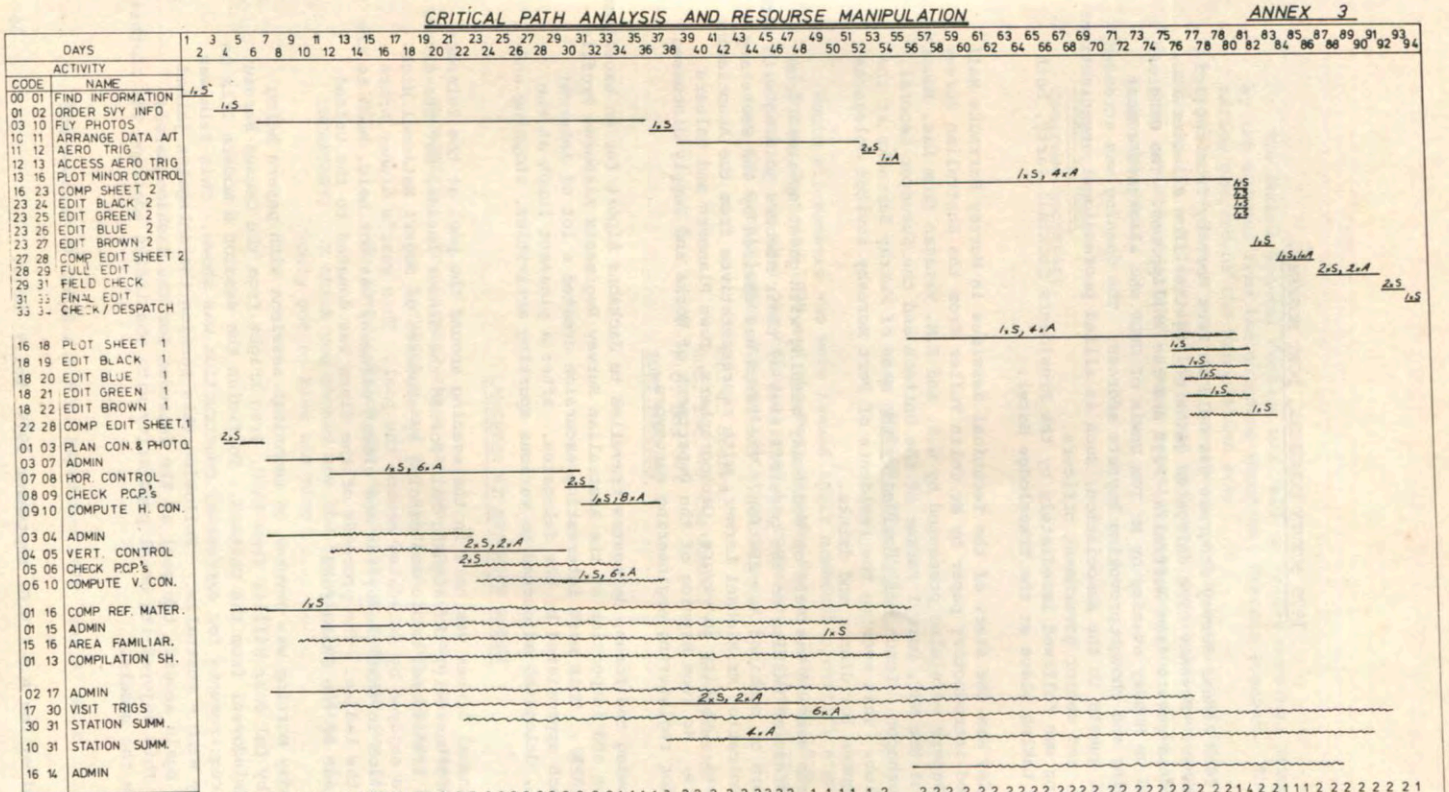
CRITICAL PATH ANALYSIS AND RESOURSE MANIPULATION

ANNEX 2



CRITICAL PATH ANALYSIS AND RESOURSE MANIPULATION

ANNEX 3



NOTES: 1. TOTAL MANPOWER ON ANY DAY REDUCED FROM 20 TO 16.
2. BY EXTENDING THE TASK TIME BY 1 DAY THE SVY REQUIREMENT IS REDUCED BY 1.
3. SOME ACTIVITIES eg. 6-10 COULD HALVE ITS MANPOWER BY DOUBLING THE DURATION WITHOUT EFFECTING THE TASK DURATION.

1979 SURVEY CONGRESS, PORT MORESBY.

The 14th Annual Survey Congress was held in Port Moresby from the 3rd - 7th September. Seventy nine delegates gathered together from all over PNG, with overseas guests from Australia, Fiji and the Philippines. The Congress was opened on Monday evening by Mr Tom Unwin of UNDP who also gave a most entertaining and thoughtprovoking keynote address. The opening was attended by special guests to the Association, such as allied professional organisations and firms, and senior government officers.
The opening was followed immediately by the Presidents Cocktail Party, both functions taking place at the Travelodge Hotel.

Tuesday saw the start of the Technical Sessions in Murray Barracks Hall with a good introductory paper by Mr Colin Fuller from the Australian Survey Office. Papers were also presented by G.S. and R.N. Vatasan from Lae, Robert Priculis of the NHC, Darryl Parker of the Unitech and the Surveyor General, Kisokau Pochapon. Lunch was provided by the mess of Murray Barracks at the Bowling Club. That evening the residents of Port Moresby invited delegates to their homes for dinner and drinks.

A forum session was held on Wednesday morning with guest speakers from allied profession talking on the possibilities of their members joining with ours in some form of combined Association. The forum was chaired by the Secretary of the Assoication Mr Michael Larmer, with representatives from the Association of Surveyors, Quantity Surveyors, Cartographers, Town Planners and Valuers as speakers. Mr Ivon Bryning of the Department of Works and Supply discussed the need for registering engineering surveyors.

Following the forum, delegates travelled to Jacksons Aiport for an excellent explanation and inspection of the Australian Survey Regiments Airborne Profile Recorder (APR). This most interesting excursion created a lot of interest and was much appreciated by the delegates. After a pleasant lunch at the Boroko RSL, delegates adjourned to various sporting activities, shopping and business.

The Annual Dinner was held in the evening around the pool at the Islander Hotel. Unfortunately, threatening rain forced the dinner inside, but pre-dinner drinks and traditional music and dancing by students of Sogeri National High School were enjoyed by delegates around the pool. This year's dinner broke with tradition in that the oyster and claret ceremony was not held, much to the relief of the ladies. The proceeds of the fines was donated to the United Nations Year of the Child Fund.

Thursday morning was devoted to technical sessions with papers being presented by Col John Hillier from RASC, Greg Knight from the Census Bureau and Akin Akindoyeni from the Unitech. To finish the session a modern film on surveying requirements for expressway construction was shown. This film was supplied by WILD - Australia. Following this session the delegates joined the ladies again around the pool at the Islander for the fashion parade luncheon. This enjoyed its usual popularity with the ladies admiring the clothes and the men the models.

The Annual General Meeting was held on Friday morning, being highlighted by the address from the outgoing President Francis Posanau. The incoming office bearers of the Association are:
President - Steven Low, Vice President - Brian Mennis and Secretary-Treasurer Ian Sparks. Friday evening wound up a most successful week with a farewell Mumu on Loloata Island, a most beautiful and relaxing end to a most enjoyable week.

JAMES N. HUNT
Congress Secretary.

NOTICE TO MEMBERS

Would all members who were issued their membership certificates at the Lae Survey Congress 1978 and the Port Moresby Survey Congress 1979, please check to see that the official seal is contained on them. If not please send the Certificates for rectification to:

Mr. I. Sparks
Hon. Sec. of the Assoc. of Surveyors of PNG
P.O. Box 372
PORT MORESBY

LAUGHTER AT MUSGRAVE HOUSE

SECRETARY: *Mr. Larmer, there are two people to see you, one is the Archbishop and the other is the Bank Manager*

MJL: *Oh Sh=T. Which one do you think I should see first?*

SECRETARY: *I think you should see the Archbishop. After all you've only got to kiss his ring .....*

Master of ceremonies, Tom Richards at the annual dinner. Seated, from left, Col. J. Hillier, Mrs Richards and F. Posanau

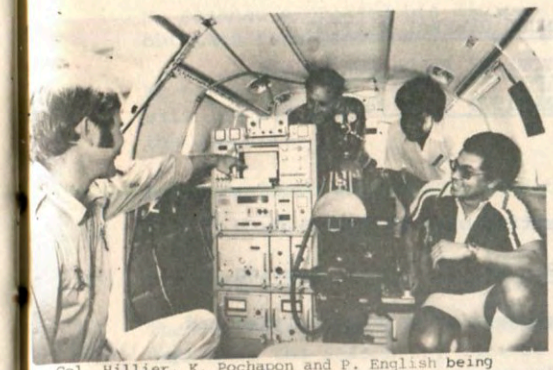
Dave Forster has Tom Richards fined, much to the amusement of Kisokau Pochapon

Whip Dance by Sogeri National High School.

Nars Herrera paying for his sins

Fun and games at the Loloata mumu

Overseas delegates Mosese Volavola of Fiji and Colin Fuller of Australia.



Col. Hillier, K. Pochapon and P. English being shown the Airborne Profile Recorder (APR) inside the aircraft.

Delegates waiting to board the Queen Air to inspect the APR.

The President, Francis Posanau, proposing a toast

Why the men enjoyed the fashion parade.

Maj. Pat Wood explaining the APR System to delegates.

MINUTES OF THE 20TH ANNUAL GENERAL MEETING OF THE ASSOCIATION OF SURVEYORS OF PAPUA NEW GUINEA HELD ON FRIDAY 7TH SEPTEMBER 1979 IN PORT MORESBY

The President Mr. Posanau declared the meeting open at 9:15 a.m.

1. Confirmation of the Minutes of the 19th Annual General Meeting

The Minutes of the 19th Annual General Meeting were circulated and were accepted.

Moved Mr Mennis seconded Mr Kronenburg.

2. Business Arising from the Minutes

Mr Larmer apologized that the Minutes of the 19th Meeting which were circulated were brief due to lack of adequate recording.

3. Councils Report

Mr Larmer read through the items on this report which was circulated during the Congress.

Membership comprised:	Fellows	5	3(Overseas)
	Hon Members		1(Overseas)
	Corp Members	112	55(Overseas)
	Associates	24	8(Overseas)
	Tech Associates	4	
	Students	3	

He also explained that the grand total has fallen due to the fact that 22 names have been struck off the Register for non payment of subscription over an extended period.

Top students award of K20 cash for 1978 were awarded to the following students.

S. Madu	1st Year
Job Suat	2nd Year
Koane Duambo	3rd Year
Faafetai Lolofietele	4th Year

Mr Larmer suggested that a different type of award be considered by the new Council as cash has always been the case and something else may be more appropriate.

Mr Posanau expressed his disappointment with the lack of information obtained from Departments and the Sub Committees by Council.

Mr Larmer advised the meeting that the latest report from Sub-Committee will be published in the Journal when he submits it to the Editor of the Journal.

Moved Mr Tabin seconded Mr Hard that the Councils report be accepted. (CARRIED)

4. Treasurers Report

The Secretary/Treasurer Mr Larmer outlined the Financial Statement. He explained the reason why balance for the year had been reduced from last year. This was due to payment of expenses on travel overseas for Mr Posanau and Mr Low.

Mr Larmer presented the auditors statement to the Chairman who read it out and also asked Chairman to call for a vote of thanks to Wayland & Wayland for the auditing they did for Association.

Mr I. Bryning questioned whether profit was made at the last Congress held in Lae. Mr Van Der Werff told the meeting that K700 was raised at that Congress.

5. Report from Sub-Committees

Mr Posanau had presented the report from the Sub Committee into registration of surveyors in the various disciplines earlier.

Mr Salaiau pointed out that on the problems of getting cadets registered and the registration of different disciplines in Surveying there was a lack of information follow up by Committee and no feed back from students.

Mr Mennis explained that Council sent information to members but response from members was very poor. He asked members to take particular interest in sending information to Council.

6. Presentation of Membership Certificates

Several members who were present were presented with their membership Certificates by the President Mr Posanau.

CORPORATE	ASSOCIATE
Amado Cano	Cecilia Aquino
Peter Doig	Maraga Gabutu
Anthony Luben	Samuel Kodawara
Skerry Palanga	Andrew Lakau
Cholai Polume	Gai Pope
	Clement Sipara
	Pilia Wami

7. Presidential Address

Mr Posanau presented his report to the meeting on his term of office and the needs of the profession.

8. Councillors for 1979-1980

The Secretary Mr Larmer announced the Councillors for 1979-1980.

Stephen Low	President
Brian Mennis	Vice President
Ian Sparks	Secretary/Treasurer
Allan Bale	Councillor
James Hunt	Councillor
John Kronenburg	Councillor
Francis Posanau	Councillor
Don Smith	Councillor
John Van Der Werff	Councillor

9. Address by Incoming President

Mr Low spoke briefly to his election and thanked the delegates for their support.

He mentioned that he would like all members to cooperate with Councillors to improve the standard of the profession and also to support the future development of the Association.

He thanked the outgoing President Mr Posanau for his term of office and his Councillors especially Mr Larmer for dedication and sheer hard work and for a job well done.

10. 1981 Congress Date and Venue

It was agreed to that the 1981 Congress be held in Lae commencing on Monday 3rd August.

Moved Mr Larmer seconded Mr Hard (CARRIED)

11. CASLE Regional Meeting 1980

Mr Hunt briefly outlined the progress of the Organising Committee. He stated that the meeting is to commence on 1st September 1980 and suggested that it be held at Travelodge. He suggested Travelodge as most delegates attending will be accommodated at Travelodge and that it was more central in means of transportation and rooms for meeting.

Moved Mr Hunt seconded Mr Sparks that Travelodge be approved for 1980 CASLE Meeting.

(CARRIED)

12. Proposed Expansion of the Association to include Allied Professions

MOTION: It is proposed that a committee under the Chairmanship of the President of the ASPNG be formed to investigate and make recommendations to the Association on the alternatives of forming a combined association with allied professions.

The terms of reference and membership of this committee to be decided by Council at an early Council meeting.

A report to be presented and circulated to all members 3 months prior to the 1980 Annual General Meeting.

Mr Hunt spoke to his motion that the terms of reference of the committee should include or examine:

(a) various forms of combined associations and an "umbrella" association.

(b) the adverse or otherwise effects which such an association would have on the professional standing of surveyors in Papua New Guinea and Overseas.

(c) various grades and types of membership for a combined association.

(d) the constitutional changes and machinery required.

(e) decide which professions should form this association and what the requirements would be.

(f) that the committee comprise of the minimum of 5 members of the ASPNG and shall have the power to co-opt the services of additional members as required.

Various members spoke on the motion raising the issues of Professional status, the possibility of an association similar to the Singapore professional group and of a separate association for the survey technicians.

Moved Mr Hunt seconded Mr Sparks.

(CARRIED)

13. Proposal to Promote Surveying Profession

Mr Larmer outlined the proposal on Movie on Surveying which will cost K2,000 and asked Mr Richards to give his findings and thoughts on this subject.

Mr Richards explained that movie can be made in terms of Projector slides which would run for 30 minutes.

Mr Moriarty of Qasco gave his assistance in that his Company has a film on aerial photography and mapping in Australia which the Assoication could use.

MOTION: That the Council continue to investigate the problems involved in promoting the profession in a manner similar to a movie.

Moved Mr Posanau seconded Mr Van Der Werff.

(CARRIED)

14. General Business

(a) Mr Larmer informed the meeting that the current balance of Association funds was in the order of K3000.

(b) Mr Hard asked if the Institution of Surveyors Australia had invited the ASPNG to attend the Australian Survey Congress and if not could the Council negotiate to have a representative attend this meeting.

MOTION: If a member of the ASPNG is attending a Congress overseas then Council would consider nominating them as the representative of the ASPNG and provide support as necessary.

Moved Mr Larmer seconded Mr Posanau.

(CARRIED)

(c) Mr Prikulis spoke on the need for a compilation of the most relevant past papers from Congresses and for these to be readily accessible.

RECOMMENDATION: That the collection of all past Journals and Congress papers be examined and also a place to store this information.

Moved Mr Mennis seconded Mr Prikulus. (CARRIED)

(d) Mr Hard spoke on the lack of Registered Surveyors and made a recommendation to the Council that the Sub-Committee be reconvened to examine this problem.

(e) National Scale of Fees

MOTION: That Council form a Scale of Fees Committee to produce a Scale of Fees more relevant to the current Papua New Guinea situation.

Moved Mr Posanau seconded Mr Tabin. (CARRIED)

There being no further business the President Mr Low thanked all delegates for being present and closed the meeting at 12.30 p.m.

S.P. LOW
Chairman

PRESIDENTS REPORT

MR E. POSANAU

This year's Congress Theme, "Surveying For Future Generation" underlines once again the question of Changes that must occur during the development process in our profession to cater for the needs and aspirations of our members.

Being the International Year of Child, we are also reminded not only to think of the future needs of our profession in isolation but also the whole community - the enviornment surveyors will live and work with. We have the obligation, the responsibility to create orderly development to benefit the people.

Changes are inevitable in any organisation because without it, that organisation will perish or die away. As immediate changes to our Association (3) important issues can be discussed:

1. The proposed "Institution of Surveyors and land Economy" to comprise of Surveyors, Valuers, Cartographers, Town Planners and Quantity Surveyors;
2. Registration of Surveyors; and
3. National (Surveyors) Scale of Fees.

1. Proposed New Institution

Whilst there may be alot of good reasons to support this proposal, it is my belief that our profession must take a cautious view at this early stage. One might ask; will we gain much to benefit our present and future surveyors? Will other groups be prepared to accept our dominating role in the formative period.

There are, as I see it three (3) possible alternatives open to us.

(i) to abolish ASPNG and create an entirely new institution representing the 5 major disciplines.

(ii) to open membership of our Association to the other four (4) disciplines.

(iii) to establish four other separate Associations of Valuers, Cartographers, Town Planners and Quantity Surveyors and then have a combined elected executive or Council for the five professions.

2. Registration of National Surveyors

It is disappointing to report that there was little success so far on this matter. Many people did not cooperate and the progress so far has been disappointing. There is an urgent need for us to pool our knowledge and experience together to improve this.

At this stage opinions seem to be divided equally on the question of whether or not we should extend registration to other five major Branches of Surveying namely,

Engineering Surveys,
Cadastral Surveys,
Geodetic Surveys,
Photogrammetric Surveys,
Hydrographic Surveys.

People are encouraged to make comments on the proposed new Survey Act.

3. National Scale of Fees

The present Scale of Fees was structured on Australian Salary Structure and I feel it is necessary to draw up a new Scale of Fees based on Papua New Guinea salary structure. A permanent Committee should now be formed to look into this.

(These are some immediate changes that I can see could be looked into. The new executive should place some of these issues on their priority list for 1979/80 programme).

Finally I would like to thank the authors of Papers for this Congress. They have been very well presented and lots of ideas - some radical - came out of them (although not many comments on them).

Last but not least, I'd like to congratulate the Congress Committee for a job well done - with a few changes too. I am sure the success of this Congress indicated the effort they put into their work.

Finally the Association, and particularly Council has been very fortunate to have someone like Mr Michael Larmer who has done an excellent Secretary/Treasurers job. He has been the tower of strength and the Association's backbone in the running of the Association. Without his dedication and sheer hard work for the last three years, I don't think the Association would be in the position it is today.

I now would like to wish the new executive and our new President Mr Stephen Low, a successful year.

RELEVANT F A C T S FOR THOSE
CHOOSING SHORT RANGE E.D.M. INSTRUMENTS

FROM K & E (KEUFFEL & ESSER) U.S.A.

K & E, America's leading surveying equipment house, established in 1867, manufactures the world's most extensive and modern range of e.d.m. instruments. Seven models, all with direct digital readout, cover various ranges up to 60km.

MODEL	TO 1 PRISM	TO 3 PRISMS	VOLTS	WEIGHT	WEIGHT OF BATTERY	MEASUREMENTS FROM BATTERY	AUDIO	ACCURACY
AUTORANGER 1	1000M	2000M	12	2.4Kg	0.9Kg	1000	YES	± (5+6ppm)
AUTORANGER S	2000M	4000M	12	2.4Kg	0.9Kg	1000	YES	± (5+6ppm)
AUTORANGE 11	2000M	4000M	12	3.1Kg which includes built-in battery.		500	YES	± (5+6ppm)

Important Features of K & E Autorangers.

All K & E Autorangers are instruments for the 1980s. Naturally, each model can either be mounted on a theodolite telescope, theodolite standard or into a tribrach. When mounted on the theodolite standards, the theodolite telescope can be plunged and no wear occurs to the trunnion axis. They are all 12 Volt systems. BUT, the most important feature is the fact that all AUTORANGERS can be attached to the K & E VECTRON electronic theodolite with 1200 line, alpha-numeric solid state field recorder and pre-programmed computer weighing 1.2Kg. The X,Y,Z co-ordinates of the instrument station are fed into the VECTRON and, once the measurement is completed, the X,Y,Z co-ordinates of the object station are displayed and recorded. The field recorder is fed into the office computer for automatic processing and plotting.

COMPARISION OF AUTORANGER WITH OTHER MAKES.

From AGA

MODEL	TO 1 PRISM	TO 3 PRISMS	VOLTS	WEIGHT	WEIGHT OF BATTERY	MEASUREMENTS FROM BATTERY	AUDIO	ACCURACY
AGA Model 10	700	1400	6	2.5Kg	1.8Kg or 3.6Kg	250 & 500	YES	± (5+10ppm)
AGA Model 12A	1000	2000	6	2.5Kg	1.8Kg or 3.6Kg	250 & 500	YES	± (5+5ppm)

From CARL ZEISS WESTERN GERMANY

Eldi 3	*400(I) or 700 (II)	700(I) or 1000 (II)	5	3.8Kg includes battery	1000	NO	*Eldi accuracy in ranges:- I:±(5-10MM); II:±(10-20MM)
Eldi 2	700(I) or 1000 (II)	1000(I) or 1500(II)	5	4.2Kg includes Battery	1000	NO	

For a detailed brochure or demonstration on the K & E AUTORANGER and K & E VECTRON SURVEYING SYSTEM, contact:-

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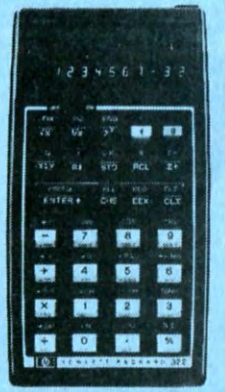

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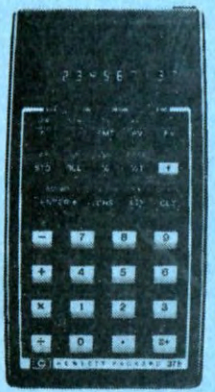

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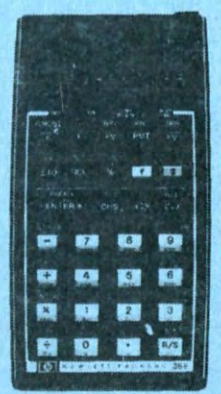

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