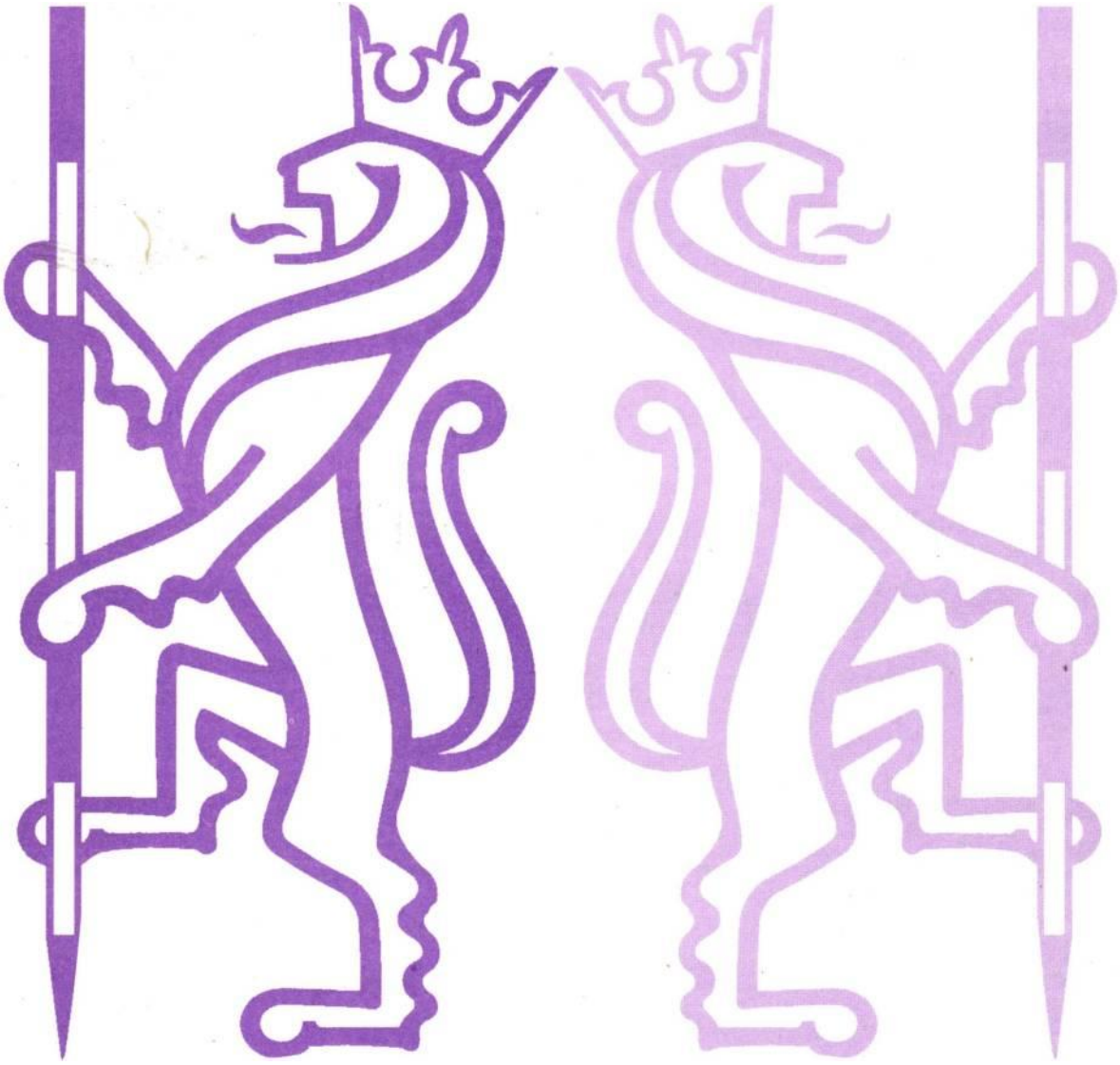
The Royal Institution of Chartered Surveyors

Geomatics

Proceedings of the Geomatics Division Conference

University of Nottingham 10 - 12

September 1999



Volume I

50th Anniversary Programme

THE ROYAL INSTITUTION OF CHARTERED SURVEYORS

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Reprinted April 2000

Contents

GEOMATICS '99 Volume 1 Contents

Introduction

On behalf of the organisers of this conference I would like to extend a warm welcome to all who attend, whether as invited speaker, guest, delegate, or exhibitor. *Geomatics *99* takes place at a time when the RICS is in the throes of "The Agenda for Change" - a major reorganisation to meet the needs of its members in a rapidly changing world. Anyone in any doubt about the extent or importance of the changes that are taking place should compare the contents of the two volumes of conference proceedings. Not only do they clearly demonstrate the technological changes that have taken place, but also the different skills now needed for efficient practice. What has not changed is the necessity for geomatics surveyors to understand mathematical concepts and follow scientific procedures in their work. These essentials can be forgotten in the process of change, including the change of the Division's name.

Although members of the Geomatics Division comprise fewer than 5% of the membership of the RICS, I see growing evidence that the Institution as a whole is coming to recognise that the knowledge and skills of its geomatics surveyors are important to all other chartered surveyors in whatever business they are engaged. It has been, and will continue to be, the intention of the Geomatics Divisional Council to ensure that when the reorganisation following "The Agenda for Change" is completed next year, its members will be ready to use the new institutional structure and procedures to achieve their professional objectives within and outside the RICS. It is my opinion that the opportunities before us are more exciting and more varied than they have ever been. We must be confident and ambitious enough to turn these opportunities into achievements. In his introduction to the second volume of these proceedings, Andrew Pilditch, who organised the technical programme and edited the contributions, discusses these opportunities.

The contents of this first volume are almost entirely about the first 50 years of the of the Land Surveying Division. As Jim Smith's history shows, there are many events and dates which might be taken to signify the Division's birth, or indeed its conception, but none is definitive and all are arguable. This should not concern us too much for we are accustomed to measures of uncertainty. We can however be confident at this conference that the Division is at least 50 years old.

The ways of life and of work experienced by military and colonial surveyors in the decades following the end of World War II have ended, never to return. I therefore decided that in addition to publishing a formal historical account of the main events relating to the Division, I would attempt to put on record some members' recollections of the last 50 years. I contacted about 30 individuals I knew personally, most of whom have now retired, and asked each to write for publication a personal account of what it had been like to work as a land or hydrographic surveyor. Almost everyone I invited agreed enthusiastically to do what I asked. Nobody refused outright; the one or two who finally refused my invitation did so only after much thought, saying that what they had done could not possibly be of any interest or importance to anyone other than themselves. I did not agree, but I failed to convince them otherwise.

Important political, social, economic and technological changes took place in the period covered by these accounts. Historians are now turning their attention to de-colonisation (and its aftermath) of territories ruled by western European nations. Official papers are being used by some academic historians to write about the colonial era in different ways and from different standpoints. Some of these accounts impute motives, or states of mind, to those who were employed by the colonial power to work as expatriates in the colonies. Sometimes these accounts seem to me to be incomplete, or wrong. It should not be expected that merely by this publication any of that will change. Alastair Macdonald's book on DOS *(Mapping the World*, HMSO, London, 1996, ISBN 0 11 701590 3) is one important source of material for historians of the colonial era. The *DOS Gazette* is another.

This publication adds more evidence in the form of words chosen by surveyors themselves (whether DCS/DOS or not) to describe their work. The contributions have undergone a minimum of editing so that the individual voices can be heard; changes to the original texts have been made only where it was necessary to produce a uniform page layout. I have however had to select fewer than half the photographs submitted; the cost of printing, particularly in colour, placed a limit on their number. The form chosen for the authors' names is a concession to modernity. Contributors have professional and academic qualifications. Many have titles or ranks and some have received honours. By ignoring all those details I have avoided offending some individuals by getting their particulars wrong, but run the risk of offending everyone by getting none right, so I offer my apologies to all.

I would like to thank those who contributed to this volume: the authors of the individual articles, the lead speakers at the five conference sessions which celebrate the last 50 years; Jim Smith for a long period at work in the archives and at the keyboard in preparing such a detailed and informative history of the Division; and Patrick Budge and his colleagues in Academic Printing Services at City University, London for producing both volumes.

Michael Cooper, editor,
President RICS Geomatics Division, 1999-2000,
September 1999.

Technical sessions to mark the 50th Anniversary of the RICS Geomatics Division. Contributions from lead speakers.

Session 1, 14.00-15.10, Friday 10th September 1999.

50 YEARS OF LOGISTICS

Alastair Macdonald

Even in the days of complicated geodetic theodolites and long before the advent of GPS, one could always argue that the practical skills involved in surveying were but a minor role for the jack-of-all-trades that a land and, I suspect, a hydrographic surveyor needed to be. Those other skills included human resource manager, vehicle/boat mechanic, accountant, clerk, first aider and logistics planner.

These skills were nowhere better exemplified than in the work associated with large national networks of triangulation. This could be a complex operation involving the coordinated movement of several surveyors and a number of light parties to a succession of hills, some of which might be easy to reach and others quite difficult. Light parties could spend several months on one hill and a surveyor might take a month to complete the observations if the weather was uncooperative. Clearly, careful planning of the operation could yield worthwhile results though it has to be said that the weather delays, which were tedious and often far and away the dominant factor in progress, frequently induced a fatalistic, suck-it-and-see approach to the logistics.

The work could involve a very large workforce. In 1931- 32, for example, Hotine employed 200 porters when he observed the section of the 30th Arc to the east of Lake Tanganyika, many of them carrying food for those carrying the equipment (and some carrying food for those carrying food etc. etc.!). Obtaining sufficient food for them all was a constant worry and Hotine had a young junior official seconded from the administration whose sole job was to arrange large dumps of food (up to 2 tons) at key locations. The whole chain, nearly 500 km long, was observed on foot, communication was by Morse signal on heliographs, the surveyors walked from north to south carrying out a reconnaissance, partied in Abercom in Northern Rhodesia for a couple of months, and then walked back north again carrying out the observations.

The 1940s saw a grudging acceptance of the internal combustion engine as something that might be marginally justifiable for this kind of work. Vehicles and boats were often pushed beyond their limits and the resultant breakdowns caused much heartache. Broken springs bound up with tree bark, Land Rover half-shafts snapping like match sticks, radiators punctured by rhinos, boats capsizing - a constant stream of problems. The problem of employing porters to carry food for porters to carry food for porters was replaced in some remote areas by vehicles carrying fuel for vehicles.

HF radios came on the scene in the 50s but were too unpredictable to be of much help. Often it was possible to speak to a surveyor in a neighbouring country, but not to one on the next hill. Communications were always primitive. UK government surveyors had to send a coded telegram to the Colonial Office every month to prove they were still alive and had qualified for their salary.

The 1960s were the decade of the Tellurometer which had a huge impact on every aspect of logistics. The long sieges of high mountains that characterised triangulation disappeared and a new station could be completed in a couple of days at most. A huge increase in output was now possible, but it required careful coordination of surveyors' movements to ensure that the observing programme went smoothly. The duplex VHF telephone link was an enormous boon and at long last everyone could understand exactly what everyone else was doing without resorting to incomprehensible conversations in Morse with heliographs. The large work-forces of the early days had been steadily reduced over the years and could now be reduced even further. The key employees were the headmen and light keepers on whose efficiency much of the progress depended. Tellurometers contributed to the de-skilling of the work and local staff could easily be trained to operate them at remote stations.

The 1970s saw the beginning of satellite-based positioning and the gradual abandonment of hilltop control stations. Today, the total dominance of the Great Triangulation in the Sky would seem to have passed most of the problems of logistics to the computer - at least for the land surveyor. If coordination is required, it is between the automated observations of a permanent station and those of a rover. Wide

views from mountain tops may still entrance many surveyors but their employers are no longer willing to pay them for indulging that pleasure. They can instead join the fraternity of on-road 4WD drivers and keep their Land Rovers and Land Cruisers squeaky clean, unless of course they get splashed whilst parked at some convenient spot on a motorway hard shoulder.

More will be expected of them at lower cost and with fewer employees. The accountants will want to know their costs per station installed, both budgeted and actual. They will battle with the Department of Transport over lane closures. Their mobile phones will track them down on wet days and send them somewhere else. The GPS will tell them where they are at the touch of a switch and, if they would like European Datum in Singapore or Borneo Skew Orthomorphic coordinates in the Hebrides, it will tell them that too. But the chances are that the work they do will be more fit for purpose and less likely to appear wasteful in another fifty years. After all, the 30th Arc was never computed on anything other than European Datum. OS has abandoned its network of pillars without many of them providing any benefit to anyone other than hill walkers. But it is easy to be wise after the event. Those national networks of triangulation were an essential element of the process of developing technology. They provided the surveyors of the time with a much more physical challenge than today's technology but perhaps they also provided a greater opportunity for mental relaxation as the cloud settled on a mountain summit in the late afternoon and another observing session had to be abandoned.

Session 2, 15.30-16.40, Friday 10th September 1999.

50 YEARS OF PROCESSING

Michael Cooper

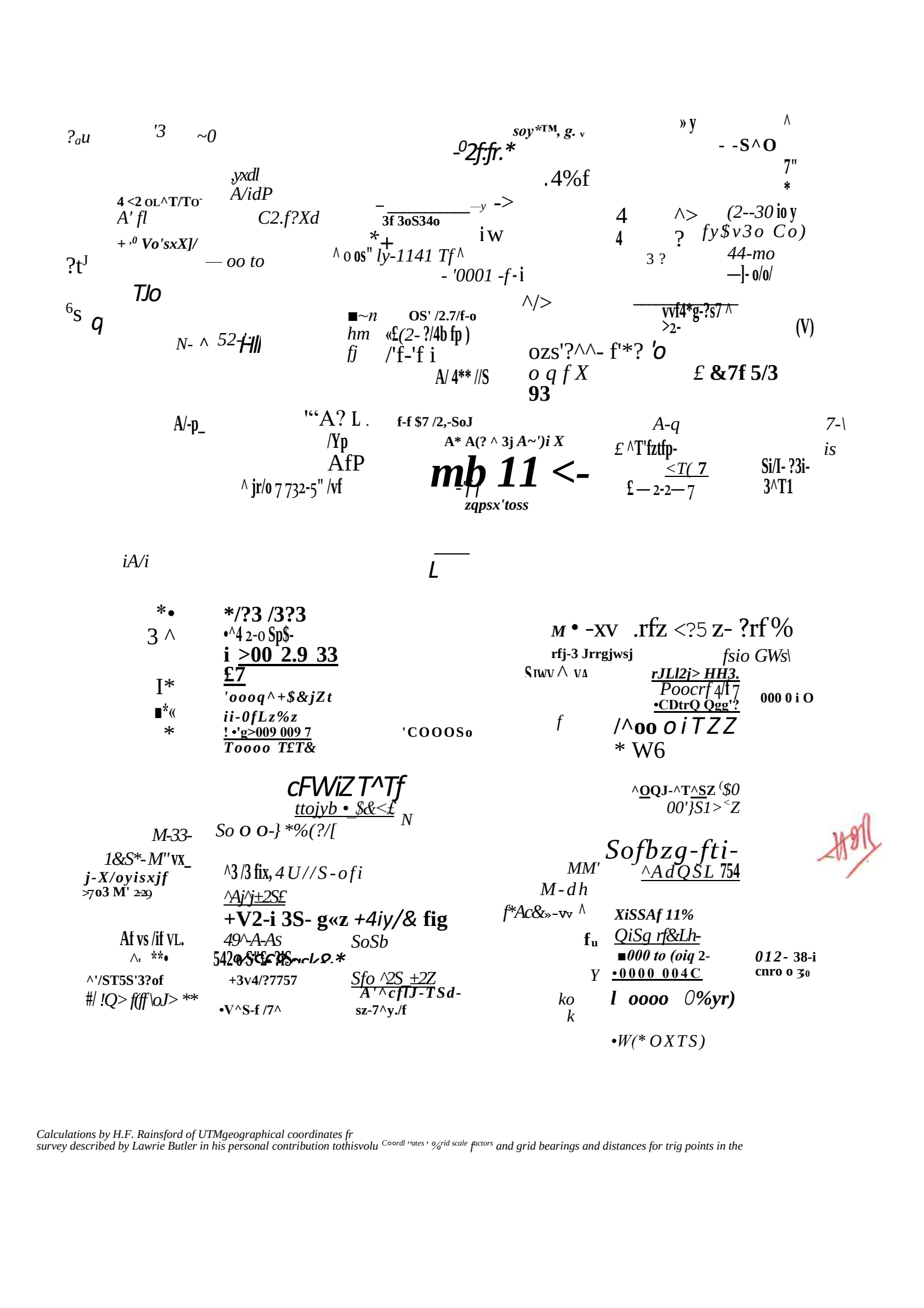
Following a brief interval when electromechanical devices were used for survey computations, electronic methods superseded manual methods with astonishing rapidity. Jim Smith's book (J.R. Smith. *Desk Calculators*, Crosby Lockwood Staples, London, 1973, ISBN 0 258 96898 2) was written at a time when new electronic calculators, some programmable, were beginning to replace electro-mechanical calculators. They were soon made obsolete by mass-production of integrated circuits, lower costs and greater reliability. The earlier transition from mechanical to electro-mechanical computation had led only to faster calculations, not to any new algorithms.

Supplied only with Shortrede's Tables of seven-figure (in the mantissa) logarithms of trigonometrical functions (tabulated for every 1 second of arc - beware the lozenge), Chambers' Tables of seven-figure logarithms of natural numbers, pen and paper, surveyors calculated such diverse quantities as: azimuth from astronomical observations; the ellipsoidal latitude and longitude of a station, given the ellipsoidal azimuth and distance to it from a station with given coordinates (the "forward problem"); the ellipsoidal azimuths (two) and ellipsoidal distance between two stations with known ellipsoidal co-ordinates (the "reverse problem"); and the plane rectangular co-ordinates of sta- * tions in a traverse adjusted for misclosure (only if acceptable of course) by Bowditch's method. Formulae particularly suited for logarithmic calculation have the form $y=a^pb^q...$ where a, b,... are natural numbers or trigonometrical functions and exponents p, q,... are positive or negative integers or simple fractions.

Computation forms were designed for routine calculations based on specific formulae. The surveyor had to write down in the designated place on the form, at each and every stage in the computation, the derived values. Independent checks on the numerical results were sometimes possible to devise without needing too much extra time. The numerical values had to be seen to be in agreement before the calculation could be regarded as complete. If an independent calculation using a different formula was not possible, the check had to be made by other means, such as an independent re-calculation by another person. It was however customary simply for another person to go through the original calculation, ticking each stage if it was found to be correct. This procedure did not always result in an independent check; a lax checker could tick without checking. In managing a computing section it was advisable to arrange for a checker to check the work of someone they did not particularly like. It was also useful from time to time to give out for checking a calculation with a known error to see if it were discovered or not and make a dreadful fuss if it were not picked up.

Replacing Shortrede's and Chambers' by Peters' Tables of eight-figure natural trigonometrical functions (tabulated for every one second of arc) and the pen and paper by a mechanical calculating machine (Facit and Brunsviga were two of the more common makes - the latter could easily be used for calculating square roots) were moves away from the painstaking manual recording and checking that logarithmic calculation demanded. Formulae of the form y = a b ± c d ± e f... are suitable for mechanical calculation: the individual products can be accumulated on the machine, there is no need to write them down. For this reason the Choleski method for matrix decomposition was of practical importance even before programmed computation, but the independent checks were almost as tedious as the original calculations. When a check gives a value different from the original value, which, if either, is correct? And in any case, if the check value agrees with the original, they just might both be wrong.

Calculating machines and Peters' Tables were replaced by electronic calculators by the late 1960's. Hewlett Packard and Casio in particular were two common makes of pocket calculator which surveyors accepted eagerly. The use of function keys was a major factor in increasing the speed of calculation, but there was some concern about the accuracy



Calculations by H.F. Rainsford of UTMgeographical coordinates fr
survey described by Lawrie Butler in his personal contribution tothisvolu Coordinates, grid scale factors and grid bearings and distances for trig points in the

of the algorithms used by one or two manufacturers for evaluating functions of a given argument and of the number of significant figures in the display that could be relied on. Such matters were never in doubt when using a mechanical calculator. The more significant change was from manual to mechanical calculation, not mechanical to electronic. The former was the first move away from the surveyor's literally hands-on engagement with the process of calculation in which each intermediate value was derived and recorded manually. The history of survey computation since then has been one of increasing opacity of the process.

Fifty years ago, one or two surveyors might have imagined the changes that programmed computation would bring to the processing (and acquisition) of data, but nobody could have expected them to have taken place so soon. Land surveyors who have been practising for the last 30 years or so have had to come to terms with the greatest changes in instrumentation and methods that any surveyors have faced before. The rates at which data can be automatically produced, transferred, analysed, processed, transformed and presented are still increasing; at the same time, costs of these activities are decreasing. The surveyor has become detached from the close physical engagement with measuring, recording, calculating, drafting and printing. Photogrammetry with digital images exemplifies these changes at all scales from the microscopic to the planetary. Automated camera calibration and bundle adjustments with thousands of degrees of freedom are becoming the norm in close range photogrammetry, and automatically derived 3D CAD-type models of the object will soon be possible. For satellite and aerial images, digital terrain models, generated automatically, are routine. Methods for image matching, feature extraction and object recognition are being developed to add automatically specific features to the DTM to produce a digital 3D mapping of the earth and other planets.

One result of the pursuit of automation is that anyone with computer skills (and that will soon be nearly everyone) can do things which formerly could be done only by highly trained and knowledgeable specialists. People having only moderate computer skills, an inexpensive digital camera or scanner, commercially available software and an hour or so to spare can create simple 3D digital models from holiday snaps taken around their hotel, or on a golf course. With a hand-held GPS receiver and data-logger they can add other features, locate everything to UTM grid and make a holiday GIS (if they are interested enough). This raises the question "Is there any need for the geomatics surveyor?" Anyone taking part in the sessions tomorrow and Sunday should be in no doubt about the answer.

Session 3, 16.50-18.00, Friday 10th September 1999.

50 YEARS OF DISTANCE MEASUREMENT

Arthur Allan

Until the development of electromagnetic distance measurement (EDM) in the 1940s, the derivation of lengths longer than a tape length required much ingenuity from the instrument designer, a deal of skill on the part of the surveyor and considerable care with any reductions and computations. As with all surveying, the environment of the measurement was often crucial in the selection of method. We think of taut wires at sea, sledge wheels in snow fields, and subtense measures inside nuclear reactors. In many situations, such as woodland or tunnel, traversing was, and still is, the only practicable method of measurement, and in detail surveying or setting out, polar methods were and are by far the most convenient, although line-and-offset methods still have their place. Geodetic base lines (typically 20 km) had to be measured in catenary or along railway lines to give scale to triangulation networks; and the dependence upon metal bars for standards of length caused much aggravation, inconsistency and incompatibility. The development of EDM and the ability to realise a length standard as a function of frequency and time has brought greater convenience, much consistency and phenomenal increase in accuracy to the whole spectrum of distance measurement.

The straight line path between two points is by itself of little use except in construction works. Other information, such as slope and height above datum, and computation techniques, are also needed to incorporate a length into a coordinate system. Sometimes length differences or length sums were easier to measure and exploit. With the advent of the microwave Tellurometer, some uncertainty existed for a time about the derivation of the air distance between points whose coordinates were known only on a reference ellipsoid. Also, these same instruments demanded a proper treatment of weights in a network calculation, and exposed the limitations of the piecemeal application of least squares which arose from calculation methods, inevitably limited by mechanical calculators.

In the Table, I have listed some of the instruments used in the past to measure distances or range differences. I do not intended to describe any of these in detail. Some were quite short-lived, while others, such as subtense bars and odometers, still have a place in the contemporary scheme of things. The optical mechanical analogue systems rarely broke down, and many could be repaired in the field if damaged by accident. Calibration and standardisation was a routine procedure (often used as an excuse to avoid unsociable working conditions) and the accuracy obtained, unlike today, was very often highly dependent on the surveyor's skill and care. From among the items listed in the

Table below I wish to comment on but a few.

Why did we have to use 100ft tapes, when others, notably in Malaysia and New Zealand, seemed happy with 300ft or even longer?

Why was the stereoscopic rangefinder not more used? E.H.Thompson always regretted this.

Distance obtained from the stadia intercept on a vertical staff is far inferior to that using two vertical angles, and the process only marginally quicker.

Hybrids were not exploited properly, such as the use of stadia readings to solve the approximate range in early Geodimeter measurement. Froome was not averse to this hybrid approach in his Mekometer, using a steel tape for the interpolation of parts of a wavelength.

The Hunter short base technique was not as widely used as it could have been, although some surveyors, like Sam Evans, exploited the method in seismic work.

Often the circumstances of a survey demanded a flexible approach; recall that busy road, a dangerous railway junction, a cultivated field, a hostile landowner demanding redress, a burial ground, a stretch of marsh, terrain pitted with potholes, land covered with cacti, a field full of randy bulls, a dangerous ravine, a noisy construction site, a dust- filled tunnel, and always the weather!

To have had the facility to point and measure would have been complete bliss! Or would it? There would have been no challenge, and no fun!

Please pass me my Disto, I have a line to measure!

Some Methods of Measuring Distances or Range Differences

(Units: feet and inches/ feet and decimals/ 66 ft and links/ fathoms/metres. Foot/metre conversions eg Sears Johnson Jolly)

Time of Flight Systems		
Camel speed	Eratosthenes	
Ship speed	Knots	
Echo sounder	Flash spotting	Radar
	Shoran/Hiran	GPS
Incremental Systems		
Pacing	Odometer	Pedometer
Strings on drum	Decca	
Steel tape	Flat	Catenary
	With tail Linen	
Cloth tape		Plastic
Laser interferometer	Vaisala comparator	White light
Chain	Gunter's 66 ft	Engineer's 100ft
Steel band	Distinvar	Distometer (diff)
Triangulation Systems		
Subtense bar	2 metre	Hunter short
Two VAs	Allan /Boghaerts	
Opto-Mechanical Systems		
Bar tachymeters	Redta	RDH/DKRT
Vertical tachymeters	Dahlta/RDS	Vertical stadia
Range finder	Coincidence BRT 006	Stereoscopic
Electro-Optical Systems		
Geodimeter	Intensity Modulated	Mirror/comer
Mekometer	Polarised light	Geomensor
Tellurometer MA100	DI 10	Near infra red
Laser ranger	Tetrameter (2-colour)	Disto
Microwave Radio		
Tellurometer	Phase comparison	
SECOR	Doppler (diff)	GPS

Session 4, 09.50-10.50, Saturday 11th September 1999.

50 YEARS OF BOUNDARIES

Brian Parsons

Based on my own experience and involvement in several projects, I aim to stress the vital role which the land surveyor has to play in every stage of a border demarcation project. It is my firm belief that any international border project which does not take full advantage of the unique skills of an experienced land surveyor lays itself open to much subsequent misinterpretation and misunderstanding. A border project may be considered to fall within the following four main phases: delimitation; drafting technical specifications; demarcation; and aerial photography and mapping.

The delimitation process encompasses study of existing treaties and agreements, field visits and reconnaissance, and study of aerial photographs and satellite scenes. It leads to bilateral negotiations between the two sovereign countries involved and to the signing of the Boundary Agreement between the two Heads of State. The land surveyor must play a leading role in this process with regard to the study and interpretation of any existing treaties and agreements, particularly those that contain "metes and bounds" descriptions, or references to lines of geographical latitude and longitude, or to lines joining geographical coordinates, or where lines of the intended border have been marked on existing maps or aerial photographs.

One of the most critical factors leading to the successful outcome of a border demarcation is unambiguous wording of the technical specifications, which need to be drafted by a competent and experienced land surveyor. The specifications must encompass every single aspect of the border agreement reached between the two countries, and must be written in such a way as to minimise any grounds for misinterpretation or misunderstanding. During the drafting of the technical specifications the land surveyor has the oppor

tunity to tighten up any loose wording or inappropriate terminology which may have inadvertently crept into the signed border agreement and which might otherwise have led to misunderstanding regarding the exact intention, if not corrected at this stage.

The demarcation process is where the land surveyor comes completely within his own specialised field of expertise. It involves the following steps. (1) Precise determination on the ground of the correct positions of each of the various border monuments according to the agreed positions and within the tolerances as set out in the technical specifications. (2) Construction of the border monuments. (3) A survey to geodetic standards to determine the coordinates of each constructed monument. (4) Computation of the geodetic coordinates.

The land surveyor is fully responsible for quality control of the aerial photography according to his specifications, and for the subsequent mapping of the border corridor at the various scales specified.

The most significant development which has affected border demarcation surveying techniques in recent years has been the universal availability of GPS. By using geodetic dual frequency receivers, and by adopting precise ephemeris values in the final data processing it is now possible to achieve relative positional accuracies to well within centimetre level with relative ease and at a fraction of the cost and time expended using latter-day conventional methods. This technique has proved to be of inestimable value in the case of recent demarcation surveys undertaken in remote and environmentally inhospitable regions.

Session 5, 11.30-12.45, Saturday 11th September 1999.

50 YEARS OF END PRODUCTS

Clifford Burnside

I will not start by defining what is meant here by the word "surveying" because all those present will know. However, the phrase "end product" does require some further elaboration because I intend to use this term in a rather broad context, as the following comments will illustrate.

Surveying, of our sort, has always been an attractive subject, if only from the point of view of the diversity of its end products. And because of this diversity it has, in its time, provided ample opportunities for persons with artistic or scientific abilities to show their mettle. However, due to the introduction of digital technology, this rich variety is perhaps not as obvious as it once was. But it is still there nevertheless and I hope it will remain that way.

The results of any advancement in a technology are most often made most apparent in the nature of the end products it produces. Some products in fact become obsolete and so cease to exist. Others change so much in the nature of their presentation that, at first sight, they appear to be new products. However, although technologies still seem to be advancing at great speed it seems to be that in fact there are few new end products now being produced. Most of the changes appear to be in form and presentation rather that radically new products. Most interestingly, this situation can be contrasted with that of an earlier era at the beginning of this century, and a little beforehand, when in fact many totally new products did appear. Things such as aeroplanes, motor cars, wireless telegraphy and wireless and television sets are just a few obvious examples. Against this background it is therefore interesting to examine how surveying has developed over the years under the influence of the great technological changes that we have experienced. And it seems that, on a first examination at least, the basic end products are much as they always were. Their forms have however changed, sometimes quite radically. Mapping information in all its forms is in greater demand than ever before and is now needed in digital form but the map and chart are still often required alongside this. Is this because we humans are just complicated electro optical/mechanical analogue devices anyway?

Often topographic and related mapping products are still, in essence, two-dimensional portrayals of a three-dimensional reality where the topographic (or related information) is set out on a planimetric base. Quite cleverly, the often important ground height information was also depicted as an elevation attribute by means of contours, the interval of which could be selected to match the terrain being mapped. However, with the use of computer generated models we now have what I would consider to be a new end product in the form of a three dimensional model: a model whose scale can be changed at will and which can be explored and examined from any selected position. To date I believe many of its uses have been in the field of engineering surveying but it would seem that the full potential of this product has yet to be appreciated by many others.

Over the years, the word "mapping" as used by surveyors has widened considerably beyond the topographic connotation so that now any form or shape can be the subject of "mapping" and this form of application is steadily increasing. In addition to such terrestrial activities there is also the data provided from satellites by remote sensing techniques and this is now another vast source of diverse mapping data and perhaps could also be claimed to be producing new end products in some cases.

Technology is a powerful influence on our end products, but it is not unique because perhaps more than ever before financial forces are now also influencing what will be produced and in what form. It seems, that if at all possible, even activities such as topographic mapping will be required to pay their way and so economic factors of this nature have greatly influenced the work and end products of organisations such the Ordnance Survey. Market forces are very real forces in the modem world of surveying.

So far I have commented on end products as seen by the

customer or user but I think it is also of some interest to consider them from the point of view of the field surveyor or cartographer. For such persons their "end product" would be some finite operation before the final one. It is here that I believe technology has brought about the most dramatic changes. For example, the end product of the plane table surveyor of years ago was clearly close to that of the final product in every way. On the other hand, a surveyor engaged on triangulation would perhaps see his/her end product as a set of nicely closing triangles. And another on high quality traversing, perhaps in catenary, would regard a small misclosure and a set of adjusted coordinates as his end product and derive much satisfaction from this. In the drawing office also there were many tasks that required great skill and dedication to produce an end product that gave satisfaction and pride to the cartographer. These are just a few examples selected to illustrate the point that so many of these intermediate "end products" have disappeared under the influence of advancing technology. Many here today will acknowledge this I believe with some regret, although I hope other skills and sources of satisfaction will have appeared to take their place in some cases at least.

In the above I have said little or nothing specifically about the end products of engineering or hydrographic surveying but many of the points raised above are also valid in these contexts and I hope persons with much greater knowledge of these aspects of surveying will make their comments. Likewise my comments on geodetic work will be also very brief in nature. Here I believe the end products are basically what they always were - parameters that describe as accurately as possible the size and shape of the Earth. But of course the use of extraterrestrial signals both from satellites and further afield have greatly increased both the accuracy and the complexity of the information now available. And it is in this context one could perhaps note one further end product of the past that is now going into oblivion, the trig pillar and the triangulation network.

THE BEGINNING

Jouke Alberda

To start with I offer my cordial congratulations to the RICS Geomatics Division on their fiftieth anniversary. Over the years I have had many contacts with the RICS, in particular with members of what was then the Land Surveying Division, and several of these contacts have developed into longstanding friendships. I wish the Division a prosperous further life.

I have a personal 50th anniversary to celebrate as well. On 12th September 1949 I arrived in Delft to start the study of geodesy, which in the Netherlands, as in several other countries, comprises land surveying and geodesy, including subjects ranging from civil and public law and land registration to physical geodesy. I could afford to start this academic education because I had got an interest free loan from the government some months before when I was demobilised after more than four years of army service. The outcome of a psychological test had been that I could study either chemistry or geodesy. I have never regretted my choice.

The Delft course in geodetic engineering had been established just the year before as a five year course having full academic status. Since 1935 there had been a 3½ year course for land surveyors. This course had a very good level, in fact it formed the first 3½ years of the new engineering curriculum. To this was added half a year of practical work with a public or private organisation. For the final year you could choose between four different groups of core subjects, complemented with optional subjects and the writing of a research paper.

The first two years were heavy, mainly because of the basic general mathematics and more specialised subjects such as differential geometry, projective geometry and optics. At the same time there were less abstract subjects such as law, geology and cadastral administration. Lectures on the theory of errors and least squares adjustment started in the second year. There were only a few introductory lectures on plane surveying and the elements of photogram- metry: you just got a list of chapters and sections of the textbook you were supposed to study. But there were many practical exercises: instrument practice, draughtsmanship, simple detail surveys, levelling; they were a bit of relief between all the theory. Besides, there was a summer camp where tacheometric mapping was practised. In the third year you came into the thick of surveying and geodesy: photogrammetry, more adjustment and error theory, map projections, computations on the ellipsoid, more law, land consolidation etc.

Although the theoretical part of the curriculum was extensive and provided a sound base for further development, the methods you learned necessarily reflected current practice. For computations this meant that students used mechanical machines of the Brunsviga type, of course in combination with a six-place table of the natural values of the trigonometrical functions. There were one or two Marchant electromechanical machines for the staff. One exercise had to be computed with logarithms. We used preprinted computing schemes from the Cadastre for all standard computations such as traverse, resection, coordinate transformations etc.

More than "A capable outdoor sort of fellow." Jouke Alberda on triangulation in Sognefjell, Norway, October 1954.

A general characteristic of the time was that much effort and great ingenuity was applied to reduce or simplify numerical calculation when possible. Apart from the general application of the approximate adjustment of small triangulations and traverses, this led to graphical methods of adjustment and to many nomograms for ancillary computations. In fact in our first year we learned to design nomograms and had to construct three of them. I remember one for the effective range of the light of a lighthouse as a function of its height. In sharp contrast to the tendency to replace computation by graphical methods, we have in recent decades seen that more and more graphical products and methods have been digitised.

In my opinion there is at least one quality that was developed by those now obsolete methods, namely numeracy - a good sense of numbers, including the ability to do mental arithmetic. I am not saying that it cannot be developed in conjunction with modem methods of automated computation, it certainly is as necessary as ever. But some time ago

I saw a team of new students doing levelling practice. I was appalled to see that the young man noting down the readings used a pocket calculator to check whether the average of the upper and lower wire readings was close enough to the middle reading.

In the summer of 1952 I had to do two months of practice and through the international exchange organisation got a place with a small private surveying firm in Norway. The boss was a civil engineer who had much experience in surveying for hydroelectric projects. He was very friendly and generous and spoke fluent English. He had a good sense of humour; we got along very well. The work was mainly triangulation including trigonometrical levelling, at first for a planning map for a small town, later for two hydroelectric projects, both in the rough mountainous fjord region of Western Norway. What I knew about surveying was adequate; after more routine I was observing quickly.

Computations and some map drawing were no problem. It was a great experience, with long walks in the rough beauty of the mountains. Frequently rain stopped our work but gave us time for trout fishing. The boss asked me if I would like to work in his firm after I graduated, and I said I would. In March of the next year the half year practice period started. With three fellow students I went to the Isle of Terschelling, one of the islands strung along the north coast of our country. The work was large scale mapping for the national forestry service and the measurement of an experimental long traverse by the method devised by the Russian Danilov. The sides were measured by establishing an invar base roughly in the middle and extending it with narrow triangles, just as in a baseline extension network. We had a complete set of Watts invar base equipment. It was clearly a few years before the advent of EDM! The traverse was about 16 km long and ran across the entirely uninhabited eastern part of the island, populated by thousands of birds of many kinds. It was the nesting season, the area was closed to tourists. The end station was a lighthouse on the next island. Again an interesting four month period; the most memorable event on the island for me was that I met the one who one year later became, and still is, my wife.

Two of our team came with me to Norway for another two month period of practice with the firm where I had been before. The work was mainly a large triangulation for a hydroelectric project in the west, including the adjustment and further computations which we did in the office in Oslo.

I graduated in June 1954 and married the day after. My supervisor, Professor Baarda, offered me a job on the staff of the geodesy department, but I had promised to go to Norway and judged that I wanted real practice before starting a career in research and teaching, which nevertheless attracted me. My wife and I had an unforgettable time in Norway, although it was not always easy. The housing situation was especially very difficult. We had learned the language. I liked the work in Norway which often had to do with projects I had worked on before. They were now under construction so that tunnel control was a new activity.

I had a letter from Professor Baarda who asked me again to come and work in his group, adding that houses were being built for the university staff. Shortly after our daughter was bom we moved back to our country, where I started work at the department of geodesy on 1st September 1955. I retired on 1st September 1988.

To quote from the Report on the History and Status of Surveying in the USA by George Bestor at the FIG Congress in Delft 1958:

"I seriously fear that the frontier surveyor, so necessary a person to the growth of our country, gave the general public a lasting impression of the surveyor as a capable, outdoor sort of fellow, slightly higher in the social scale and in education level than a plumber or carpenter, but definitely something less than a professional man or scientist."

This impression is understandable, also in other countries, when you see such a capable outdoor sort of fellow. But well - what is an impression worth?

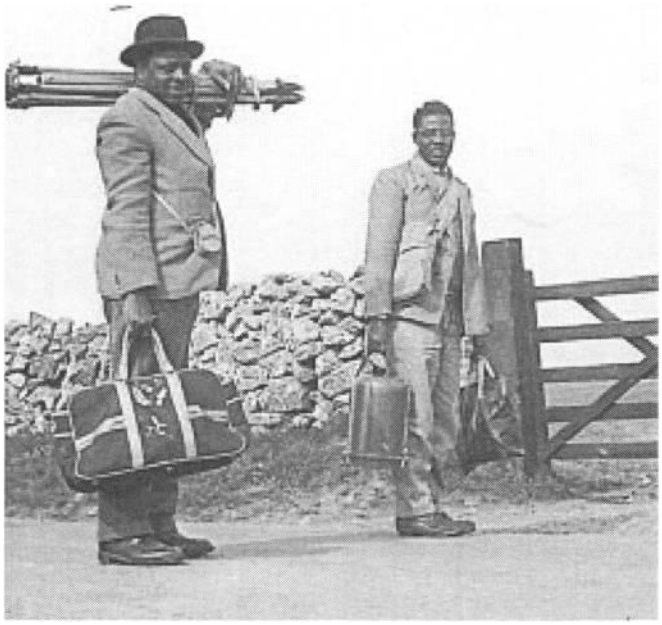
HOLLWEY'S ACADEMY, 1960 TO 1970

Arthur Allan

I first met John Hollwey at the Commonwealth Survey Officers Conference in 1959, and on hearing I was looking for a job, he invited me to apply for a newly created post at the South West Essex Technical College, later to be affectionately known in land surveying circles, because of many name changes, as "Hollwey's Academy". The new post was created to provide teaching for the RICS final examination in geodesy. I joined the staff in January 1960, to be given a heavy teaching load of 23 hours per week in which I had to teach A-level applied maths for RICS first examination, map reading to quantity surveyors, cartography and topographical surveying for the RICS intermediate examination, geometrical geodesy for RICS finals, and mathematics to City and Guilds students of woodwork. The surveying section was staffed by John R Hollwey, Zenon M Michalski, W Kenneth Kilford, George Harrison and H J Jones, with assistance from John H B Maynes (civil engineering), and Norman M Abbey and Fred Taylor (land law). Further support was given by Mrs Church, Mrs Hollwey and later John J Loader (all maths), Geoffrey Fisher (physics) and Bob Smith was a valuable fixer and store-man. The land surveying section formed part of the large Department of Architecture and Building, headed by Fred J Batson a mechanical engineer. The department ran professional courses in civil and structural engineering, general practice and quantity surveying, architecture, craft courses in building, woodworking etc: a veritable gallimaufry of subjects and academic levels.

Having evolved from technical school to technical college in 1938, the college, ably led by Dr Lowry, was going through a troublesome metamorphosis to polytechnic status: from a tightly controlled administration under the control of Essex County Council to a self governing body. Few internal awards were made. Most students were examined by external bodies, City and Guilds, professional institutions such as the RIBA and the RICS, and for two external degrees of the University of London; although there were some notable exceptions in the case of HNC and civil engineering students examined internally with external moderation.

The land surveying course was of five years' duration. The first two years brought studies to A-level standard in pure and applied maths and physics, together with examinations in drawing, map reading, and chain surveying and levelling, all examined externally by the RICS. After two further years, students sat for the RICS intermediate examination in topographical surveying, computations, land registration, and engineering surveying, and had in addition to submit as course work an estate survey and a plane table survey, again to be examined externally. To those who have never experienced it, teaching to an external syllabus



Dressed for the field, Somerset, 1962. Okuwah (Nigeria, left) and George Bakibinga (Uganda, right).

examined by persons unknown to teacher or examinee was a nightmare of guesswork and frustration. To be fair to the RICS, as I subsequently came to realise being party to the RICS examinations from the inside, painstaking efforts were made to set fair standards both in the questions posed and in marking.

John Hollwey (ex Gold Coast Survey Department) introduced field courses held away from Walthamstow, in Somerset - his home county. Each year there would be a battle with Essex County Council to obtain the necessary funds to pay for staff subsistence. In these battles John showed the typical aggression needed of a rugger hooker, which was his favourite position, often reducing pay clerks to tears before the cash was forthcoming. In fact the whole effort to drag the college from a school to university mentality was a war of constant attrition. Pantographs were set up in corridors to demonstrate the need for a cartographic laboratory, hand calculators were noisily ground away in a communal staff room to secure our own staff accommodation, the librarian Miss V. L. Jenkins aided and abetted to secure the necessary journals and sets of reference and textbooks, and the head of department and instrument manufacturers colluded at many subterfuges to evade the stranglehold of the customary annual round of expenditure. Heady times these were, but quite debilitating!

After a period of agonising growth and a staff turnover showing appearances by Keith Kear, Mike Barrett and Alan Haugh, the academic staff was augmented by the arrival of Cliff Burnside, Greg Cole, Barry Gorham and Alan Ingham. Ken Borley took over the stores from Bob Smith. Fred Batson then had to deal (I must say success

fully) with a dedicated bunch of assertive individuals, whose main purpose was to raise the course to the highest possible standards and develop some measure of innovation and creativity. On the academic side, all staff had had a survey education which was limited to the very specific applications in colonial surveying or in the Ordnance Survey, with the crucial exception of "Mick" Michalski, who was steeped in the wisdom of the tomes of Jordan's "Hand- buch der Vemessungskunde" and many others. For the British-educated staff to break through their own academic ceiling was no mean task, and without the stimulus, encouragement and downright aggressive criticism of "Mick", it would probably not have taken place. By the time the college came to present a case to the Council for National Academic Awards for its degree course, all the hard thinking had been done, the course units were in place and the justification could be argued with a cogency and enthusiasm that was bound to succeed. So the CNNA degree in land surveying sciences came into being in 1969.

It was a curiously awesome experience to nurse the first ever degree students through their course. It must have been an equally strange feeling for the students themselves, who realised that they were making history. As a staff member I cannot thank them too much for the way they accepted the challenge to see that their opportunity was not wasted. It would be invidious to mention names - many are now well known in the survey profession and speak for themselves. From the staff end, as members of the interim academic board, we went through endless discussions preparing the way for proper polytechnic institutions with sensible staffing links with appropriate universities, where the main research would be done. All of this effort was thrown on the altar pyre of personal ambition by the first Director of the Polytechnic and a wonderful opportunity to establish a financially viable cooperative dichotomy in higher education was missed.

Priddy adders at work, Somerset, 1962. I to r: Mike Rice, Dave Watson, Dominic Moss, Jan Karalus

SURVIVING THE COUPS

Malcolm Anderson

A succession of military coups and unrest among the people brought an end to Nigeria's brief flirtation with parliamentary democracy. The Northern Nigerian Survey, which had already been weakened by the departure of most of its expatriate surveyors was, in September 1966, struck a mortal blow by the exodus of many indigenous members of staff. As a result, less than a year after I took over the topographic mapping section from the departing Cliff Burnside, it went abruptly into terminal decline.

Survival in Northern Nigeria in the 1950s and early 1960s had meant little more than making sure my bed roll and Shortrede tables arrived safely at the next camp site. Suddenly, with rioting on the streets, survival took on a new meaning. In 1967 I moved to the minesfield cadastral section on the Jos plateau where our tertiary trig beacons, constructed as resection targets, stood on the hills like solemn white madonnas, more conspicuously than any OS trig pillar ever did. Perhaps the greatest risk to their survival, and mine, was that the area had the second highest incidence of lightning strikes in the world.

The Survey office was adjacent to a fuel storage depot, a possible target for Biafran air raids. As if to prove it, three audacious mercenaries on a reconnaissance mission landed their plane at the airfield one day, drank beer at the club, and flew off again, apparently unchallenged. Soon afterwards there was an enormous bang, a blinding flash of light, and all the telephones rang simultaneously. The office had been struck by lightning.

When Northern Nigeria ceased to exist as a political entity in 1968 and was divided into six new states, the future of survey looked uncertain. Staff were transferred according to their birthplaces, and records and equipment shared. There was a great shortage of senior people, and expatriates, charged with the statutory responsibilities which the title 'Surveyor-General' conferred, were asked to set up and oversee the new survey departments. After arranging the subdivision of the minesfield cadastre I was posted to such a position at Bauchi in the vast North-Eastern State where I headed a slowly expanding and very busy unit over the next 8 years.

Nigeria's oil revenues provided funding for development and I was soon faced with a huge cadastral programme together with work on administrative boundaries, township control networks, control and field completion for aerial mapping, State thematic mapping, town planning, assistance with the US 12th parallel survey and the provision of control and map information for all government departments, developers and the public. I appointed several well known British and Canadian companies for aerial photographic, mapping and town planning work and DOS teams were at work on medium scales topographic mapping.

Few local people with the requisite educational qualifications showed interest in taking up surveying as a career, but I managed to recruit a few contract surveyors and overseas volunteers. However, one "qualified" planner sent to me unannounced from an Asian country never quite grasped the concept of contours and habitually tried to absolve himself from the engineering problems which his designs were apt to create!

Unpredictable events sometimes made life interesting; for example, when townsfolk, aided by policemen, made off with the remnants of my office roof after a storm, leaving precious cadastral records exposed to the elements; when termites tunnelled their nocturnal way through my map stocks; when a monkey climbed through my office window and attempted to purloin my Hewlett-Packard calculator; and when a Bilby tower was pulled over by the US 12th parallel team hoisting components using a powerful truck instead of manpower.

On other occasions my map stocks were suddenly declared classified documents and requisitioned for military exercises; at a military road block an ex-survey labourer, proudly wearing his battledress, recognised me, threw a smart salute, and shouted for the barrier to be opened to let the "General" through; the army commandeered survey vehicles for "emergency" use, which transpired to be journeys to country markets for domestic food and firewood supplies, picking up fare-paying passengers en route; bush survival techniques were necessary when fuel supplies, and electricity, water and telephone services failed; a change of military regime meant replacing the mandatory pictures on the office walls and hastily departing on tour when a black- edged card arrived on my desk inviting me to witness an execution by military firing squad; and having to explain why I had acted in land acquisition and survey matters on behalf of a now discredited administration.

In 1976, after more upheaval, the North-Eastern State was in turn abolished and I moved to Bomo, one of the three new States which replaced it. The dispiriting task of apportionment of staff, records and equipment was repeated, this time with such avarice that in the quest for spoils one obsequious individual held that coveted items of survey equipment be broken into three parts of equal weight, and my reasoned solution for dealing with rights overlapping inter-state boundaries was met with arrogant intolerance. I was detained on military instruction and my passport was confiscated.

One of the qualities of the statutory cadastral system, incorporating rigidly controlled survey and accurately charted plans, was that it provided the security required for development loans from the banks. But, due to staffing shortages and frequent changes of priority, a huge backlog of work had developed. My proposal to speed up the grant of title by the use of aerial survey was regarded by a newly empowered society (which lacked understanding of even the simplest methods of surveying and had no notion of the surveyor's ideals and motivation) as a confusing technical attempt to perpetrate a cadastral system which was running into disfavour. A simpler means of acquiring secure rights in land was needed, something more akin to established local authority and customary systems, which could be

manipulated to personal advantage if desired, and which did not depend upon survey plans. Very senior people and lands staff began bending the rules of land administration and, with the aid of "moonlighting" junior surveyors, engaged in malpractices which threatened the probity and accuracy of the statutory system.

Adherence to the letter of the law had landed me in hot water several times so, with the future likelihood of more coups, more new States and the erosion of the system I was employed to maintain, I decided to look to my own survival and my future career. When the opportunity came to return to England in 1977 as Chief Land Surveyor with the Milton Keynes Development Corporation I did not hesitate. Ironically, one of my first tasks upon arrival was to examine, on behalf of our engineers and planners, a recently arrived consignment of familiar looking large scale maps of African bush country. I declined to join the Milton Keynes team which had been contracted to go out to design the first phase of Nigeria's new capital city, Abuja. ***(See also colour page 20)***

THE NANDI TOWER

Bill Barnes

In January 1955 I had been employed as a Staff Surveyor by the Survey of Kenya for all of 3 months. For most of that time I had been engaged on preliminary checking of cadastral plans. I had learned how to say "please", "thank you", "hello" and "goodbye" in Swahili and the previous year I had completed the 9 month Land Surveying Diploma Course at University College London. Apparently, in the eyes of the Director of Surveys Jim Butler, I was ready for some serious survey work. He evidently believed that I, with such a wealth of experience, could lead a party of surveyors to undertake the recce, pillar construction and observations of the primary triangulation of north Nyanza, making connections to several trig points near the Uganda border which had recently been coordinated by the Directorate of Overseas Surveys. Fortunately, included in my party were Laurie Bamford, John Caukwell, Derek Pavely, John Hobson, Steve Lowsley, Ian White and Bernard Blowers, all of whom could speak fluent Swahili and most of whom were well experienced in bush life and a great deal more knowledgeable as regards surveying than I. "It should only take you a couple of months" said Jim Butler, "you'll be back in Nairobi before March or April." He was right. We returned to Nairobi in March 1956, fourteen months later!

The reason for this extended safari was largely due to the weather. Those familiar with northwest Kenya will know the conditions that prevail during the rainy season: murram roads (no tarmac in Nyanza in those days) become quagmires; high humidity and low cloud make visibility during the day difficult; primary observing to lights during the hours of darkness is virtually impossible. To help fill in the time we were subsequently directed to recce, monument and complete the observations of the secondary trig breakdown of our primary scheme, to construct and fix by intersection a suitable signal on the summit of Mount Elgon and, just for good measure, to provide photo control for a couple of settlement schemes at the foot of Mount Elgon.

When going on safari, one visited field headquarters to acquire transport, equipment and porters. Little did I know that we were the last of several such groups being made ready for safari and, as a consequence, we were left with the dregs - that is, the dregs of the transport and some of the equipment. Our Land Rovers and truck were, on the whole, knackered. Some of the tents were far from waterproof and few outers fitted the accompanying inners. Camp tables, chairs and beds seemed to have minds (usually evil) of their own and were generally inclined to a state of collapse whenever humans went anywhere near them. However, on the bright side, the items of technical kit - theodolites, levels, etc. were in good order, particularly the Wild T3, that beautiful theodolite with which we were to carry out the primary observations. But more of that later. Still

Intersected signal on the summit of Mount Elgon, Kenya, 1955. Tony Talbot (Agricultural Officer) standing left, Bill Barnes standing right.

on the bright side, we were also allocated a great group of porters including two splendid headmen. Although, on occasion, they had every right to protest, particularly when salaries were late in arriving, or when the rain poured in through their flimsy tents, or when yet again they were instructed to manhandle more signal-making tree trunks or loads of sand and cement or jerry-cans of water up yet another enormous "hill", there were very few complaints.

One such hill formed part of the Nandi escarpment and on its boulder-strewn summit it had been decided to establish a primary triangulation point, the central point of a classical centre-point polygon. One of the rays from this point passed westward across the ridge of the escarpment to another primary point, Mwibale, some 2030 miles away. From the recce it was obvious that this ray was obstructed by trees in the Nandi Forest atop the ridge. "Not to worry, we'll build a Bilby Tower" said I. Observations to calculate the required height of tower to clear the forest were duly carried out (taking care to make the necessary corrections for earth curvature and atmospheric refraction) and the results checked and rechecked. We needed a 60ft tower. The request was transmitted to Nairobi HQ and eventually a truck arrived with the components and construction plans of the tower.

According to John Loxton, Assistant Director (Field), it was possible to erect the tower in a day - that is, on the flat lawn in front of Field HQ, with forgiving earth and with people who knew exactly what they were doing. At Nandi the site was horrendous to say the least. The boulders sur

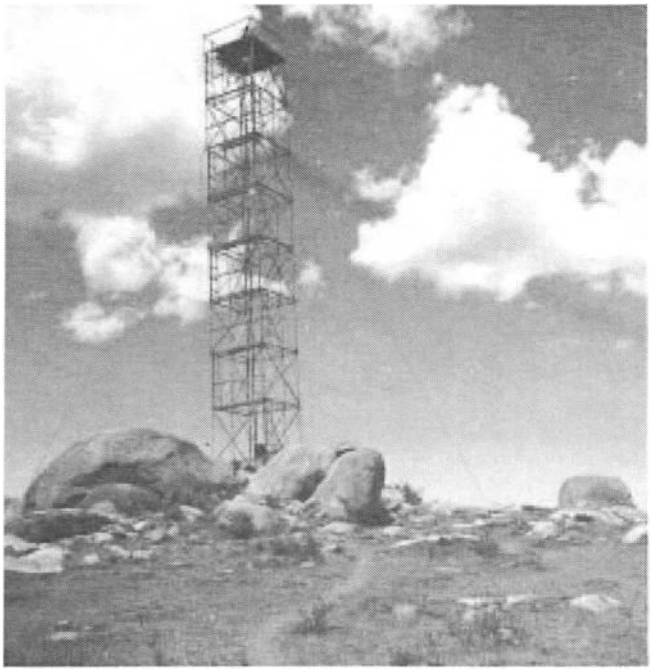
rounding the pillar were enormous. It soon became evident that the anchors of the upright supports of the inner and outer tower would require concrete footings several feet deep as opposed to the 6 or 7 inches as recommended on the design drawings. As to construction know-how, neither I nor my observing partner, Bernard Blowers, had ever built anything more complex than a crane from a Meccano set (though Bernard was a genius with a faulty car engine). However, the footings were duly constructed and work started on the erection of the steelwork.

Now I should say that I never have had a head for heights and I was therefore full of admiration for Bernard who appeared to be totally devoid of nerves when suspended on high. It was he who clambered and swung up the supports and struts of the rising tower emulating the Colobus monkeys in the nearby forest. It was he who very nearly came to an untimely end when forgetting to use the safety rope and falling a couple of sections between the inner and outer towers from about 40ft before managing to cling on to one of the supports. It was he who completed the tower and who coaxed me to the top one starlit, windless night only to find, when observing, that the topmost branch of an unidentifiable tree in the forest was still obstructing Mwibale! Frustratingly, the Mwibale light could be clearly seen, but due to the single offending branch the light was totally diffused. Imagine the scenario: indigenous rain forest stretching over undulating ground from a point a few hundred yards from the pillar to the crest of the escarpment a mile or so away. How do we locate the tree? Compass traverse, rope and whistle, smoke signals, poles fitted with coloured bunting we tried everything, but that cursed branch remained stubbornly fixed in the theodolite's field of view following each attempt.

I should emphasise that this indigenous forest contained some very large and very valuable trees. Cedar, podo, elgon and olive were recognisable, but there were many other equally exotic specimens with which we were unfamiliar. Sadly, recognisable or not, many of these forest giants were sacrificed in the name of progress as Bernard and a couple of the more agile porters were let loose in the forest canopy with axe and panga. Despite lengthy discussions and explanations, the local Forest Officer, who could not be convinced of the need for this sylvan mayhem, promptly lodged a formal complaint, together with a sizeable invoice, to Survey HQ.

At this late stage, and by now grasping at straws, it was thought that perhaps the problem could be solved by increasing the height of the instrument by a small amount. The instrument tripod was therefore lashed fast to the observing platform and the instrument secured to the tripod and centred over the ground pillar. That night, glory be, standing on a beer bottle crate to view through the elevated instrument, I had my first unobstructed view of the Mwibale light.

At this point I should explain the design and structure of our tower. There were in fact two square-section towers, each guyed independently by wires to ground anchors. The inner tower supported the instrument platform plumbed



The Nandi tower, Kenya, 1955. Founded on boulders.

over the ground pillar. It was totally independent from the outer tower which gave access to the observing platform by means of vertical ladders and metal grid catwalks provided for each vertical section. Each vertical section was some 10ft high with single safety rails provided for the cat- walks but not for the ladders. Recognising the possible dangers of climbing this structure in the dark, with T3 theodolite, field book, lantern, a flask of coffee and blankets (it could get extremely cold at night in Nandi especially if the wind was blowing), we had devised a routine for ascending and descending the tower. Bernard, with lantern, blanket, field book and flask would ascend the first 10ft ladder. I would then do likewise, passing the theodolite through the hole in the catwalk to Bernard who would then move along the catwalk to the foot of the ladder of the second section. There he would wait with theodolite secure until I reached him with the other bits and pieces and took charge of the instrument. He would then ascend the second ladder and wait on the second catwalk until I had followed and passed the theodolite to him through the catwalk hole. This process was repeated up the six vertical sections of the tower and then reversed on descent. This procedure appeared to work admirably and the observations went on apace. However, due to the number of stations to be observed from the tower, the long observing distances involved, the unstable weather, and the fickleness of some of the light units at the distant stations, it took six weeks to complete the observations.

One night, about three weeks into the observations, a particularly strong wind was blowing from the west wreathing the tower in swirling, wispy cloud. Our ascent routine was progressing satisfactorily until section 4 was reached. Bernard, as usual, had moved along the catwalk with theodolite and blanket and I was now climbing the section 3 ladder. For some unaccountable reason he had then placed the theodolite on what he thought was the cat walk and began to climb the next ladder. Unknown to him he had placed the instrument on one comer of his trailing blanket and as I appeared through the hole of the catwalk, to my horror, I saw his blanket being pulled from under the theodolite as he started to climb. Too late! As I bellowed a warning, the T3 tilted and, as in slow motion, disappeared over the edge of the catwalk. We stood numbed, totally transfixed for what seemed an eternity before we heard the sickening sound of the impact on the rocks 40ft below. Bernard's first printable words were "Well, there goes my career with the Survey of Kenya!"

We descended the tower, located the instrument amongst the boulders and proceeded to my tent near the foot of the tower to inspect the damage. In the tent my wife Marjorie, recently arrived from the UK, had heard the impact and had instantly thought that one of us had come off the tower. Great was her relief when she learned that the "only" damage was that sustained by the T3. The upper part of the protective carrying case was badly dented and there was a distinct smell of spirit emanating from within. Surprisingly, however, on releasing the securing hooks, the cover came away effortlessly and our hopes rose. Both bubbles had shattered but they could be easily replaced. Our hopes mounted. The horizontal motion was tested. Smooth as silk. Our hopes increased. The telescope was transited or, should I say, an attempt was made to transit the telescope producing an ominous grating, crunching, grinding noise. Our hopes were dashed!

The matter was reported to HQ. I was briefly recalled to Nairobi for an enquiry, received a bit of a roasting and some learned advice from my superiors, and within a short time was back at the tower with a replacement T3 to complete the programme, but with a changed routine. Henceforth, the instrument, strapped in a harness, was hauled up or lowered down the tower using three independently secured ropes each capable of taking the weight of 50 T3s in freefall! Overkill maybe, but destroying one T3 is enough in the life of any surveyor and we were taking no chances with the second.

The Nandi Tower observations were duly completed and I can only assume that they were acceptable. Our reduced angles were certainly within acceptable tolerances but we were not responsible for the adjustment computations they were left to the computing boffins in Nairobi or DOS. Presumably they met the requirements, otherwise I most certainly would have heard about it.

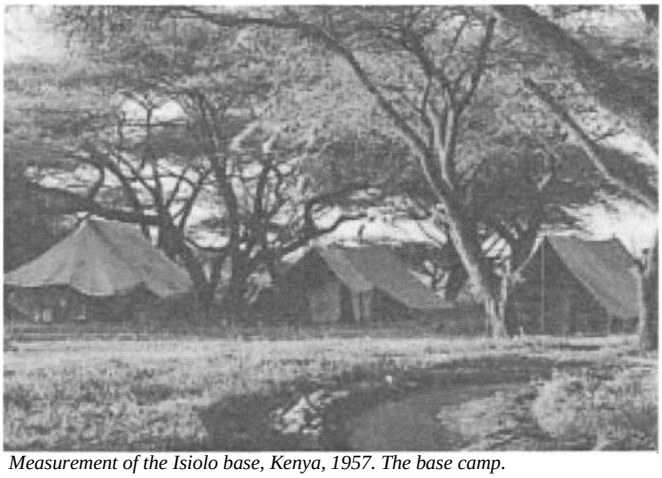
Today, with the almost universal use of GPS for the provision of geodetic control, most of the trigonometric monuments of national frameworks have become redundant. Apparently, one can now apply to the Ordnance Survey to adopt (and presumably maintain) any trig pillar that takes one's fancy. If the same policy now applies in Kenya and I was still resident in that country, I would certainly seriously consider the adoption of that Nandi primary trig point even without its tower!

NEW LAMPS FOR OLD

Derick Bell

In March 1957 a strange beast crawled slowly for thirteen miles across the African scrub around Isiolo. The backbone consisted of two 100ft invar tapes constantly switching from carrying poles to measuring tripods and held in free catenary by heavy weights. The skin was formed by 120ft x 7ft of hessian, supported every ten feet by a labourer with a 6ft pole, which crawled forward in strict time with the tapes. The antennae were clearing and aligning parties establishing forward tripods at carefully sited 100ft intervals; the tail, a levelling party establishing tripod head heights before the tripods were rushed ahead to feed the voracious aligners. The nervous system constantly measured the temperature using three invar clad thermometers on forked sticks while reading tape graduations on the microscope heads of the tripods. Spending a month at either end of a 100ft tape trying to simultaneously read magnified graduations to an estimated 0.00001 of a foot every 40 seconds tends to create a very nervous system.

The beast moved forward in 100ft steps and covered an average of a mile a day. On reaching one end it turned tail and retraced its path solely to see how far it had gone. The finally-corrected back and forth measures agreed to one part in 1.5 million. The measurement took from 8th March to 8th April in 1957 and provided full-time employment for three D.O.S. surveyors (the present author, George Godon and Capt. Alan Jauncey R.E.), a staff surveyor (Mike Barrett), two cadets of the Survey of Kenya and over 60 local headmen and labourers all under the guidance of Principal Surveyor Poitr Kozlowski. All were housed in a comfort-

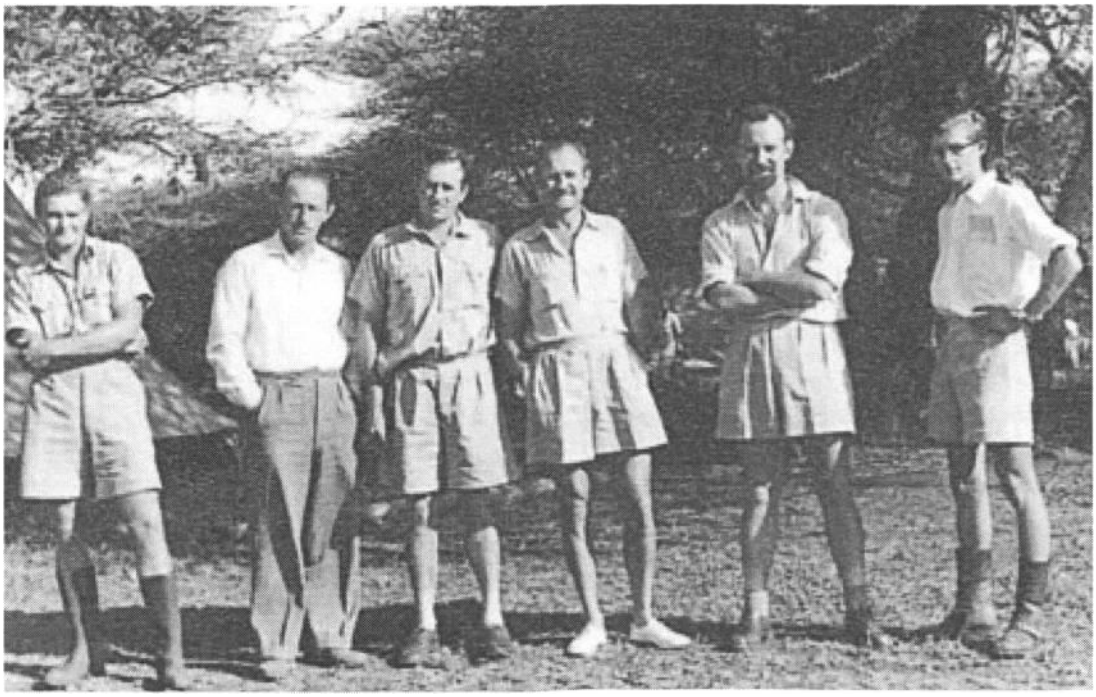


Measurement of the Isiolo base, Kenya, 1957. The base camp.

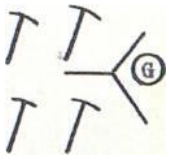
able tented base camp in the bush where a succession of eminent and interested visitors were entertained.

In July 1957 I returned to measure the same base in a matter of minutes as part of the first serious use of the Tel- lurometer. The remeasurement was the first leg of the 400 mile Tellurometer tower traverse from Isiolo via Garissa and Garsen to the coast at Malindi. This also took a single month and a similar work force deployed on measuring, lightkeeping, building towers etc. but, by the nature of the task, it meant spending every night in a lonely bivouac or Wimpey tent at a different point on the roadside a much less comfortable existence.

The Tellurometer measure of the base agreed with the, ground measure within 3 inches in 13 miles or one part in 280,000. It was happily accepted, the MRA 1 Tellurometer became the first of a new generation and the Macca Base Equipment passed quietly into history. Life was never to be so leisurely (or so monotonous) again.



Measurement of the Isiolo base, Kenya, 1957. Surveyors (l to r): J. Vaughan; George Godon; Mike Barrett; Piotr Kozlowski (in charge); Derick Bell; and R. Holloway.



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Appendix E

Personne11 and Duties

P^M.Kozlowski - 0 i/c - admin* and general assistance where needed

© © ©

Aligning Party *Z*J♦Godon J♦Vaughan

© **Headman III & lab* for rough tape**

G © **4 labs* - emplacing tripods**

Measuring Party J.F.Bell

/ **M*M*Barrett R*Holloway**

2 **Headmen II - weight carriers**

2 Lab*I - trestle bearers

© **3 Lab*II — thermometer boys 2x3**

Lab*I - tape carrying teams

(S) Headman II — i/c windshield ©

© **13 Lab*II - windshield supports**

Levelling Party

(j) Capt.A*Jaimcey R*E*

• Lab*II - umbrella boy ©

2 Lab.I - staff boya

General

(5) Headman III l/c

O 8 Lab*II — tripod boys(each having his own tripod)

(C) 2 Lab*II — water boys

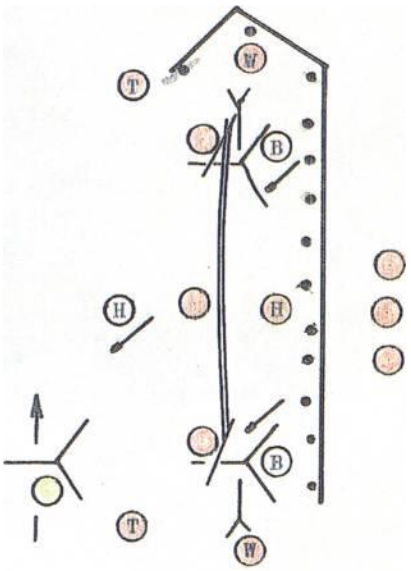
© Cookboy - Surveyors' boys took this duty in turn

Base Camp

Storeman

Headman III i/c

4 Lab*II - camp duties



O

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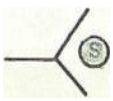
In addition a general float of some half a dozen boys to cover incidental casualities, sickness, discharges etc*



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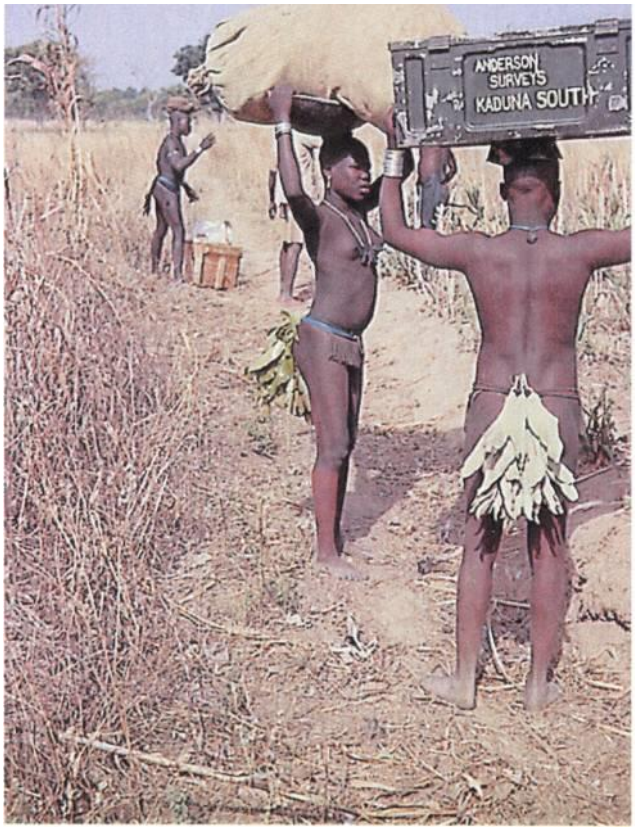
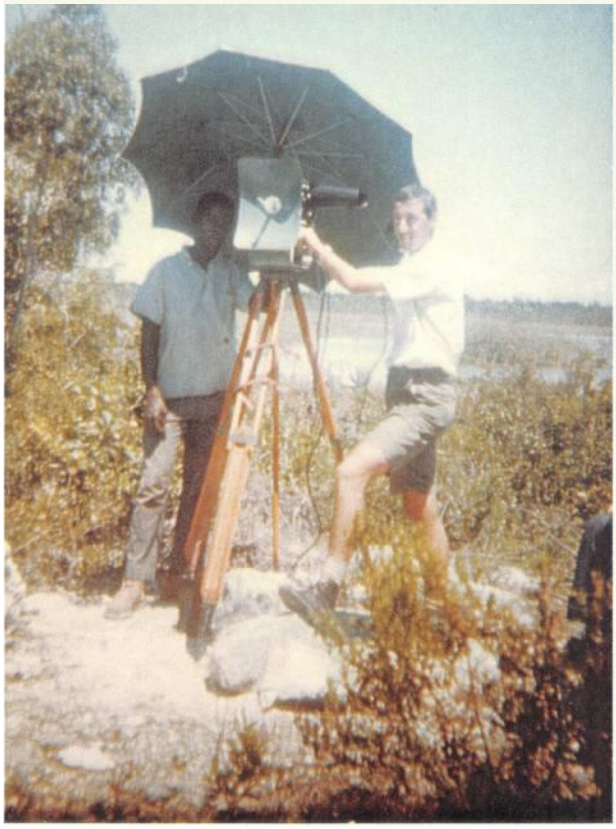
Measurement of the Isiolo base, Kenya, 1957. Diagram showing the disposition of the measuring party.



Young Kadara porters on trek from Libene. Northern Nigeria, 1963. (Malcolm Anderson)



New Providence Island, Bahamas, September 1963. David Broome, chainman and Tellurometer MRA2. (David Broome)

A crumpled Bilby tower near Damaturu. Northern Nigeria, 1969. (Malcolm Anderson)

MAPPING SOUTH GEORGIA

1955 - 56

Tony ***Bomford***

Members of the 1995-96 South Georgia Survey ; at the head of the Konig glacier above Husvig whaling station on 30 November 1955, the 59th day of the first 60-day sledge journey.

L to r: Tom Price, b.1919 (mountaineer); Louis Baume, 1919-1993 (mountaineer); Keith War bur ton, 1930-1959 (2i/c, mountaineer, doctor); George Spenceley, b.1922 (photographer, mountaineer); Tony Bomford, b.1927 (1st Surveyor); John Cunningham, 1931-1980 (mountaineer); Duncan Carse, b.1913 (leader); Stan Paterson b.1924 (2nd Surveyor).

On 10 February 1955 I was surveying in the Usambara mountains of what was then Tanganyika, under the benign control of Chris Bere, many hundreds of miles away in Dar es Salaam. A letter from John Rawlence, one of my avuncular minders at the War Office, arrived by runner from the Lushoto post office. Duncan Carse had met the Director of Military Survey at a cocktail party, and persuaded him of the benefit to both parties that would result from seconding a military surveyor to finish off the map of South Georgia. Duncan had already led two privately financed expeditions to survey the island, with varying success; but he knew what he needed to finish the job: two competent surveyors and six experienced mountaineers. I was asked if I would like to go, and replied by telegram.

So on 25 August after acquiring instruments & stores in England, eight of us sailed from South Shields on board a whaling transport. The second surveyor was Stan Paterson, a statistician by profession who had carried a height traverse across Greenland on Simpson's expedition, and could handle a theodolite and calculating machine with equal facility. He was a competent mountaineer, and so were all the others except Duncan. We arrived off South Georgia in a rose-pink dawn on 25 September. The main island is about 120 miles long, seldom as much as 20 miles wide, with a deeply indented coast. Mt Paget rises to 9625 ft and twenty-three peaks exceed 6000 ft. About two thirds of the island is covered in ice and many glaciers flow into the sea. The weather is bad: the summer temperature is usually between -5°C & +5°C, not cold by polar standards, but often wet and unpleasant. Mists and high winds predominate. Nobody has ever lived there permanently, but three companies had whaling stations on the north coast, and the summer population rose to 2,000, of whom about six might be women. The annual catch was worth about three million pounds sterling. The surrounding seas were full of hazards, and four ships had been lost or badly damaged since the second World War. The interior of the island was uninhabitable and deserted.

On his two previous trips, Duncan had learned how to live, travel and work in the interior. We man-hauled three sledges, lived in small two man tents, and on our first journey were in the field for sixty days, completely self-contained. We seldom had to backpack, but could carry our sledges and surmount rugged country. By the end of March, we had spent 140 days in the field: surveying had been possible on 31 days; we were able to travel on another 49; and on 60 the weather had confined us to our tents.

I was entirely clear as to our task: not to survey more of South Georgia to some preconceived standard of accuracy, but to complete a map of the island at 1:100,000 as best we could in the time available. Triangulation was not a severe problem. Time was the enemy. Our mountaineering skills went into choosing triangulation stations that could be climbed rapidly, and in getting safely back to camp, often in mist. A survey party consisted of three men, and a full set of observations required three hours of intense work, during which they had to keep warm and in their right minds. There was no question of building cairns on unoccupied summits, but many of the peaks were sharp and made fair targets in a theodolite. On an exploratory survey at 1:100,000 an error in position of 10 m is trivial, but the scale error in a line joining two such points 10 km apart is 1:1000 and the azimuth error 3 minutes; and unless controlled these errors mount rapidly. Instead of measuring just one or two baselines and astro azimuths with extreme accuracy, by the end of the season the 240 trig points (88 occupied) on South Georgia were controlled by 8 taped baselines and 18 sun azimuths with accuracy sufficient for our purpose. We observed astro fixes whenever the skies were clear, but in 1955 - 56 this occurred on only six nights.

The problem of recording the topography had not been resolved satisfactorily on Duncan's previous trips. We had no air photographs: there was no aircraft, no airfield, and no money. Plane tabling was too slow if not impossible. Haphazard ground photographs are difficult to compile into a map, and photos are no use until one has access to a dark room. A photo-theodolite had been tried in 1951, but the photos turned out badly and the angles proved inadequate. A rapid, comprehensible and permanent method was still required. We took hand-held panoramic photographs covering the full horizon at every survey station, and while the observer and booker were recording angles the third man drew an accurate and detailed panorama on squared

Tony Bomford with the theodolite and Louis Baume with the tripod coming down from "Icing West" (4792 ft) on 14 February 1956. Mount Paget (9625ft) at top right.

paper with the help of a prismatic compass. The theodolite was always set in the magnetic meridian, and when the main angles were finished, the drawn panorama was flooded with as many angles as time and the weather permitted, recorded direct on the squared paper. The panorama also indicated, with their temporary names, the distant trig points to which the surveyor had observed. The weather usually prevented us getting all we wanted at a station.

We carried a Favag handcranked calculating machine, natural trigonometrical tables and a sliderule with us in the field, and computed and plotted the triangulation when confined to our tents. In a better climate we would have had more time for observing and less for computing, but there are many advantages in computing and drawing as promptly as possible. Difficulties frequently arose; but with the work fresh in the surveyors' minds, they could nearly always be resolved at once from memory. Six months later and 6,000 miles away that might not have been so.

On the same principle, as soon as we were back at base, the panorama photos were developed and printed, the calculations were completed, and a map of the area just surveyed was drawn. We drew at 1:100,000 with 500 foot contours. This may seem a large interval for the scale, but the island is so mountainous that except for some low areas near the coast this interval gives a fair picture of the terrain. After our first journey, a draft map was ready for printing six days after our return to base. A map of the western end of the island was ready before we left on our third journey; and when we arrived back in England, draft maps had been drawn of all the areas surveyed. They were later to be improved, but we thus insured against the lost of our records, and against their unintelligibility.

There were other benefits. We had something to give the whalers, which persuaded them that their kindness and assistance to us had not been given in vain. The draft maps also helped Duncan's financial situation: the expedition was undertaken without public funding, solely on the money Duncan could raise (£4,500) and he returned with something to show for it.

Lying up in bad weather, and for the first week on the ship coming home, I had another task: revising (from edition 1 of Bomford's Geodesy) for my final RICS exam. I took it in the captain's day cabin on 12 April 1956, with Keith Warburton, the expedition doctor, invigilating. I did not find it easy. The RICS has long prided itself on having people able to sit its exams anywhere in the world, and for a while this was their prize example. It was some time before I knew I had passed.

Surveying an island from within, it is inevitable that the offshore side of long peninsulas and neighbouring islands remains invisible to the surveyors. Duncan returned to South Georgia, carefully briefed, for the southern summer of 1956 - 57. He travelled everywhere he could with the sealers, then with the whalers, and then on foot around the whaling stations. He returned with 1600 photographs, near-

The return measurement of the Brogger base-line, 8 February 1956. It had been a lovely morning, and we had started measuring angles from the base terminals and its extension at 0400h. Now it is nearly noon. The outward measurement went well enough, but on the return measurement the wind has risen and with hoods up and the wind roaring it is difficult to hear words of command. Tony Bomford is lining up the leading end. Drift is beginning to scurry across the snow and measurement is difficult, but the two measures agreed satisfactorily and we retired to our tents and sleeping bags for a hot drink and a sleep.

ly all in panoramas, and with greatly improved compass-controlled drawings of the coastline. Early in 1958 I received four weeks leave to compile the new information, and to revise our previous mapping from all the photographs available.

Petra Searle and the cartographers at Overseas Surveys turned these 1:100,000 compilations into a map of South Georgia at 1:200,000, DOS 610. They were rightly proud of it, and for many years a copy was exhibited in the entrance hall at Tolworth. It must have been one of the last topographic maps made without a single air photograph; but it was nevertheless described by the Royal Geographical Society as "setting new standards in Antarctic mapping." All the expedition's debts - no great sums to be sure, but they seemed large to Duncan - were paid from funds available to the Governor of the Falkland Islands: it was generally thought that he got a bargain. The members of the expedition each received a gratuity of one hundred pounds, no great sum either, but we all accounted ourselves fortunate to have been on the expedition the five survivors still keep in touch. The Admiralty produced a new version of Chart 3596.

Some air photographs have since been acquired, initially handheld near-vertical photographs from Royal Navy helicopters, some of which I later compiled into large scale maps of about a quarter of the coast. A little more mapping has been done in the field, notably Fagan's 1:25,000 map of a poorly mapped area north of Royal Bay. Small local improvements have been made by the geologists of the British Antarctic Survey. One hears of high altitude photographs in colour taken from long-range aircraft, and of course there are satellite pictures and GPS fixes. But none of this has been compiled into a new topographic map available to the public: when I bought a map of South Georgia in 1998, the 1958 edition of DOS 610 was the map I got. Last year I had the pleasure of circumnavigating South Georgia in Jerome Poncet's 20-metre schooner Golden Fleece, map in hand. DOS 610 is not an Ordnance Survey map, and a rigorous survey would certainly improve it; but for a map compiled, as it says, "from exploratory surveys made by improvised methods in bad weather", it is, except where glaciers have since retreated, surprisingly hard to fault in the field.

Further reading:

Bomford, A.G. & Paterson, W.S.B. "The survey of South Georgia" *Empire Survey Review* 107 & 108, January & April, 1958.

Bomford, A.G. "The South Georgia Surveys" *Royal Engineers Journal* 73(2), June 1959.

FROM E.17 TO TROPICAL PARADISE

David Broome

From an early age a love both of maps and the outdoor life almost guaranteed that I would enter the land surveying profession. GCE's were passed and the local careers officers pointed me in the right direction to the South-West Essex Technical College in London's E.17. Attendance there enabled me to remain living at home and to continue pursuing my life-long passion of cycling.

At the end of the course in 1961 I, along with Peter Kennedy and thanks to an introduction by Horace Wason, was offered a junior post in the Crown Lands Office of The Bahama Islands. Being situated over 4,300 miles from the UK and straddling the Tropic of Cancer, this group of 700 Islands and over 2,000 cays and rocks was to become my home and proving ground in my chosen profession for the next four years. To get my knees brown, Deputy Crown Lands Officer H.A.Hing-Cheong issued me with a vernier theodolite and steel band together with instructions to undertake a succession of small site surveys, mostly of land reclaimed from the sea. Such surveys sometimes included a requirement to assess structural soundness and a valuation.

Eventually I was provided with a brand new Wild T1 theodolite and sent off to the Out Islands on various larger projects. These usually comprised the re-location of old Crown grants, re-surveys thereof and subsequent sub-divisions. The aspect of Out Island work which proved to be the most demanding was the administration. Projects had to be estimated by time and cost and these estimates adhered to as closely as possible. Equipment such as steel rods and cement for monument building, water containers, axes and machetes for bush-cutting and other items not locally obtainable had to be purchased. Chainmen were allocated by the survey department, but local labourers were recruited on site (and not infrequently later fired and replaced). Various administrative forms had to be regularly completed and an account run for the project. Finally, passages were booked on Out Island Ferries or Bahamas Airways and accommodation booked in advance. All this was quite daunting for a 20-year-old living away from home for the first time for any length of time but soon became quite a routine activity.

The Bahamas are covered by dense secondary-growth sub-tropical bush and cadastral surveys of the type I undertook required line-cutting of existing and proposed boundaries and road reservations. Sometimes the lines were several thousand feet in length and I soon learnt the hard way that many chainmen could not be left with the responsibility of keeping lines straight. My initial naivety was eventually replaced with a cynicism that lines being wrongly cut would have to be re-cut, thereby extending the job and providing more wages. The bush also included a number of

New Providence Island, Bahamas, September 1963. David Broome, chainman and Tellurometer MRA2. (See also colour page 20).

trees such as *Metopium Toxiferum* and manchineel, the sap or dust from leaves or bark of which was poisonous, causing severe blistering of the skin. Needless to say, my youthful enthusiasm ensured that I regularly fell victim. However, there was an abundance of wild fruit trees and bushes that were a constant source of enjoyment and another new experience for me.

To alleviate boredom whilst traces were being cut, I often organised competitions and even joined in myself on occasions to see who could cut the quickest and cleanest. Palmettos were a great challenge but the very soft wood of the gumelemi tree was a joy to cut. Getting labourers to cut the bush low enough for clear sight-lines was also often a problem especially as some of them were Haitians with no English. My GCE French proved to be unequal to the task and my shouts of "Coupez le bois bas" were generally met with gazes of open-mouthed incomprehension or giggling. Gestures had to be resorted to in fine old English tradition. High temperatures, especially in the bush, high humidity most of the year, sometimes but not always a fairly spartan diet and occasionally water of doubtful cleanliness giving rise to inevitable gastro-intestinal problems all proved to be tiresome. However, such problems were significantly outweighed by the outdoor life, the frequently magnificent scenery, the good nature of Out Island people, the sense of humour of chainmen and labourers alike and the undertaking of work that gave great satisfaction even if not techni

cally demanding.

The Directorate of Overseas Surveys had provided control on and mapped a few of the larger islands. Another of my tasks was to provide "approximate" overall mapping of some other islands up to a hundred miles in length by use of USAF aerial photography, "control" from nautical charts, slotted-template lay-down and sketchmaster plotting. Even some hachuring to indicate hills was added on later versions. It was decided that a system of registration of title was needed in view of the existing ambiguities of legislation. (I wrote my RICS thesis on the topic and a system was eventually introduced under the supervision of David Leach.) The control provided by DOS on New Providence Island, on which Nassau the capital stands, had to be densified to approximately 1 kilometre intervals and I was selected to carry out the work, which also provided the material for my RICS practical task.

Tellurometer MRA 2 models had been used for the original control traversing and were still in the Colony. Hence, I used a combination of traversing, triangulation and trilater- ation to undertake the work. I did some ground taping, had junction figures to adjust and some small offshore cays to include in the scheme. Reconnaissance, station building, observations and computations all combined to provide a most stimulating and challenging project. I shall never forget the occasional difficulty of getting a clean break on a stationary green circle within the cathode ray tube, especially on some of the measured lines over water, which caused ground swing. The climate also caused surveyors to appear like pandas when the head came away from the black rubber shield over the CRT.

Although in later years with Hunting Surveys and Plowman Craven and Associates I was to become more of a "desert" man than a "bush" man, I always retained fond memories of those early formative years in a truly great profession and in a tropical paradise.

A FEW BACKSIGHTS

Northern Nigeria in the Fifties

Clifford Burnside

When my posting in the Colonial Survey Service was changed suddenly from Malaya to Nigeria I had to consult an atlas. Like many other people at that time I was not at all sure just where Nigeria was - somewhere on the left- hand side was it? And so when I disembarked from the m.v. Accra in Lagos in May 19541 was somewhat apprehensive and more than a little bewildered. A first footing ashore onto the African continent at Takoradi a few days earlier had been a bit of a shock too. It was hot, humid, smelly and overcrowded and my first sight of the vultures perched on the top of a market shed added to my sense of unease. "My God! What have I let myself in for ?" However a great deal of reassurance then appeared in the form of a senior surveyor (Dennis Willey) who had been detailed to meet me and put me on the train next day for the three day journey up country to the Jos Plateau in northern Nigeria. Jos I was told was perhaps the best posting a novice surveyor like myself could possibly wish for and so slowly my doubts began to lift. There was no doubt the african continent was an interesting place to be but quite a change. Dennis was an excellent host and duly got me and my "loads" as he kept calling my collection of boxes onto the midday train next day. His final gesture, which I still remember with considerable gratitude, was to thrust a large wad of money into my hand commenting that as I would probably not be paid for at least three months it would help to see me through. How right he was! But did he sense that I was flat broke after 18 months at the School of Military Survey living on a rather meagre allowance?

For me all rail journeys are interesting and so this slow narrow gauge journey was a great experience. It got better and better as we progressed northwards, but I also got dirtier and dirtier because the engine burnt poor quality brown coal mined in the Enugu area and seemed to produce much smoke but little power. However, as we slowly chugged northwards the nature of the topography began to change and became more open and hilly. At about midnight on the second night of the journey, the train stopped at Kaduna Junction, some 500 miles or so from the coast and the location of the Headquarters of the Northern Nigerian Survey Dept. At this point the Deputy Director of Surveys (Keith Sargeant) came aboard to greet me and handed me a fine mahogany box with my name painted upon it. It contained a brand new Cooke Troughton & Simms 20" vernier theodolite.

Early next morning saw us slowly grinding up the gradients that finally took us to about the 4000 foot level as we approached the Jos Plateau. Now, this was real surveyors' country with no thick bush but wide open rolling plains dotted with granite hills and with dramatic inselbergs sticking up all over the place.

A massive trig beacon south of Bukuru, Jos Plateau, Northern Nigeria, 1959. L to r: Cliff Burnside, Jack Ashton, Mick Miles. (See also colour page 39)

I think my stay in Jos lasted just three days, during which time I unpacked the boxes of tropical paraphernalia supplied by Griffin & MacAlasdair of Farringdon Road London. This old-world firm specialised in supplying such gear to missionaries and had no doubt supplied the likes of David Livingstone in his time. In fact much of their range seemed to have changed little over the years. Certainly the tropical linen suit I found I had bought (but never ever wore) came into this category. However, the folding camp bed complete with mosquito net, the water filter, the 5 foot zinc bath, the Tilley lamps, the charcoal iron (for ironing the linen suit) and the Roorki folding arm chair all proved invaluable in the days ahead. In fact, the metal bath proved to be one of the very best of purchases. After a long hot tiring day in the bush, a gallon of hot sweet tea and near total immersion in my bath full of hot water reeking of Dettol helped no end to ease the weary bones. This daily event proved quite often to be a source of considerable interest to the children in remote villages and so I soon got quite used to the awareness of small black faces and little white eyeballs peering at me in wonder through the holes in the zana matting that was supposed to provide privacy.

Having unpacked my gear and made purchases of tinned food and so on (on credit of course) at the local canteens and with the bare minimum of technical instruction I was then dumped in the bush with my first surveying tasks. To help with these however I had been provided with a headman, 12 survey labourers and assorted survey equipment. Beforehand, I have no doubt that my headman was given strict instructions to look after the new raw recruit and see that he did not make too much of a b***** fool of himself. To the best of his ability my first headman (Auta Katsina) did just that, within the limits of human ability that is, and no doubt like many other surveyors I remember him with great affection and gratitude.

The mining operations on the Jos Plateau were concerned with alluvial tin and colombite deposits and varied in size from very large operations carried out by international companies to lone miners working obscure deposits in even more obscure places. All mining was carried out within surveyed and demarcated mining leases and their demarcation was the main work carried out by surveyors such as myself. The work consisted of a surround traverse observed with steel tape and 20" theodolite, the production of the definitive lease plan at an approved scale showing the distances and bearings of all boundary lines. All calculations were carried out using Chambers' log tables and Shortrede's logs of trig functions to single seconds. Line bearings were derived from altitude/azimuth sun observations and so all minesfield surveyors rapidly became particularly slick at sun azimuth determinations. For my first attempt I think I was glad that the tropical day was 12 hours long but, with practice, I eventually was able to complete the whole operation in just about one hour. The lease also had to be fixed to adjoining leases (if any) and also tied into the national system. This latter could provide some interesting problems especially in those days well before advent of any EDM. My favourite technique was to set out and observe to short base lines to determine the necessary distances.

Movement about the plateau was also interesting for me at this time. The Department only had two old lorries and these were not generally available to the likes of me. In addition, the Director of Surveys (Keith Hunter) was not too keen on motor vehicles for his junior staff " more b***** trouble than they're worth" he was quoted as saying. And so with no immediate approval for a loan to buy a kit-car I trekked around the plateau using carriers rounded up from adjacent villages as required. Many a miner in his powerful truck stopped in amazement to view this remark-

Northern Sokoto Province, Northern Nigeria, 1958. Cliff Burnside and camp-site during astro-fixing. (See also colour page 39)

able sight the tin bath full of pans and kitchen gear being the subject of many a photograph.

As for living accommodation, none was provided. I was in fact an itinerant surveyor moving from job to job and staying in either rest houses on the edges of native villages or (much better) in the compound of a miner in a rest house provided for the use of his visitors. These latter sometimes had a paraffin-operated fridge with cold beer in them. Throughout northern Nigeria, village chiefs were required to set aside one mud house on the edge of their village to provide simple accommodation for any touring government officials such as myself. The *sarakin baraki* in charge of the hut would also provide wood and water and, quite often a small gift in the form of some eggs or a scrawny looking chicken. During my 12 years in Nigeria, I rarely used a tent and only when villages were too few and far between. It was about a five man load when on trek what with its main canopy, fly sheet, poles, bath room extension, verandah etc. Apart from the size, it took time to erect and take down and so was a bit of a nuisance when travelling long distances such as when on trig recce or when astro fixing control for mapping purposes. Mud huts were generally much cooler and when in good condition better protection against tropical rain. Often however they had other more permanent residents such as bats, snakes and other wild life. Being on the edge of the village, one did experience the African way of life at first hand and I for one thought this one of the perks of the job.

I well remember my first Saturday night in a native village. Usually after dark things get remarkably quiet, but this particular night there was a great commotion with frantic drumming and much singing and shouting. Being brought up on a Sanders of the River concept of Africa, I carefully crept out of my hut to see what was going on an orgy of some sort perhaps? But no, I was sadly disappointed. It proved to be nothing more than about a couple of dozen people lying about (literally) in front of a great bonfire and managing to make a remarkable amount of noise. Africans I discovered were good at that sort of thing.

At a much later date and in another part of the country I did experience an evening event which I still recall as an interlude of pure magic. It was in Bauchi Province in quite a large village on the edge of the Yankari Game Reserve, across which I was hoping to set out a chain of secondary trig points. This particular evening the village seem to go to sleep at about 7 pm as usual but by about 9 pm there was a large harvest moon low in the sky that produced a scene more in keeping with one might associate with tropical Africa. No doubt because of the lightness of the evening, a deep sounding bass drum began to beat out a slow majestic rhythm in one part of the silent village. And then, in another part of the village, as if in response to this, a single wind instrument with the sound of something like a *cor anglais* picked up the theme and then between them they began a stately duet; the one responding to the other in turn. Sometimes there are times when one wishes one was not alone and that an event could be shared by at least someone else. This was an event of this nature and by no means the only one I experienced in my 12 years in Nigeria. But the moon drifted down behind the palm trees all too quickly. The music became slower and slower in its beat until finally, it just stopped and the silence was again complete. It had been a wonderful form of African tenebrae.

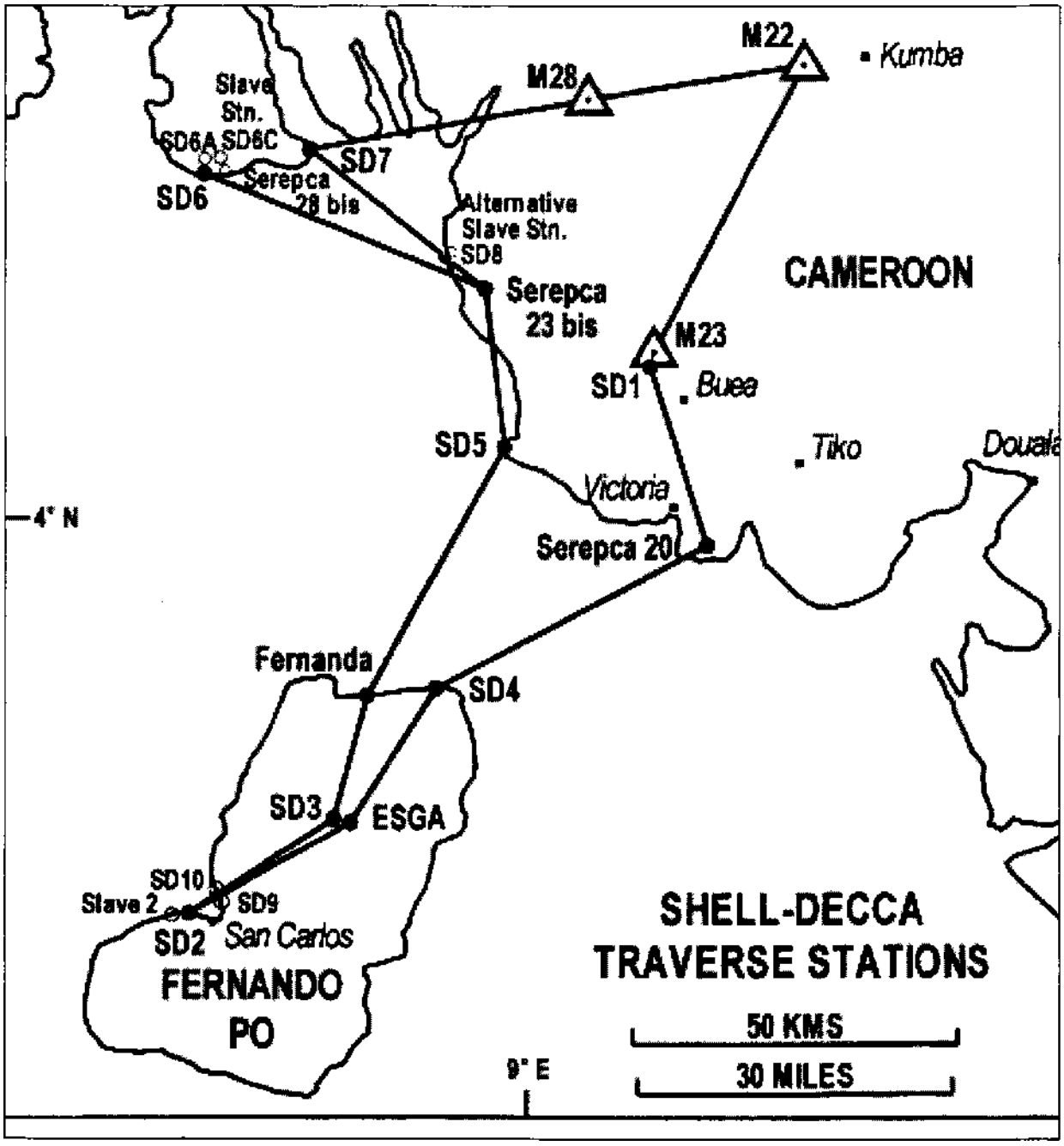
WEST CAMEROON AND FERNANDO PO IN THE 1960s

Lawrie Butler

In 1968, the Decca Navigator Company on behalf of Shell commissioned J.A. Story & Partners to carry out a survey relating a point, SD6C, in West Cameroon and another point, Slave 2, in Fernando Po to the Nigerian Colony Grid (Mid Belt). Originally the plan was to traverse from the former Nigerian M Triangulation (by now in West Cameroon) across to Fernando Po and thence back to the Cameroon shoreline, along to point SD6C, closing on Shell

traverse stations off Calabar in Nigeria, but due to civil war hostilities in Eastern Nigeria at that time, no attempt was made to enter Nigerian territory. Instead the traverse was to be closed back on the M Triangulation.

The southern area of West Cameroon is dominated by the great massif of Mt Cameroon, the highest mountain in West Africa, rising to 4100 metres above sea level and taking the form of an ellipsoid elongated SSW - NNE. From the road-head at Buea (1100m), the slopes become steeper to reach the 2750m level after which the upper area is more-or-less a plateau, but with a final rise to a series of uplands created by the most recent volcanic activity. The climb is not difficult and can be rather tedious, yet exciting when one is lucky enough to see the peaks of Little Cameroon and Fernando Po beyond. The climb up and down the mountain (as a tourist) is usually regarded as a 2- day exercise, the first day via Hut 1 to Hut 2 at the



The traverse network.

2750m.level and the second day to the top and back down to Buea. Below Buea, the forested zone gives way to cultivation. The coastline west of Victoria varies from rocky hills, plantations and sandy beaches to muddy swamps at the west end of the survey. Fernando Po is a similar massif, but at a lower level (301 lm.).

Regarding access, Mt Cameroon limits roads inland to a route from Victoria to Buea, thence to Kumba and beyond. West of Victoria the only road follows the coastline to Ide- nau (west of SD5) and further movements west are by engine boat. At SD6, with no local villages and widespread ooze offshore, a helicopter was used in and out from Debundscha. With Fernando Po being an island and part of a different sovereign territory, any movements to Fernando Po had to be via Douala and scheduled airlines.

Climatically, the area includes probably the second wettest part in the world, Debundscha (SD5) having an average annual rainfall of 1079cm (425 inches). Snow has been known to fall on Mt Cameroon. Visibility from Victoria to the summit is rare and it is common for cloud to obscure the top or appear in the middle reaches or the lower areas. September is in the middle of the West Cameroon wet season (an average of 61 inches in that month alone) and the dry season does not usually start until December. With this survey being a commercial exercise, the results were required as soon as possible and unlike a Government project where the survey could be postponed to the dry season, this survey had to be carried out despite the weather.

The initial survey party of two surveyors, myself (who had already spent two years in Buea from 1958 to 1960) and Stewart Bryant, an ex-military surveyor, arrived in Douala on 30 August 1968 where we were met by the Decca administrative officer seconded to the project, Sandy Gale. A third surveyor, Frank Seager (also ex-mili- tary) joined the party on 9 September. By the end of October, traversing from M23 to SD6 via Fernando Po had been completed. Stewart Bryant returned to U.K. so that Decca with its seismic programme imminent could compute the work as a hanging traverse. Fortunately by the 5 November, John Roberts of Decca was able to confirm that Shell had agreed that the traverse should be closed back onto the M trigs. This section across the swamp and equatorial forest belt to M28 proved to be the most difficult, but all survey work was completed by the 30 Novembrer

The existing basic control was the M Triangulation. This was originally intended to be first-order, but had been relegated to second-order: the accuracy of any one survey point relative to another was said to be of the order of 1:50,000. The only other survey work of any value in the Cameroon area was the French Serepca traversing and since this followed the coastline, the stations where found were re-used. In Fernando Po, 1:50,000 maps showed coordinates of various first- and second-order trig points (based on the Gauss Projection). These stations were visited and used where feasible. No records of heights of the M and Serepca stations were available. In Fernando Po, the same 1:50,000 maps showed heights based on mean sea

Little Cameroon and Fernando Po, 1968. Seen from below Hut 3 on Mount Cameroon. (See also colour page 39)

level at San Carlos and this height datum was used.

Pressure from Decca to get the preliminary results meant that no complete recce was carried out prior to the actual observations. In particular, the line from Serepca 23 bis to M23 was thought to be a through ray and it was only when observations were started that this line was found not to be intervisible, due to the convex slopes and the fact that M23 had been sited on the north side of the mountain. This necessitated a prolonged recce looking for a point (SD7) from which both Serepca 23 bis and M28 were visible. Access to SD7 was by engine boat and then by small canoe, both surveyor and instruments being “pushed” through the ooze by local labour. Needless to say, station SD7 on mudflats was only regarded as a means to an end. Again by virtue of the siting of M23 and with no certainty of visibility between M23 and the Victoria area, an extra station commanding views to the south was emplaced on Mt Cameroon.

Equipment taken out for this survey included 1 Wild T3 theodolite, 2 MRA2 and 3 MRA101 Tellurometers, 2 Watts survey beacon lamps and 2 helios along with ancillary equipment. The Wild T3 and the Watts lamps (usable up to 90 kms.) proved ideal in every way since with the prolonged periods of rain and poor visibility it was decided to do all observations at night. The MRA2s were tested on arrival in Buea but shortly afterwards speech communications became distorted. Later, no break in the circle could be obtained on one instrument while on the other the circle could not be enlarged. The MRA2s were then set aside (along with the “useless” helios) and all distance measurements were carried out using the MRAlOls. Their speech communications proved indispensable for coordination of both distance and angle measurements. Power supplies demanded heavy duty batteries carried manually and more than one was dropped en route. Each horizontal angle was attempted on 8 zeros and usually this was achieved. It is usual to measure vertical angles around noon but in this case when all horizontal observations were done at night, it obviously was more convenient to observe the verticals at that time also, particularly since it was found that daytime cloud often cleared at night. Two measures of the vertical angle were made.

All computations were carried out by Hume Rainsford at

the Mitcham office of J.A. Story and Partners. Being ex- DOS, Hume was in his element, computing in UTM coordinates, deriving geographical & then converting to Nigerian Colony Grid, despite having to deal with thermometer readings in centigrade & fahrenheit & barometers graduated in inches, millimetres and millibars - commercial firms are always reluctant to throw out “useful” equipment despite the inconvenience. The survey network was treated as two traverses with a common line Fernanda - SD4. All lengths were reduced, the maximum difference fore and back being 0.304m, the majority giving much closer agreement. Trigonometrical heighting over the north traverse of 226km closed to 0.229m and that on the southern traverse (98km) closed to 0.493m. The angular misclo- sure on the northern traverse was 1.92" while that of the southern traverse was 2.33". Linear misclosures of the two traverses were 1: 84,606 and 1: 552,945. An interesting byproduct of this survey was the derivation of a new height for Mt Cameroon of 4044m.

The survey project was very satisfying, despite being always haunted by the possibility of breakdown, particularly of the Tellurometers, the only means of communication available. Frank Seager spent 18 days on Mt Cameroon, camped inside Hut 3 (still awaiting repair after being damaged in the 1954 volcanic eruptions and came down literally “washed out” and rather the worse for wear). I spent a night at SD6 on a sandbar (which was later found to have been washed away by an abnormally high tide) and having thought I was on my own, was rather dismayed to see a footprint outside my tent the next morning - presumably an itinerant fisherman. Another scary memory was of hitching a lift from Tiko with an unknown pilot in a two-seater, skimming over the forest canopy under threat of a tropical storm to make a rather bumpy landing at Douala.

Among the more enduring impressions were the climatic changes by being one night at over 4000m in driving rain with temperatures around 3°C and another night at around sea level in mist at temperatures of around 29°C, never being properly equipped for the one but always having no difficulty in coping with the other. Nevertheless it is likely that all staff derived more satisfaction in those days of old fashioned traversing (as well as triangulation and levelling) than staff working with the latest equipment today, who no doubt could complete in a week the same work that had taken months in 1968.

(Fernando Po is now known as Bioco, Decca is now part of Racal and Messrs W.J.M. Roberts and H.F. Rainsford are now deceased. I joined Federal Surveys Nigeria in 1956, leaving in 1967; was with J.A.Story & Partners from 1968- 1983 and managed Electrodetection Ltd from 1983-1997.)

Hut 3 on Mount Cameroon, 1968. Stewart Bryant (l.) and porters..

A FORMATIVE LAND SURVEYING EXPERIENCE

Bernard Chiat

The land surveying world which I entered in South Africa more than 50 years ago was almost totally directed towards land registration even though the curricula of the specialist BSc degrees there covered fully the wide range of subjects considered relevant at the time to the study of the discipline - land, topographical and engineering surveying, geodesy, photogrammetry, field astronomy, land law, underpinned by courses in pure and applied mathematics and physics.

After graduation I joined a firm comprising two qualified practitioners supported by a draughtsperson, a typist and two or three unskilled field assistants. This was a typical set-up, suited to the tight regulations which governed registration surveys. For historic reasons, the shapes and dimensions of the parcels had to be defined with high precision - angles and bearings to 10" (sometimes 1"), sides and planimetric co-ordinates to 0.1 foot (30mm) or 0.01 foot, depending on circumstances, and in general, boundary terminals were marked by beacons of prescribed form, e.g. steel pegs or pipes, concrete blocks, etc. Prior to World War I some of the surveys had been of such dire quality, that in the late 1920's a new survey act with regulations appended had been placed on the statute book which not only set these high standards, but required all the measurements for a title survey to be undertaken either by the qualified surveyor himself or under his direct supervision. No wonder there was no place for surveying technicians as assistants. Furthermore, all the field records, computation sheets and supportive plans had to be submitted for examination in the office of the Surveyor-General of the province along with parcel diagrams (documents for attachment to title deeds) before they could be approved by a professional assistant, himself a fully qualified surveyor.

The firm I was with was located in Port Elizabeth, a city of half-a-million inhabitants with the practice extending to areas of the countryside as far as perhaps 80 miles from base. When a survey was sufficiently distant, we either stayed in a local country hotel or with the client and his family in the homestead on the farm of interest part of which, usually, was being alienated.

Whenever required (or convenient), surveys were connected to trig stations, control points established by the national trigonometrical survey office (TSO), usually cylindrical concrete pillars 4 foot (1.22m) high with central pipes, also spires and flagstaffs, supplemented in some towns by reference marks, pegs set in concrete below ground level under removable cast-iron covers. Lists of coordinates on the equivalent of the National Grid for all of these were available free to surveyors from the TSO. Before fieldwork for a survey commenced, photostat copies of diagrams of parcels likely to have relevance for defining the boundaries with which the survey was directly concerned were obtained from the Surveyor-General's office in Cape Town, unless they were already held in our own files.

The reconnaissance for the survey entailed searching for the beacons at the terminals of the boundaries referred to in the preceding paragraph and when any of these were missing, such others as would provide evidence of where they had stood. In urban areas, not surprisingly, this often meant scrabbling around in uncomfortable or unpleasant comers. Next, a network of control stations had to be set up for fixing on the co-ordinate system, either national or arbitrary, all those beacons found which were of interest or from which any beacons to be placed could later be set out. On farmland, the density of trig stations made triangulation the preferred method supplemented by minimal traversing - the fact that distances were being measured by 300 foot steel band made this an economically favourable procedure. For urban surveys the order of importance of the techniques had necessarily to be reversed. In all cases allowance had to be made for sufficient redundant measurements to check the results and provide an indication of their precision.

The field measurements provided a most enjoyable interlude - as long as one did not have to suffer too fierce a sun, freezing temperatures or high winds. It should be remembered that at the time of which I write, optical micrometer theodolites were standard -1 can imagine that prolonged use of a vernier or moving-wire micrometer instrument would have provoked an entirely different reaction in me. Computations were performed using a mechanical calculating machine, in my case a lever type, and six-figure natural trig tables. Away from home, these usually continued into the night until the distances and bearings from the control points most conveniently located for setting out the beacons to be placed had been calculated. Empirical methods of adjustment were applied - semi-graphic for triangulation, Bowditch for traversing. Field work was completed with the placing of the new beacons and measurement of extra angles and lengths for checking purposes, also measurements sufficient to plot with graphical accuracy significant topographical detail - but not contours - on new parcel diagrams. The surveyor would prepare the office copies of plans required as part of the survey records and a report justifying the boundary positions adopted. Finally the draughtsperson would make any required tracings of plans and prepare the diagrams of any new parcels resulting from the survey. A diagram has a figure drawn to scale representing the parcel, data such as boundary lengths and bearings, area, legal name of the property, etc.

Although the overwhelming majority of surveys resulted in the creation of a handful or even just one new parcel of land or had the purpose of merely replacing lost beacons, the remainder were concerned with lay-outs of estates comprising a large number, maybe hundreds, of plots. For these, a topographical plan showing contours would have to be prepared to accompany the application for planning permission to proceed with the proposal. This is an indication that the surveyor was not just a "peg basher" but had

to exercise, too, professional expertise in managing the office, even allowing that the size of staff was likely to be small, dealing with clients, designing estates and less ambitious schemes for subdividing land, and preparing planning applications to local, provincial and national authorities.

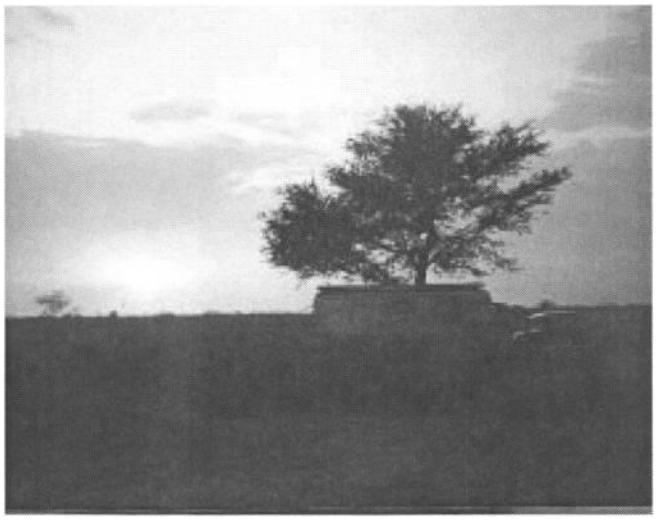
The system was effective in that it virtually eliminated the possibility of expensive boundary disputes. On the other hand, the meticulous examination by government officials of the details of surveys represented a lack of faith in the ability of the professionals to judge the integrity of the measurements for which they had signed, apart from extending the time required for completing land transactions. Furthermore the obligation placed on surveyors to be closely involved with routine measurements meant that almost all of their time was devoted to title surveys and closely related activity and that they were unlikely to apply their special skills in areas such as civil engineering. Fixed boundary surveying as described may have evolved to deliver a service to a privileged minority of an inequitable society, yet with the development of field instrumentation to produce rapidly co-ordinates of high precision, elements of its procedures should form part of the armoury of designers of all types of cadastres.

DOMESTIC ARRANGEMENTS

Jennifer Cooper

After spending my first tour in Lagos it was exciting on returning from leave to hear that we would be going to bush. Mike was given the job of re-defining the scale of the Nigerian primary triangulation using the Tellurometer MRA 2 to measure the sides of triangles at each chain junction. The work coincided with the issue of caravans to surveyors working in bush and ours duly arrived - silver in colour with FEDERAL SURVEYS painted in black on the sides. Gone were the days of pitching tents at each stop - instead we would do it in style with a brand-new caravan complete with an air conditioner, mosquito-screened windows and doors, bench beds, a wardrobe, writing desk and bookcase and a kitchen area with a kerosene cooker and fridge, cupboards and worktop, a sink, shower unit and last but not least an Elsan-type loo. There was enough room between the two beds for a cot - we were taking our three month old baby with us and our dog Bannister.

In order to run the air conditioner and lights we had a generator and that is where the snags began before we even left Lagos. The generator didn't work, so it had to be taken to the PWD to be fixed. The intended date of departure came and it was still in pieces - the person responsible for mending it sacked, having sold off some of the parts! Mike decided that we would have to go without it. Makurdi, on the river Benue in the northern region, was to be our first base and after battening everything down in the caravan we loaded the car with the cold-store carrier, water filters, baby bath, carry cot, pram wheels, dog and of course - Nicholas. We set off leading the procession. A Land Rover towed the caravan. The labourers and all the survey equipment followed behind in a lorry. Finding that we had to keep stopping to wait for them to catch up we decided to bring up the rear, keeping a fair distance behind so as not

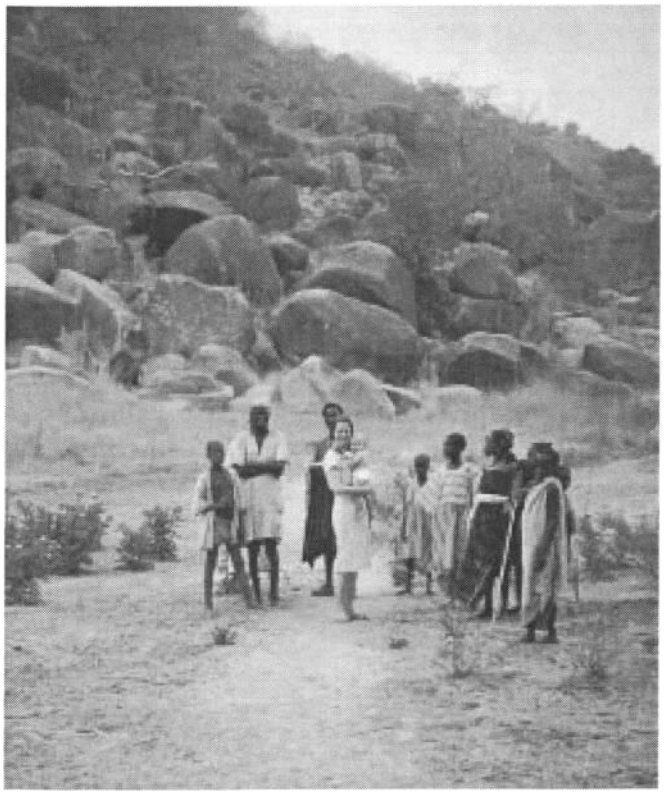


Sunset over a caravan camp-site, April 1963 Gidan Makere, Sokoto Province N. Nigeria, near the Border with Niger. *(See also colour page 40)*

to get covered in clouds of dust once we had left the tarmac. We had to stop by the roadside to feed Nicholas and I soon got used to the sea of faces that would appear from seemingly nowhere. We felt like a travelling circus with performances daily at 10 am and 2 pm.

Our first overnight stop was at Akure where we parked in the grounds of the rest house. Opening up the carvan we found the contents of both the kitchen cupboard and bookcase strewn all over the floor, the front off the air conditioner and the desk lid jammed. My job was to see to Nicholas while Mike unloaded all the necessary bits and pieces from the car and Land Rover. I had the daily job of boiling water for the filters and sterilising bottles and after that making sure that everything was secure before we moved off again. Another night's stop - this time in a school compound and then an early start the next day in order to get the ferry across the Niger from Asaba to Onit- sha. We joined the queue of cars, mammy waggons, lorries and foot passengers and eventually drove on to the ferry, hemmed in on all sides - no sign of the caravan which was ahead. We crossed the Niger in the heat of the day and discovered that the caravan was still on the Asaba side of the river. Several hours later it finally arrived but with a broken tow-bar. The driver had not unhitched the caravan, so as he drove up the ramp onto the deck of the ferry, the caravan was still coming down the ramp on the shore. Of course the tow bar broke. We had to book into the catering rest house until it was mended. Mike somehow managed the next day to find a welder in the middle of Onitsha market.

Off again at last and another night parked in another school compound. By now the scenery was changing to more open countryside. A relatively uneventful last leg of the journey before we reached Makurdi where Mike's work would begin. The next nine months would take us to the edge of the Sahara beyond Sokoto before going to a house in Okene where Mike's teaching career began at the Federal Survey School. Sometimes we only stayed in a place for three or four days before moving on to the next chain junction. Mail followed us around the country. We mastered the art of packing and unpacking the caravan without further mishap though the rutted laterite roads began to take their toll and we once saw the caravan ahead detach itself from the Land Rover and roll slowly into a culvert. It was important to camp near a source of water and if possible under the shade of a tree. Our water usually came from the river and was brought as headloads in jerry- cans or from the local village well when it was hauled up in goatskin buckets. Laundry changed from Persil white to river water brown. We had stocked up on Heinz baby food before leaving Lagos and used the local markets to buy fruit, vegetables and meat, usually goat or chicken although further north guinea fowl were plentiful. There was sometimes a small local store which sold tins of Peak milk, tinned butter and bacon and sacks of Golden Penny flour complete with weevils. And of course, Star beer. I remember two of their exotic names - "Honolulu" and "Starlight" stores.



An early evening stroll, Kotorkoshi, N. Nigeria, March 1963. (See also colour page 39)

We all suffered from boils and bites which easily became infected by the dust and at times we had to find a mission hospital to get antibiotics. The temperature inside the caravan sometimes soared to 120° during the day. We rigged up a battery fan to keep Nicholas cool. When the repaired generator eventually caught up with us, we discovered that the air-conditioner was not working! Too much shaking on the corrugated roads had wrecked it. A nice idea, but...

Bannister produced nine puppies to add to our menagerie of chickens and guinea fowl (which we kept in wicker baskets for our later consumption) and a goat the labourers had bought. Mike went up and down hills with the Tel- lurometers and I pushed Nicholas out for walks in his pram with an eye on the birds of prey flying overhead. Life was never dull. A Fulani arrived with his daughter - she had nearly severed a toe and I was expected to render first aid. My ministrations with Dettol and a bandage were rewarded the next day with several chickens. Our Spode dinner service survived the bush and we still use it today, nearly forty years on, but there is nothing quite like dining off a camp table in the moonlight on the edge of the Sahara to the strains of Victor Sylvester on the BBC Overseas Service.

UNRECORDED LIFE IN THE PRIVATE SECTOR 30+ YEARS AGO

Ron Craven

What a task to put words on paper, when asked to write a few words about early days of a private surveying company, previously unrecorded. The trouble with referring back to old records is that the mind keeps recalling the incidents which the old jobs recollect. What times we had, what locations, from the wilds of Scotland to the heat of the Middle and Far East. What ignorance, going to some far distant place, with the very basic equipment, no GPS in those days and no thought of how long is the job going to last. We were just looking for the adventure of it all. Maybe it was not ignorance but confidence, although I have always thought ignorance was a good qualification in many respects!

No mammoth briefing sessions, one phone call, collect ticket at the airport, do not forget customs declaration for the survey equipment and hopefully someone would meet you at the other end. These were frequent, rather than the exception. This variety of overseas locations was mainly due to survey information required for microwave routes, to establish communication towers for mobile phone systems, which today are commonplace throughout the world, but nearly thirty years ago seemed to be pie in the sky. Surveyors were sent to all areas of Saudi Arabia and to lots of countries in east and central Africa. I recall the secretaries in our UK office remarking that their knowledge of geography rose to heights they had never imagined possible.

One never to be forgotten call in 1966, yours truly was asked to travel to Libya, at very short notice. An architect, designing some new hotels for the Kingdom, had discovered at the eleventh hour that his proposals had to include 1:500 site surveys of the proposed locations. The next three weeks were like a paid tour of Libya, as some dozen or more sites were scattered throughout the country. It was more like a Land Rover car rally than doing survey work, as the sites were the size of postage stamps and always sand. The problem was travelling from one site to the next. The sites were as far apart as locations along the Mediterranean coast, to some hundreds of miles south into the Fez- zan and each site only took about a couple of hours field work. By far the most pressing problem for the surveyors, which outweighed everything else, was that two days after our arrival in Tripoli was the Saturday of the World Cup Final at Wembley. It was a lucky coincidence that all the surveyors happened to arrive back in the hotel by three o'clock on that Saturday. We watched the match on a combination of TV via an Italian channel (all the players in what appeared to be a snowstorm) and BBC World Service. England! England!! England!!!

I digress. The first complication in those far-off days was how to cost and charge for survey work. From the very first we thought it would be considered very professional to charge for work in guineas - at least we would get a shilling more than if we charged in pounds. This seemed to work, although in our second job we had difficulty in getting paid and had to resort to threatening legal letters. We eventually got paid 50 guineas, a year late. On reflection this incident was an excellent, though expensive, lesson in ensuring that we chased clients to get paid on time.

In the 1960's in UK our largest client was the Ministry of Public Buildings and Works and how polite and formal those venerable civil servants were, never once were Christian names the order of the day. I remember on more than one occasion, after a morning meeting in London at their offices, being asked to partake in a lunch time snack, at a local hostelry, conversations still in the formal manner. It was also the norm to have exactly a one-hour lunch break, and also the norm for the Head of the Survey Department of the MPBW to consume five or six pints of Guinness in that period. Needless to say I abandoned the attempt to keep up with them - well, sometimes.

In those days specifications for the survey work was almost unheard of. If a company called themselves surveyors, they were supposed to know what was expected of them, no volumes of written instructions on how to produce 1:100 surveys (or 1/8 scale as it was in those days) were needed. The end product was what mattered, and whether or not the client was happy with it. I often wonder if the RICS specifications for large-scale surveys have created a millstone around present-day surveyors' necks, especially when the documents have found their way into the hands of the non technical client.

The buzzword in the early seventies was "metrication". Practically all clients were working in Imperial measurements. Scales and the resistance to change were immense -

Ethiopia, 1956. Ron Craven on the move. (See also colour page 39)

it is hard to believe that now. I recall meeting an architect with a local authority who asked me reluctantly if we were in a position to provide a site survey at 1:200 scale, as they had had instructions that all future work should be metri- cated. He said he foresaw a big problem with levels, and he suggested that we provide the levels in feet. The reason for this request was that the Ordnance Survey benchmarks were all in feet and they had not yet converted them to metres. I think he was quite impressed when I told him that we knew the conversion factor. Work converting all MPBW Imperial drawings to metric used to flow in. I am convinced that they thought we had some very clever equipment that we fed Imperial drawings into at one end and at the other end a metric sheet came out.

I recall one meeting I had in London with a venerable civil servant surveyor who was close to retirement. We discussed a proposed very important survey of a site in London. The meeting went on in its usual formal manner, except we were in the early days of metrication. The question of scale arose and I was informed that it had to be 1:500 metric. An old drawing was produced and I was informed that this was in 1:500 imperial. There was a moment's pause, followed by "Mr Craven, your new metric survey at 1:500 will be slightly larger than this 1:500 imperial one." Ah happy days!

THOUGHTS IN A TIME WARP

Memories of Uganda in the 1960s *Peter Dale*

Having done my National Service as a surveyor in 19 Topographic Squadron RE, and having graduated from Cambridge thanks to the inspiration of John Jackson, a former editor of the *Survey Review*, I applied to the then Colonial Office for a job as a land surveyor. I was offered three choices - to work in Malaysia, Kenya or Zambia. I indicated my priorities and having been sent on No. 26 Army Long Survey Course at Newbury - along with my Cambridge colleague and friend John Leonard -1 was posted to Uganda. Being married - Archie Hamilton at the School of Military Survey had allowed me two days off just before Christmas to get wed -1 wanted a more sedentary life than that offered by the Directorate of Overseas Surveys (DOS). Beryl and I arrived in Uganda at the end of 1961 when Idi Amin had just been promoted from Sergeant Major to Major; when we left in 1968 he was a Brigadier. In 1961 Uganda was a Protectorate although soon after our arrival it was granted internal self government and within a year it achieved full sovereignty and nationhood.

Having just graduated it was assumed that I knew all about electronic distance measurement and the Tellurometer MRA1. It wasn't true, but what I didn't know I soon had to leam as I spent most of my first two-year tour as a surveyor living under canvas and climbing hills. On top of these we built pillars to a DOS specification - vaguely circular, four feet high, painted white with a black band at the top. From a distance they could look like a black man sitting down wearing a white shirt - especially when viewed upside down through a theodolite. It was often all that I could do to get to the top of the hills carrying two aerial photographs, a pocket stereoscope and a "pricker" - a needle with which to mark on the photographs where we built the pillar. My supporting team of Ugandans carried jerrycans full of water, 50 kilo bags of cement, or bags of sand - all on their heads, thus leaving their arms free to drive off snakes or fold back the thorn bushes. Later we would revisit the pillars armed with helios, theodolites and Tellurometers and connect them through a series of traverses.

This of course gave me a great opportunity to see the countryside. There are few countries as beautiful as Uganda. Winston Churchill called it the Pearl of Africa. It never suffered the indignities of colonialisation, so race relations there were better than in many other parts of the world. The rich diversity of wild life - both flora and fauna - the charm of the people and the wonderful landscape made it a memorable place in which to live and work.

Our second tour was spent in Kampala where I was Dis-

trict Surveyor with some thirty teams working on cadastral surveys across much of Buganda, the central area of the country. When the British first arrived at the end of the 19th Century they misunderstood the native land tenure system in which the local Chief was the trustee of the land, not its owner. Being wily people the chiefs did not disabuse the *mzungu* (as we Europeans were known) who had thought that the chiefs were owners of the freehold. Thus the *mailo* system was bom and the chiefs became freehold owners of square miles (hence *mailo*) of land. My task was to supervise the cadastral surveys of this land, a process that in some cases cost more than the market value of the land itself.

My third and final tour of duty was in Entebbe where I ran the survey training school, teaching youngsters with a Junior Leaving Certificate (not much beyond 11+) to do catenary taping and traversing. They did it very well. It was always a mystery to me why in countries such as Australia such work had to be done by a graduate with a professional licence and no more than two assistants working under his direct personal supervision.

All good things however had to come to an end. Family education in particular was proving a problem since standards were undoubtedly dropping as politicians rather than professionals filled the best schools with their progeny. A letter from John Jackson opened a new door for me and in 1968 I gave up my permanent and pensionable (P&P) post and went to teach in Cambridge (on a salary of £1900 per year). And thereby hangs another story.

But what did those of us who worked through the winds of change in Africa achieve? The Directorate of Overseas Surveys left behind a magnificent set of 1:50,000 scale maps that sadly proved very difficult to keep up to date. They also provided a network of primary levelling (measured to submillimetre accuracy) across the country for reasons that we local surveyors could never understand. The network included one primary benchmark that was built for safety into the fabric of a police station in West Nile District; so keen was the local police chief to preserve it that when a new police station was built he had it dug it up and re-embedded in the new building without notifying the survey authorities. No wonder our secondary and tertiary levelling never closed.

In general, we on the local P&P staff of countries focused on the cadastre and urban mapping. On the positive side, we achieved a "lands and surveys" infrastructure that in spite of civil war has in general stood the test of time. Although the cadastral system suffered badly because of this war, it is currently being brought up to date. Some things have disappeared. All the triangulation pillars that were built in southwest Uganda for cadastral control were knocked down as it was said that under every tenth pillar the *mzungu* had buried a gold bar. Not true. Under every pillar we buried a brass bolt as a witness mark that was supposed to be a precaution against vandalism by elephants.

Personally, I left Uganda both older but also wiser and with a pension of £142 per year for my pains. Whatever benefit the Ugandans gained from my modest contribution pales into insignificance compared with what I learnt.

BORGU BOUNDARY BLUES

Colin Emmott

In January 1959, the Permanent Secretary instructed the Director of Federal Surveys, Lagos, to implement an agreement entered into between Nigeria and Dahomey, Nigeria's neighbour to the west. The agreement was that, after Nigerian independence in 1960, some 200 miles of their common boundary would be adjusted, demarcated and surveyed. The stretch of boundary in question ran from Illo on the Niger, southwards to the upper reaches of the River Okpara and coincided largely with the western boundary of Borgu Division of the Northern Region of Nigeria.

This was an important task for Federal Surveys in the delicate political climate of the day. The survey would involve reconnaissance and observation of secondary triangulation some 150 miles westwards from the primary chain running from south to north along the western side of the Niger valley. But the department was small, its remit large; geodetic and other control surveys as well as mapping over the whole country and the Cameroons, and the few relatively experienced surveyors were already committed. This job, therefore, was given to a young surveyor who had arrived in the country three months before, fresh from Newbury. The following are extracts from his diary.

Sunday 3 January 1959. Eight o'clock on a perfect Lagos morning, not yet hot and the streets are empty and quiet. Why though do we go to bush on Sunday? Two Bedford 3- tonners are being loaded with camp gear, survey equipment, plane table, T3 and two survey gangs - thirty men in all under the direction of headmen Musa and Isa. Things are sure to go well with Moses and Jesus each of whom has over ten years army service behind him as well as a deep knowledge of the ways of the survey labourer. Over Carter Bridge and across the causeway, the road leading to Ibadan and Ilorin is tarred and a pleasure to drive on, particularly on Sunday when the mammy wagons are few. The first stop is Fiditi. This roadside market is the place to stock up on fresh fruit, particularly ripe oranges that are dark green, and bright yellow bananas that can only be cut with a machete. The road cuts through high rain forest until, at Ibadan, this is replaced by dense secondary growth after generations of slash and bum farming. Once beyond Oyo the farmland on both sides of the road becomes continuous until the border between the Western and Northern Regions when scrubland begins. "Why?" I wonder. We arrive at Ilorin in mid-aftemoon. This is the provincial headquarters and an important southern staging post en route to Kaduna, Zaria, Kano and the rest of the "Holy North". The men go off to find lodgings in the town and I book into the catering resthouse. Ilorin CRH is well known in the North for its comfort and food. A group of chalets set under shady neem trees amidst beds of canna lilies and fifty yards from the club, it is ideal for the dusty traveller.

Kaiama, Northern Nigeria, 1960. The Emir of Kaiama (in sunglasses) welcomes a federal surveyor, Dick Rogers (also in sunglasses). (See also colour page 39)

Dinner then early to bed.

Monday 4 January 1959. Up early, breakfast (full English) then for some last minute shopping in the canteens. The main item is beer. Experiments have shown that Becks is the most palatable of those available when drunk warm, and since federal surveyors do not have fridges, this is a most important consideration. Furthermore it comes in cartons of twenty-four and two of these cartons form a head load. By mid-morning the lorries are ready and we head northwest along a good but corrugated laterite road towards Kaiama, which is to be home and field headquarters for the rest of my tour. The road carries on to Bussa (the nemesis of Mungo Park on his way to the sea after discovering the source of the Niger) and then, crossing the Niger by ferry, to Kaduna, the regional capital. Arriving in Kaiama, by mid-afternoon I have moved into the bush rest-house, unpacked and taken stock of the surroundings. The house itself is large and built of stone with a pan roof covered in thatch. This is slipping off at one end but still keeps the place cool. Meanwhile the survey gangs have gone off to the town. The impact on the local economy of these men, with salaries of 3s 3d a day as compared to the northern rate of 2s 4d, is likely to be great.

Tuesday 5 January 1959. The main object today will be to pay a courtesy call on the Emir of Kaiama. Until the relatively recent establishment of Bussa, 68 miles up the road, as the divisional headquarters, the Emir had been the most important leader in the division. Borgu is the largest division in the region, and one of the most sparsely inhabited. Kaiama is situated at the crossing of a main trade route from Yorubaland in the south to the important centres to the north, and the old east-west route between the Niger and Dahomey. The Emir's palace is surrounded by red mud walls with an impressive entrance hall which is the focus for ceremonial occasions. We exchange greetings and presents, then it is time to view the town. When he passed through it in 1826 on his way from the coast to Sokoto, Hugh Clapperton described the town as a straggling and ill-built city with a population of 30,000 people. Now it is neat and well built with a population of no more than three thousand. The east-west trade is long gone but Kaiama is still important in the trade to the north and between Dahomey and Ilorin. The road leading south-west to Yashikera on the Dahomey border will be important for the trig reconnaissance and even more so for the observations, which will involve moving light-keepers and heliomen around. This road, marked on the only map available, which is at 1: 250,000 scale and of doubtful accuracy, had been improved and surveyed by Joyce Cary when he was ADO Borgu here in 1917. As well as road building, Cary had written his best african novel *Mister Johnson* based on his life in Kaiama.

Wednesday 6 January 1959.1 decide to climb the rocky ridge just north of the town. This will be a start to the recce. The climb is easy but finding a viewpoint more difficult. When I do, I can only see about a mile because of the dense haze and realise now what was meant in Ilorin when I was asked how I would manage to survey in the Harmattan which was thick this year and would last until March.

Crikey, what now? I had better send a telegram to Lagos!!

HYDROGRAPHIC CONVERSION

Alan Haugh

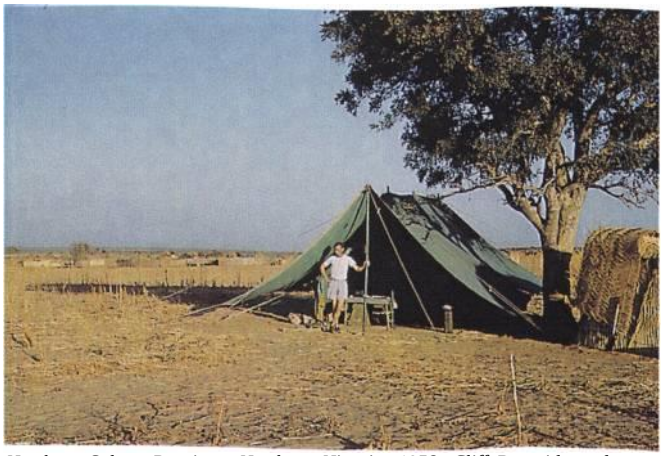
After Nigerian independence brought to a premature end an intended career in the then Colonial Survey Service (foil owed by a very enjoyable period teaching at the then fame d South West Essex Technical College alongside well kno wn academic surveyors Michalski, Kilford. Allan, Hollwey and Maynes) a feeling that one was perhaps not cut out to be an academic brought about a career direction change.

In deciding to join an international oil exploration company as an operational field surveyor one had little idea of what might be involved except world wide travel, required versatility, and a greater concern with geodetic positioning for assorted company operations rather than emphasis on the cadastre and map production of a colonial survey department. Moreover, at that time (late 1960s) the oil industry was in the early stages of exploration and production offshore. So a somewhat rapid conversion of a land su rveyor/photogrammetrist to a basic hydrographic practitioner was called for. A week's graphical tidal analysis and prediction practice at the feet of Commander Glen (of pre D-Day beach surveys renown but then the Tidal Officer at theHydrographic Department Taunton), another week at the then Decca Surveys school in Brixham gaining acquaintance with the deployment and operational use of Decca Navigator and HiFix, and a few days at Kelvin Hughes in Hainault with soldering iron, working through the innards of the MS26 echosounder and appreciating the fundamentals of sonar, was the basic technical training arranged by BP. Thereafter it was all on-the-job. And mostly on the North Sea. No computers, no automatic recording or fix marking or plotting, everything computed by slide rule, hand-cranked calculator or log tables. And everything read by eye, booked and plotted by hand on booking sheets (in triplicate) and pre-constructed lattice charts, after one reached the survey area and the weather and sea state enabled the team to begin work.

To reach the survey area it was of course necessary to board a ship. Early commercial survey ships were well short of Royal Naval standard. They were a motley collection of small vessels pressed into a new urgently required service for which they were never intended. Inshore ferry boats, small trawlers, small cargo vessels, tugs, small deckload supply vessels, even old landing craft, were all used for surveying. Some had a pervasive aroma stemming from previous use or spilled diesel. Others had a resident population of four and six legged passengers. Catering was often difficult and rudimentary, performed by an odd group of true individuals who for unknown reasons actually wished to process food on a small ship. Often shallow draught and though ballasted in the absence of cargo, they often exhibited a variety of sea induced movement and this occasional sailor, as representative of the oil compa ny client aboard a Decca or Gardline vessel, began to feel pretty queasy shortly after exiting the Yarmouth river, a state that might last the whole voyage if the sea never drop ped. Surveys then were often prolonged by the alliance of bad weather and unstable vessels. Appetite and weight loss aboard coupled with what became a most delicious British Rail breakfast on the train back to London are firm recollections of this period.

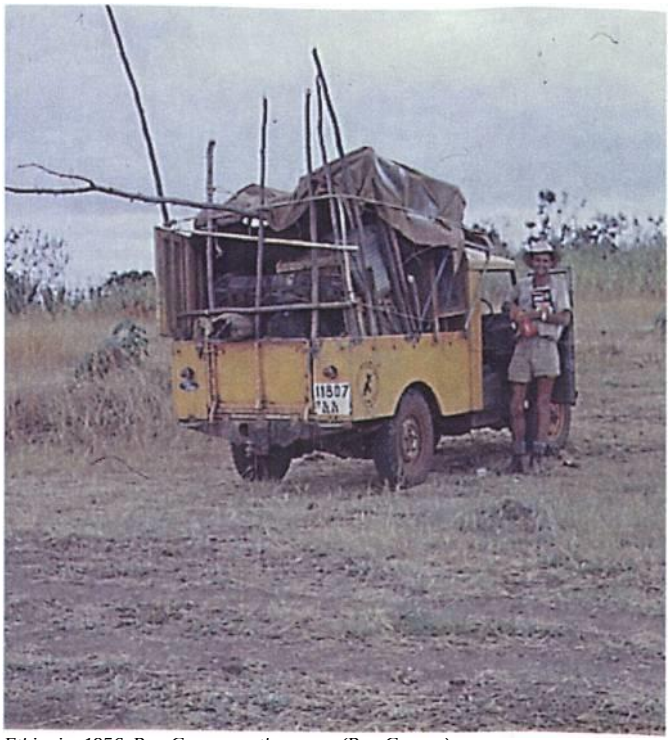
Work began as one sailed down river. Knowledge of one' sprecise position (to 20m or so) depended on maintaining a record of one's path across the hyperbolic position line lattice of the HiFix and Sea Search chains, with additional information from the more open patterns of the much less accurate Decca Navigator general navigation chains. Sea Search and HiFix each provided only two position lines and only the fractional part of the lane readings was delivered automatically. To maintain identification of the whole lane count one had to continuously book them, from a point whose HiFix or Sea Search coordinates were known, as the vessel passed through them and as the equipment's dials, locked on to the signal, ticked over. This count would perhaps be from a rig on a drilling location, one of the then few platforms, a navigation buoy (though these were generally unreliable as they could change position appreciably as the tidal height and flow direction changed). So it was that as one passed the light at the Yarmouth ri ver entrance one set the correct lane number and thereafter began to log the HiFix and Sea Search readings every minute or so and at course changes, and hoped and prayed that a storm or other atmospheric disturbance would not blot out the signal and cause the lane indicator dials to spin out of lock, thus losing one's knowledge of one's position. Indications of forthcoming instability might cause the preparation of a marker buoy to be dropped before complete signal loss with the ship hove to to await more stable conditions before resuming the count and passage to the work site. If conditions did not allow, this lane count loss required return to a reliable reference point (rig, platform etc.) and resumption of the count from there. Clearly a survey location in the middle of the North Sea could require somewhat lengthy and perhaps repeated exercises of this nature. At eventual arrival on site a tightly moored marker buoy would be dropped to serve as a local reference point for the duration of the survey. Correct lane count could then be reestablished in the event that signals were lost by bringing the ship alongside the buoy and inserting the correct lane counts onto the HiFix pattern counters. There were other techniques which assisted the surveyors to ensure positional integrity, use of ghost buoys for example, which were unmarked points where readings from all available Navigator, Sea Search and HiFix chain patterns could be computed back in Yarmouth, radioed to the ship and compared with those observed. But positional determination in the middle of the North Sea was always problematical and essentially a daytime only operation as one was at the limits of HiFix coverage and the dreaded skywave at night inevitably produced interference and lane count loss.

A massive trig beacon south ofBukuru, Jos Plateau, Northern Nigeria, 1959 . L to r: Cliff Burnside, Jack Ashton, Mick Miles. (Clifford Burnside)

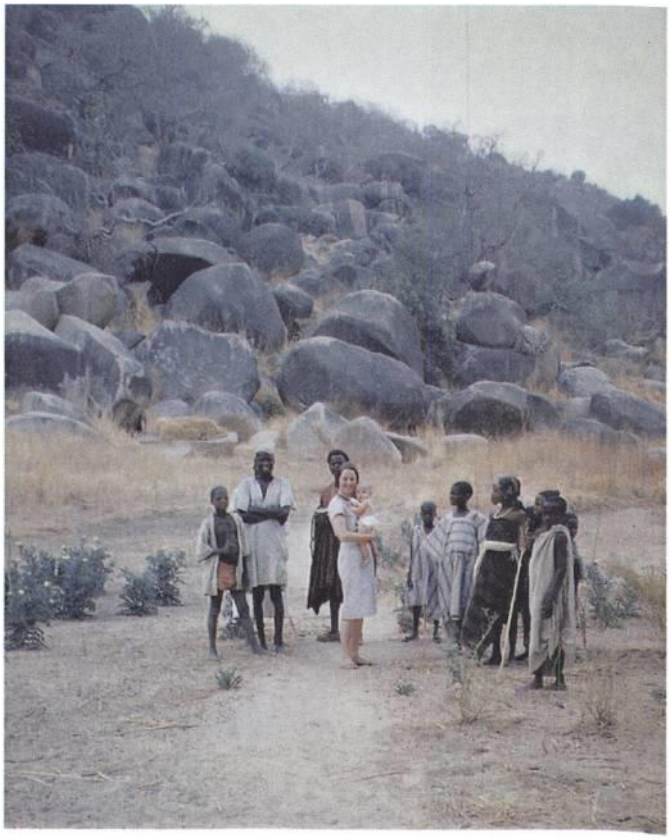


Northern Sokoto Province, Northern Nigeria, 1958. Cliff Burnside and camp-site during astro-fixing. (Clifford Burnside)

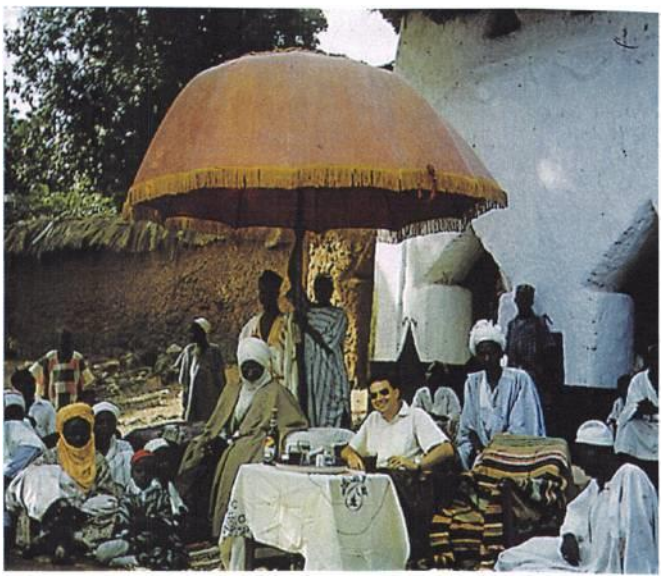
Little Cameroon and Fernando Po, 1968. Seen from below Hut 3 on Mount Cameroon. (Laurie Butler)



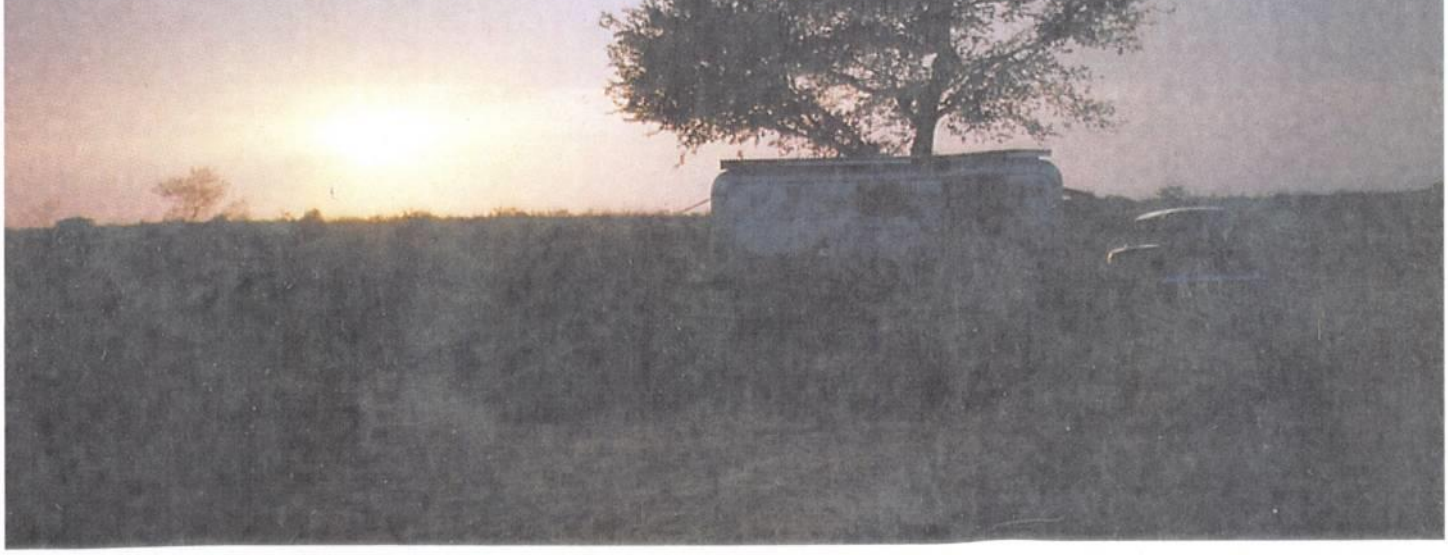
Ethiopia, 1956. Ron Craven on the move. (Ron Craven)



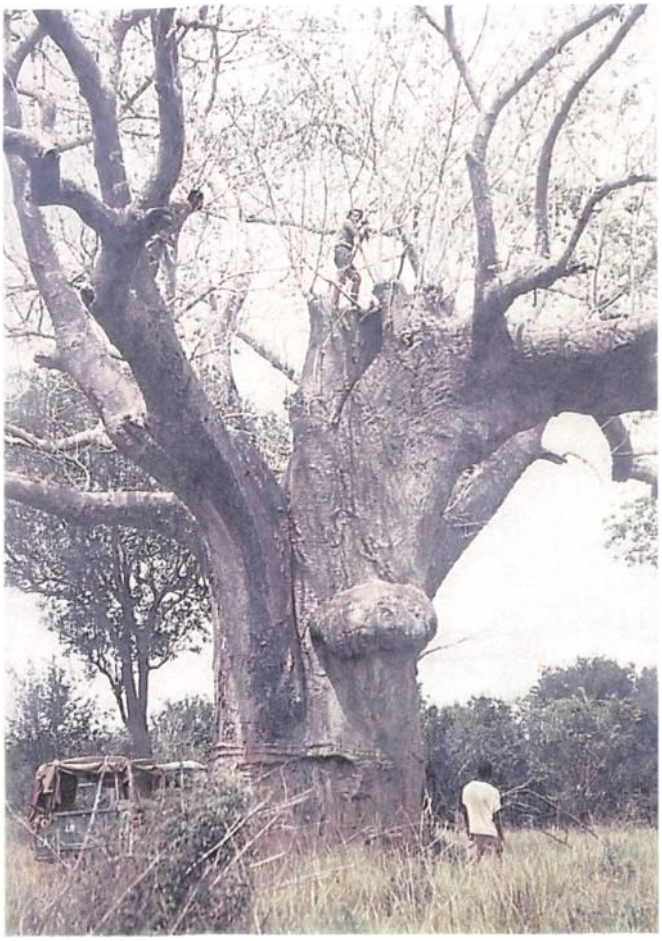
An early evening stroll, Kotorkoshi, N. Nigeria, March 1963. (Jennifer Cooper)



Kaiama, Northern Nigeria, 1960. The Emir of Kaiama (in sunglasses) welcomes a federal surveyor, Dick Rogers (also in sunglasses). (Colin Emmott)



Alan Haugh (r.) directing the launch of BP s 48 Hz sidescan sonar fish before A-frames and Health & Safety Regulations. Pipeline survey off the Humber, 1970. (Alan Haugh)



Alan Haugh up a gum tree (or baobab) observing secondary control for a BP land seismic survey. N.E. Kenya, 1972. (Alan Haugh)

Most survey voyages at this time, in the early stages of North Sea exploration, were for rig sites or for rig positioning. But a number of seismic vessels were also criss-crossing the North Sea and their positioning was also being conducted in similar ways. However with a 3km cable trailing behind the vessel, accurately reestablishing lost lane count was not a very easy or perhaps rigorously pursued operation and seismic positioning was a somewhat less reliable activity. Site surveys, as now, usually consisted of echo sounding, side scan and sub bottom profiling, with coring and bottom sampling. All data was analogue and interpretation of the records and manual plotting on preprepared sheets were conducted on board in rather rudimentary conditions.

HiFix would not work on jack-up rigs since there was too much high reflective ironwork, so rigs were positioned by the survey vessel laying a set of marker buoys to form a prearranged pattern, into which the rig was towed and stood on its lowered legs as close to the required position a s its tugs could manoeuver it. Its final position was determined by sailing round it and recording and plotting positions where the three or four legs came into line, finally reading off the chart the pattern readings where the shape of the rig fell and computing these to grid and geographical values, after suitable application of pattern corrections, if known, for the area.

One particular 1970 episode sticks in one's mind and illustrates the difficulties. The Gulf Tide rig, a three legged jackup had been hired by BP to drill in Dutch Block B13, almost as far from land as one can get in the southern North Sea. The site survey had been conducted and the rig positioned on location but it had been found when preloading (whereby it fills its hull tanks with sea water to create a n over-heavy state as it jacks up out of the water) that its legs continued to sink into the sea bed. Pre-loading was stopped and the rig moved off but jacked-up light at a nearby spot. It was therefore necessary to find a nearby drilling location with stronger subsoils which would safely support the rig. Decca's "Trailblazer" vessel, a relatively tiny- ship with very restricted workspace and accommodation, was mobilised for the re-survey and in poor weather set sail for the location, lane counting during daylight as it went. After some weather delays during transit and after arrival, surveys over proposed alternative locations were conducted with an emphasis on trying to achieve good subbottom profiler data showing strong subsurface reflectors, which might indicate better load-bearing conditions. In the light of the site difficulties it was decided that the still somewhat dubious records had to be got to the rig insurers for scrutiny before the alternative locations could be approved. But the ship would ake some 30 hours to reach Yarmouth and it might still be needed on site to conduct further site surveys if the current alternatives were deemed unsuitable. So it was decided that the company representative should take the records back to London by helicopter from the rig, which of course involved getting onto the rig. For some reason this decision arrived after nightfall so a night-time basket transfer was arranged of the writer along with another crew member whose sea-sickness had been so bad as to cause him to vomit blood, the intention being to fly out on the next morning's helicopter. However "Trail- blazer" had no afterdeck and the small forward deck was almost entirely occupied by a small hatch. So in an apparent lull in dismal weather the ship edged towards the seemingly towering rig and a personnel basket was lowered by the rig's crane driver. In a procedure not now permitted for safety reasons, the ship's captain tried to keep his vessel stationary as the basket arrived over the hatch. The intending basket transfer passengers had together to throw their baggage inside the net, clamber onto the outer base rim and hold tight on to the net while the crane driver hauled up clear of the hatch and superstructure of the bucking vessel, all in as quick time as possible. The fear and apprehension over the exercise was tempered by the relief at getting off an uncomfortable rolling ship, and arriving onto a solid rig deck, with the thought of a beckoning comfortable bed and the superb rig catering to fill an empty stomach to follow. But the transfer was just in time. Deteriorating weather then prevented any helicopter flights for more than a week and probably also any basket transfer attempts. So the records did not reach London as intended. Meanwhile the "Trailblazer" was running out of fuel and provisions and had to return to port, actually arriving several days before the helicopter flights could resume. The final outcome was that the soil conditions in the area of the proposed drilling location were deemed unsuitable for this part icular jack-uprig which had spent almost a month, at a cost then of about £10,000 per day, on standby. Thereafter no jackup rig was taken to a drilling location without a detailed deep soil analysis of samples recovered by a deep core drilled from an anchored ship. Truly live and learn. Expensively!

Of course the last thirty years have seen tremendous changes in offshore surveying practice. DGPS positioning is now universal and essentially gross error free. Buoy marking for positions is seldom used, the GPS being mounted on all offshore vehicles. Site surveys in the North Sea are still practised in much the same way as before but with hugely improved sensor, processing and presentation equipment and with the benefit of a vastly expanded general data bank for the area. Ships used are larger and more comfortable and user friendly. The weather is much the same but because of the better ships, equipment and deployment methods does not limit operations to the extent that it once did. Survey personnel are better qualified, paid better and have much better tools and methods to apply. Most of the booking and recording drudgery has been eliminated by digital procedures, and the final presentation of the data is largely automated and available as the ship reaches port or, by modem communications, even before. However, perhaps it is now all too easy and some of the technical challenge has been lost. Now perhaps the emphasis is more on the financial aspects of operations and how the contracting companies can maintain profitability.

(See also colour page 40)

THE ARMY CONNECTION

Brian Irwin

Prelude

The fruits of war are not all bitter. Some are ironically sweet, and without doubt the Second World War paved the way for a substantial improvement in the professional standing of Britain's land surveyors. These men had come from far and wide to provide the massive survey support needed by the Allied Forces in a global war; Royal Engineers from the Ordnance Survey and from the Survey of India; surveyors from our many colonies, and from the air survey companies; academics with a bent for geography or mathematics; younger men with the same leanings who were attracted by the subject and later stayed with it; and many others. All were thrown together under the same khaki umbrella, and in four years of war a fraternity was built up among professionals who had been fragmented before. When the fighting ended, men of vision within this fraternity, conscious of the fact that they badly needed and deserved a professional home, turned to The Royal Institution of Chartered Surveyors to provide it. In due course, the Land Surveying Division was bom, and it accepted as its founder members a wide crosssection of surveyors from all backgrounds whose experience in the wartime and earlier years had provided them with a shared sense of identity. After the War, the khaki umbrella shrank as many resumed civilian life. However, those who stayed on in the Army as Royal Engineer surveyors continued to play their part in the life of the fledgling Division. Additionally, the Army Survey Course was set up at about this time and was accepted by the Institution as covering most of the ground required for its professional qualification. Thus many of those who have since graduated from the course, civilians and military, foreign and British, have been able to proceed to membership of the Institution with a minimum of additional examination. So it is that at this moment, twelve serving officers of the rank of Major or above have FRICS or ARICS after their names, and the strong links between the Army and the Institution live on. *Vive la connexion*! With this in mind, the following brief account is offered in the hope that members of the Division may be interested to know what their military colleagues were getting up to some forty or so years ago, at which time the writer was privileged to command 42 Survey Engineer Regiment.

The Near East, 1956 - 59

42 Survey Engineer Regiment, comprising some 400 soldiers of all ranks, was at that time the largest and most powerful military survey unit outside Britain. It was stationed in Cyprus, to which it had recently moved from the Canal Zone in Egypt. One of its components, 19 Topographic Squadron, was located in Iraq. In the Army, Military Survey is responsible, broadly speaking, for providing it with the topographic information which it needs in order to move and fight; there are responsibilities to the RAF too, but these need not concern us here. It is important to remember that providing topographic information involves not only the arts of land surveying, including photogrammetry, but also all the cartographic and reproduction processes needed to make a map - and, nowadays, the whole range of technological wizardry which is used to present topography to increasingly high- tech fighting persons. In addition, a major but highly important part of Military Survey's work is producing the

15 miles SW of Pengwin, Iraq, June 1957. 3 Tp camp at 3,500ft. See also colour page 48)

data which helps a weapon to hit its target. One of the benefits of being stationed in Cyprus in those days, apart from its delectable climate and facilities for an enjoyable lifestyle, was the fact that Britain was concerned with trying to maintain the peace throughout a wide area of the Eastern Mediterranean, in the Arabian Peninsula, and in East Africa, all of which places had various pots boiling at any one time. Consequently, there was a never-ending call to produce up -to-date mapping at next to no notice in case we might have to intervene in the latest trouble spot. This kept the adrenalin flowing and gave the Regiment a very definite sense of purpose.

At this time, Enosis (union with Greece) was the cause of a certain amount of civil unrest in Cyprus. The consequences were not as alarming as the Press would have had the world believe, but security precautions were very necessary and pervaded every aspect of life. Fortunately, the Regiment was stationed at Zyyi (pronounced Ziggy), a small and predominantly Turkish carob port where no trouble was ever experienced; however, the threat was always there, and the Regiment's guard could never for one instant be dropped. This inevitably imposed a drain on resources which could have been used more productively, but an army has to accept such things. As the soldiers were always being told, they were soldiers first and surveyors second.

In Iraq, things were outwardly more peaceful for 19 Squadron, although the coup of July 1958, in which King Feisal was murdered, was ultimately to bring their work in Iraq to an abrupt halt. They were there at the request of the Iraqi Government, their principal task being to provide

barometric height control for a new high quality 1:100,000 map series covering most of the country; but they were also putting in a certain amount of supplementary planimetric control where this was needed. Other work include the annotation of air photographs to show the nature of the terrain, especially in the desert; names collection; route surveys; and sundry other tasks relating to other mapping scales. They also had the satisfaction of observing a first order triangulation between Ramadi and Fallujah which required the use of the Bilby tower, and which effected an important link between two geodetic networks.

The Squadron was based in Habbaniyah, commonly known as Hab, about 20 miles west of Baghdad. This was a Royal Air Force base, a magical Garden of Eden created out of the desert with the aid of unlimited water from the Euphrates with which everything was irrigated liberally and frequently, so that trees, grass and flowers grew in profusion. While in Hab, the soldiers wore uniform, but when surveying outside they were dressed in a motley assortment of civilian clothes and moved about in Army vehicles devoid of any military insignia and bearing Iraqi number plates. This was at the request of the Iraqi Government, but deceived hardly anybody. The Squadron's work took it into remote parts of the desert on the one hand, and into the wild and beautiful Kurdish mountains on the other. The unit was organised into three troops of about 20 men; each troop operated from its own tented camp and was under the command of a young subaltern. Communication with Hab was by means of shortwave radio sets of wartime vintage which needed a certain amount of TLC to operate, and although contact was meant to be a regular daily routine it was susceptible to terrain, weather and Mr. Murphy's well known Law. Thus the soldiers needed to be self reliant and self sufficient, one of their major problems being to keep their ageing transport on the road or rather, on the move, for tarmac was a rarity where they were working and off road movement was the norm. Even the main road from Baghdad to Kirkuk was still under construction in those days.

The young officers who commanded the three troops were all doing their National Service, which in some cases they had extended by one year to 3-year Short Service Commissions. Either way, their useful period of service after completing their training in Britain, though all to short, demanded a great deal from them. Military Survey was lucky to have been able to pick and choose to some extent, but nevertheless, almost without exception, these young men earned the unstinting admiration of the Regular officers who commanded them and, equally important, the respect of the more streetwise NCOs and soldiers whom they commanded and with whom they lived and worked in close proximity. They grew up very quickly, but this would not have happened had the material not been right in the first place. Both in Iraq and later in the Aden Protectorate, after the coup of 1958 had made further work in Iraq impossible, they were first class. To mention but a few names: Lieut, (now Professor) Peter Dale, who needs no further introduction; Graham Cox, a resourceful and

Brian Irwin contemplating a washout and a six-hour wait. Iraq, 1957.

ebullient young man who was later distinguishing himself as a civil engineer when he sadly died at an early age; Liam Maguire, a very able officer, mature beyond his years, who later accompanied an SAS operation as surveyor (and survived!); Barney Rosedale, whose expertise with his troop's first aid kit in aid of ailing Kurds revealed a latent talent for medicine which persuaded him to change professions on leaving the Army; John Benstead, whose artistic gifts and laid back sense of humour belied a stalwart nature; and many others.

No account of these times would be complete without a passing salute to the Tellurometer, which made its first appearance in 1954, and later came into use in 19 Squadron in Aden. This radical invention, and its numerous successors which operated with ever decreasing frequencies (and hence ever increasing accuracies), brought a fundamentally new approach to the provision of planimetric control. All of a sudden, accurate measurement of long distances had become quick and relatively simple instead of being slow and painstaking. The traverse had become a viable option where triangulation would have been the preferred technique in the past. In military surveying, where time is often a crucial factor and where hostile humans may make the peaceful occupation of nicely conditioned triangulation points somewhat hazardous to say the least, the flexibility offered by traversing was of enormous benefit. *Ave atque valel* Technology has now moved rapidly ahead and the ubiquitous GPS is having its day; how 19 Squadron could have done with a few of those in Iraq. *(See also colour page 71)*

BENGAL TIMES

Jan Karalus

In September 1962 as a newly qualified surveyor, Fairey Air Surveys assigned me to their ground control party in East Pakistan at the start of their second survey season. The task may have been a standard one for the company, which had been founded in Bengal some forty years previously, but to a twenty-three year old who had never before travelled outside Europe the adventure was total.

After more than twenty four hours of travel from London, the Lockheed Constellation landed in Dacca in a late monsoon downpour through which we struggled in an ancient taxi to the Shahbagh Hotel, the best in town, and I subsided gratefully onto the mosquito netted bed, underneath the ceiling fan, to recover from the journey. Even the large gecko which was observing me from the ceiling gradually failed to keep me awake.

That was a time when the survey season was a reality which could not be overcome by the technology of the day. Last year, whilst engaged in petroleum development and exploration in Bangladesh, seismic surveying continued throughout the year, albeit with reduced productivity in the monsoon, thanks to the availability of GPS and vessels of a type which just were not available then. In 1962 our first task was to visit the previous season's base camp area to assess the flood condition and then to reestablish the camp.

For the first six weeks as the countryside dried out I worked in base camp preparing aerial photography for our Bengali surveyors to control and learning the important art of serious camping. This had changed little if at all since the days of Empire. Various sizes of standard Indian Army pattern cotton tents, with or without fly-sheets were issued according rank and status: 12ft square with 3ft walls and 6ft ridge plus fly-sheet with bell-end for bathroom was top of the range for an expatriate surveyor. The number of labourers who crowded into a tent of that size was amazing and they did not have a fly-sheet. Power for lighting and cooking was provided by paraffin because it was available in local markets, and base camp even boasted a paraffin refrigerator.

As soon as conditions permitted I was put to the real test of professional competence: to set up my own camp on the other side of the Jamuna River (some 13 miles wide) and observe a line of geodetic levelling along the Tangail Mymensingh road. I was on my own and wondered whether I had bitten off more than I could chew. Suffice to say that with the determination of despair and the help of my loyal Bengali staff, most of whom had already spent the previous season with Fairey and knew the form, everything went perfectly. Even the levelling closed. Moreover, I learned not to camp in the romantic shady gardens of a mined Zamindar's Palace ever again. It wasn't so much the shadowy serpents that glided through the camp in the evening that gave cause for concern they were only after the frogs who were after the jute moths who were attracted by our Tilley Lamps but the sloughed cobra skins which I would find in my tent most mornings, where their former owners had sought escape from the cold night air. My nightmare was that I might be called upon to administer the intravenous snake bite serum which the four expatriates each carried to administer to any one of our 500 local staff in case of need. Fortunately for our staff, the need did not arise in my camp.

Having proved my mettle, the party chief then gave me the prize ground control of Belkuchi district. Although Bengal is one of the most densely populated areas in the world, communications have always been difficult because of the mighty rivers which crisscross and shift and flood and flow seasonally in different directions with a force which can destroy whole towns and transport infrastructure. In 1962/63 the Belkuchi survey area was isolated even by Bengali standards. It was surrounded by major rivers on three sides and there were no motor roads or motor transport in the whole district.

A bullock wagon trail ran from the railhead at Sirajgang, southwards for about 30km through Belkuchi town to a ghat on the Baral River where country boat ferries plied the 1 mile crossing to Pabna District and the nearest motor road. The east-west extent was about 20 km. I camped at a village called Samaspur because it lay midway along the north-south artery and because it boasted a magnificent banyan tree in whose cool shade a small market was held twice a week and which also accommodated a *chaikhana* open all hours to travellers and campers and serving lovely hot sweet tea (bay leaf optional).

For five months I controlled the operations of 5 photo levelling teams and 6 photo interpretation teams. With two Land Rovers and trailers I would move the teams' camps, prepare their work assignments and check the results. Sundays were special. I would take the week's survey results and empty petrol drums to the Southern Ghat, 15km and four hours away. After checking that the party chief was on the other side (and vice versa) I would hand the survey package and empty drums to a boatman and the party chief would despatch a boat with full drums of petrol and any other supplies previously requested. These Sunday sightings across the river were the closest contact that I had with the outside world. Then it was four hours of dusty and difficult driving back to camp, a hot bath in the tin tub and a *cordon bleu* dinner cooked by Anthony on his two ring burner complete with a paraffin can converted into an oven. The dinner table outside the tent entrance was formally laid with starched table cloth, silver and napkin and any British passerby might have mistaken the scene for a Camp Coffee label.

As most of the local staff were muslim, Friday was observed as the weekly day of rest and any who were in Samaspur on that day would join the Land Rover trip to Sirajganj. While they went to market I would visit the barber and, in the afternoon, we reserved the back row of the local cinema for the matinee performance. This small treat, which cost only 3 mpees for the whole row, created good will and loyalty out of all proportion to its cost. The

films were terrible.

It may be that the first expedition, like a first love, is the most memorable. Certainly Bengal made an enormous and lasting impression on my life. The population pressure, poverty, disease, natural disasters, dust and, in my case, cultural isolation, were never to be equalled again. And yet the prevailing memories are of the beauty and fertility of the countryside, and the hospitality, friendship and, above all, the resilience of the people. I returned to Belkuchi in 1975 and the isolation of the area was again emphasised by the fact that it harboured the last pocket of smallpox in the world. In June 1998, the Prime Minister of Bangladesh opened the Jamuna Multipurpose Bridge. Its western landfall is by Samaspur which will now become the Clapham Junction of Bangladesh.

(See also colour page 47)

TRANSITING THROUGH CHANGE

John Leatherdale

1958 was a good year to start a career in land surveying. Over the following 40 years, there were to be unimaginable political, social and technological changes. At the start it was the Boeings and Land Rovers and Tellurometers which were making fieldwork so much easier and setting a much more demanding pace.

Transport was a bizarre mixture of new and old. The Boeing Stratocruiser could cross the Atlantic without refuelling at Shannon and Gander. Projects which used to take years could be finished in months, leaving time to work on another continent or two before the year's end. We learned to drive Land Rovers across desert, through elephant grass and swamp and became devoted to what now seem grossly underpowered rattletraps with discomfort designed into them. We still paddled dug-out canoes up the Niger and employed whole villages to move camp by headload porterage. Others were using mules in the mountains and dogs in the snow. Local people were amazed by transistor radios and I think we were too. Then helicopters made the most remote areas accessible and provided the most exhausting form of travel yet devised. Single side band radios and the telex, primitive forerunners of the mobile phone, never quite empowered the bosses at home to intrude on field-men's privacy or dictate the next day's work. We ignored them and used our initiative.

In 1958, the MRA1 Tellurometer had just arrived - we had MA6 in Sudan to map the Roseires dam site and reservoir. A screw was provided to adjust the speed of light to your own satisfaction, which produced some interesting scaling errors. The old hands thought it incompetent to use the voice communication system, priding themselves on their ability to measure and move on without a word. I was taught to shine a heliograph and promptly blazed it on full power at Tony Bancroft on a hilltop 40 miles away. Back at camp, he did commend my persistence in keeping the mark dead on target all day. We still did our own computations by Facit and Peter's tables, without making too many detectable mistakes. We observed stars for position and azimuth and recorded time on tape chronographs (except Arthur Allan who used iron filings). Then Alwyn Robbins designed a portable crystal clock with a cunning device to record time signals to a few hundredths of a second. Doppler and GPS changed all that. Today surveyors do not hang around long enough to get to know the local people, their culture and idiosyncrasies. Perhaps the next generation will ask, "You mean you had to go out on the ground?"

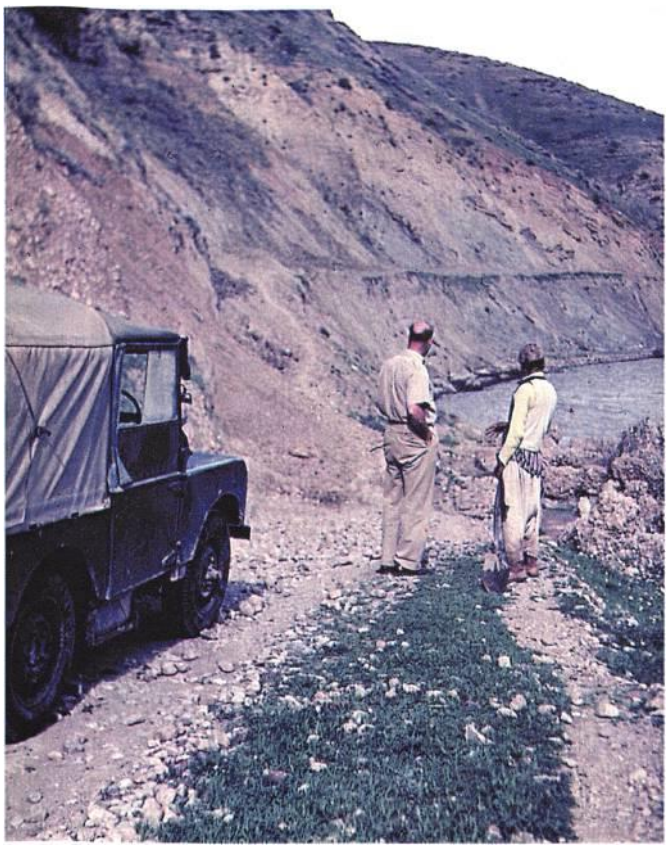
Instruments were still designed by individuals. We could listen to Wadley explaining the improvements in the MRA2 Tellurometer; Santoni demonstrating the mechanical lens distortion correction device on his Mark V stereoplotter; and Yzerman describing the space rods of the PG2.

The 60s, 70s and early 80s were good decades for field surveyors in the private sector. There was work to be done in the remaining colonies, the new Commonwealth and in most other countries outside the Soviet block. There was an enormous range of contracts for 1:50,000 scale national mapping programmes, urban mapping, dam sites and reservoirs, irrigation, roads, oil exploration and production and more. Some surveyors branched out into architectural or underwater photogrammetry, industrial measurement, monitoring and maintenance surveys. Only cadastral surveying seemed to be in decline. I have always preferred working project by project. Each project had a clear and usually beneficial purpose and we worked until the job was done. The problems we had to solve were usually of our own making, not government procedures set down by a previous generation. Each new project was a fresh start with opportunities to do better. One of the occupational hazards was getting arrested or at least apprehended, usually for taking photographs or being thought to be taking photographs. I have been detained in five or six different countries but never more than once in each. The police in Jeddah used to pick up one of our field completion surveyors several times each month for months on end. If he wasn't getting arrested we wondered if he was doing the job properly. Surveying different things for different purposes in different countries was excitement and satisfaction enough for young surveyors. We did not feel the need to influence the way the world was run as well.

When a surveyor moves into management he loses his practical touch much faster than he is prepared to admit. This was brought home to me quite bluntly on a supervision visit to Saudi Arabia when the project manager asked me to turn a few traverse angles for him. He considered it necessary to send his not-quite-four-year-old daughter with me to find the traverse station. Having found it for me, she sat on the Land Rover bonnet and watched my efforts at centring a tripod over the station and getting it level enough to take the theodolite - a demanding task when you are out of practice. "My daddy can do that much better than you", she said. Since that day nobody has invited me to operate a total station, doppler or GPS receiver and certainly not a soft-copy image station. Improving communications made management very hierarchical. New theories for flatter pyramids and devolved responsibility have given the initiative back to the field-men - with much greater accountability.

The last decade has been quite different. The dominance of the market economy, privatisation, global competition, the over-supply of oil and the cut-back in public spending have not been good for land surveyors, accustomed to being funded mainly by governments, international development agencies and oil companies. Privatised utilities and a more cost-conscious oil industry are no longer lavish spenders on surveyed data. These changes brought new opportunities. The failure of central planning and the break up of the Soviet Union brought land issues to the top of the political agenda. Reinstatement of individual rights to land and property and the safe operation of land markets have created an urgent need for cadastral surveying and land registration, far beyond the human and technical resources available. This epidemic has spread from Eastern Europe and the former Soviet Union to China, Vietnam, South Africa, the West Bank and Gaza, perhaps even to South America. The demand for advice and technical assistance in setting up affordable land registration systems in an acceptable time scale is insatiable. Even countries with long unbroken traditions of private land ownership, cadastre, Torrens, Lairds or general boundaries, are taking the opportunity to upgrade their legislation and technology to improve the quality of service to an ever more demanding public. Surveyors have been given a rare window of opportunity to participate in the formulation of national policies for land administration. The moment will pass and new generations will have to seek new challenges. At least the last four decades have been good, because we made them so.

(See also colour page 47)



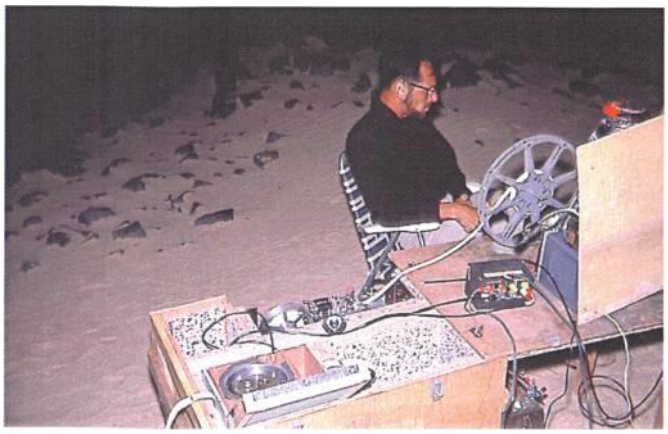
Now what? Landslide N of Dar Bend-I-Khan, Iraq, April 1957. (Brian Irwin)

A country ferry, spring 1963. Belkuchi, E. Pakistan (now Bangladesh). (Jan Karalus)

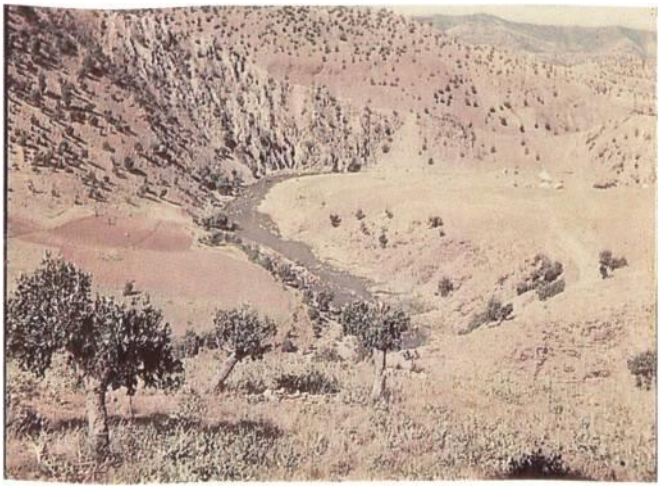
End of season group photograph, Jan Karalus & team, June 1963 E. Pakistan (now Bangladesh).

The mess at base camp, Christmas 1962. Near Palma, E Pakistan (now Bangladesh). (Jan Karalus)

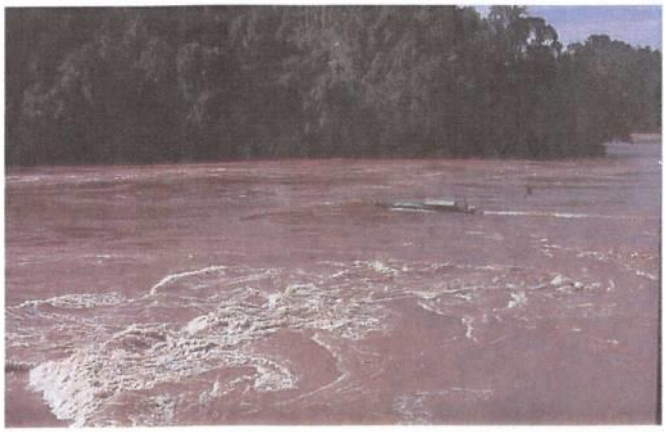
Dry headloads and wet feet. On trek across the Accra Plain in the rainy season. Ghana, December 1963. (John Leatherdale)



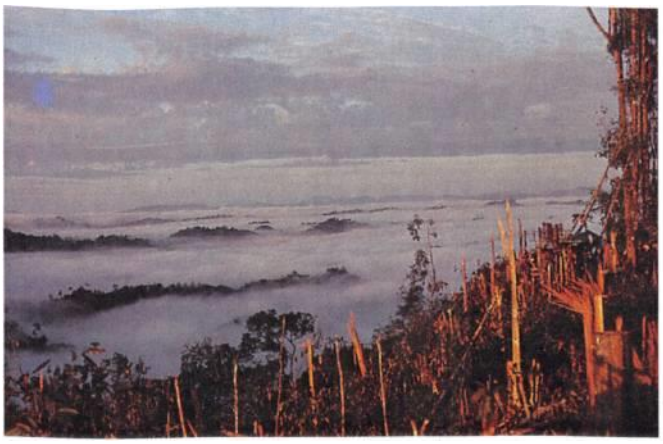
Harry Glennie using a tape chronograph for Laplace azimuth control. Geodetic network, Saudi Arabia, July 1967. (John Leatherdale)



*15 miles **SW of** Pengwin, Iraq, June 1957. 3 Tp camp at 3,500ft. (Brian Irwin)*



DOS canoe on the Rajang River rapids. Sarawak, 1969. (John Leonard)



A trig point after tree felling. Sarawak, 1969. (John Leonard)

Mountains and terraced fields, West Aden Protectorate, I960. (Hugh Woodrow)

Col R.C.A. Edge & Maj G.A. Hardy (behind) in dispute over a trig location. W. Aden Protectorate, 1960. (Hugh Woodrow)

Hugh Woodrow being well guarded by Federal soldiers and local militia. W. Aden Protectorate, 1960. (Hugh Woodrowj

SURVEYING IN BORNEO IN THE LATE SIXTIES

*John **Leonard***

With my necessarily self-sufficient family in tow I had surveyed for 10 years in third world countries each of which had turned out to be more developed and less ''different" than we expected. Was Sarawak which was to be our last overseas posting going to prove the exception? Our base was Sibu, a small mainly Chinese town, where we were given a government house on stilts to keep its head above the twice-monthly floods from the neighbouring Rajang River. Although a long way from the sea, the river was tidal and vast. It was also the motorway up which the two gangs travelled each month, leaving wives for 3-4 weeks to survive without their men and, in the absence of a suitable school, to educate our children (and George our orphaned Gibbon). We each travelled in style in 60-foot dug-out canoes built by our own staff, and driven by twin 40- horsepower outboards. A tarpaulin covered the equipment in the bow which at speed rose five feet into the air. The sahib sat under a very low corrugated iron roof from which my corrugated forehead bears witness to the number of times I forgot to duck.

Despite the skill of our boatmen, shipwrecks were not unheard of as there were major rapids to traverse. Whenever possible we landed before these barriers and carried the equipment past to a spot from which we could be picked up again. On reaching the tributary which was going to provide access to our area for the month, we changed "horses" by borrowing local smaller canoes. However small the canoes were, we always ran out of water before we reached our hoped-for destinations, and that was where our splendid Iban staff took over. Loading the theodolite, radio, chainsaws, petrol, tarpaulins, and rice into their *selabits* (baskets made by them from split cane and carried on their backs with a plaited band around their head to share the weight) these small tattooed and muscular men could carry vast loads all day across the grain of the country through sweltering rain forest. Navigation on the ground was difficult almost as soon as you'd left the river. The country was blanketed by dense tree cover, and although prominent, each ridge looked remarkably similar to its neighbours on our small-scale aerial photography - like the myriad folds on a wet beach when the tide's gone out.

After one month the horror of leeches was forgotten; they were impossible to avoid anyway and, providing one's blood was of the good clotting kind, of minor inconvenience. Sweat bees that clustered on the eye-pieces of binoculars and T2s were more annoying, and near streams the mosquitoes raided in clouds, but we remained surprisingly fit. On arrival at the chosen site, in no time the men had erected a platform of cut branches, uprights, and a ridge pole over which the green tarpaulins were stretched. We slept like sausages on a grill pan (although because of constant sweating I never got as brown as my gang despite

L to rDougAmott (DOS Regional Survey' Officer), John Wright (DOS Deputy' Director Surveys) and Willy West, Cpl, RE. Sarawak, 1969.

the heat!)

Tawa appeared on the payroll as head-man, but he was seldom visible. Carrying his muzzle-loading blunderbuss, he would disappear, sometimes for days, but would eventually return, often hauling a wild pig weighing considerably more than any of us. Like my locals I was by choice a carnivore so I ate snakes, lizards and birds when they were on the menu, but when vegetarianism was forced upon us, the rice was flavoured with forest leaves; these men were jungle survivors, and we often dined on "millionaire's cabbage" from the heart of a palm tree.

My job was to provide height control for 1:50,000 mapping of the eastern divisions of Sarawak. This area was bounded to the south by the extremely sensitive border with Kalimantan. Sibu's Chief of Police who was also a good friend asked me to report to him each month any movement of guerrillas we might observe. I was forced to remind him that if I became known as a police informer this would compromise our ability to work in the area (quite apart from our safety); I subsequently shared the hospitality of several remote long-house communities with bands of "freedom fighters" with whom an understanding of mutual invisibility was reached. Nevertheless, they joined in the inevitable partying which our arrival always inspired, but were perhaps less disturbed by the ancient mummified heads which hung from the rafters, or by the cockroaches swimming in the palm beer which good manners required us to drink!

We used a wonderfully simple but pragmatic technique for the work which depended upon first finding a ridge orientated roughly parallel with the arcs of required control points. You needed two distinct high points on the ridge separated by 300-400 yards. If nature did not provide these for you, you created them by high-cutting trees of sufficient girth to form elevated observing platforms. You then cut a line between the two so that an accurate taped distance could be measured, and cleared all the trees from both ends of your base in the required directions. This last task sometimes took as much as a fortnight despite the steep

slopes involved; this was primary jungle with trees of up to 200 feet in height. Without chain-saws we would have been there for months. As it was, these were relatively lonely days for me sitting on the top on my own with only the occasional direction to give to a gang who knew what to do, and enjoyed the noise and risks involved in knocking down like ninepins a huge area of partially cut trees with the last to be felled.

I observed from each end of the base the horizontal angles subtended to the crowns of distinctly shaped trees on the tops of a series of distant ridges. Vertical angles plus the computed distances gave you two solutions for the height of each selected tree. We became really rather efficient at recognising the same distant tree from different places, at identifying it on the photography, and at estimating its height above the forest floor. Using a circular slide-rule all the work could be checked, and any re-observations completed before the site was left for nature to heal the wounds we had caused. Despite all the time lost by travel and tree cutting, we could achieve sufficient control for several hundred square kilometres, of mapping each month.

The jungles of Borneo certainly proved to be "different" from anything I had experienced before, and our home base seemed wonderfully welcoming and comfortable on our return, even if we had only a few days to enjoy it before roaring off up-river again. After all, we were getting £1 per night camp allowance - not to be sneezed at.

(See also colour page 48)

BACK BEYOND THE INFRA-RED

Early morning on Kindoroko, N. Pare Mountains, Tanganyika, 1955. Kibo & Mawenzi summits of Kilimanjaro behind.

Alastair Macdonald

I joined the Directorate of Colonial Surveys in March 1955. I therefore had some two years before the advent of microwave and, later, infra-red instruments heralded the end of weather-dependent surveying. I was posted to Kenya where the party was observing a chain of primary triangulation along the border with what was then Tanganyika.

Many of the stations between the coast and Kilimanjaro were sited on hills between 5,000 and 7,000ft high and the moist air flow coming in off the Indian Ocean would frequently result in their summits being encased in cloud for days on end. We adopted the unsophisticated strategy of simply arriving at the hill to be observed, and sitting on top of it until it was finished. The design of the chain was such that there would be a minimum of 5 rays to be observed at each station. This meant that not only had your hill to be clear but also the five hills to which you were observing. The length of the rays - up to 60 miles - required accurate alignment of the heliographs and observing lamps that local employees were shining to your hill. If a distant light was not showing, there was much agonising over whether it was off line or in shadow and/or cloud.

You always arrived at the summit full of hope for an ideal, clear night revealing half a dozen lights winking away from around the horizon. The observations would be carried out amidst rising tension (would the cloud descend before completion?) - 8 zeroes complete, 12, 13.., 14...., 15....., at last all 16 zeroes. Next day, you would be off down the hill

and on to the next station.

Of course, it was never like that: during the day, helios would come and go on the surrounding hills as cloud passed across the sun, at night the cloud would come down with nightfall. To start with, the stay on the mountain would be enjoyable, a pleasant climate compared to the hot plains, a huge 360° panoramic view from time to time, an interesting book and a salary coming in too. But, as days turned into weeks, boredom soon took hold, only endurable through a nai ve belief that tomorrow would be different. Eventually, it was but, on some hills, there were 4 weeks of waiting for the arrival of a clear night. Even then, it took a superhuman effort of will to get out of a warm bed when a lightkeeper woke you at midnight to report that the cloud had lifted and all lights were shining.

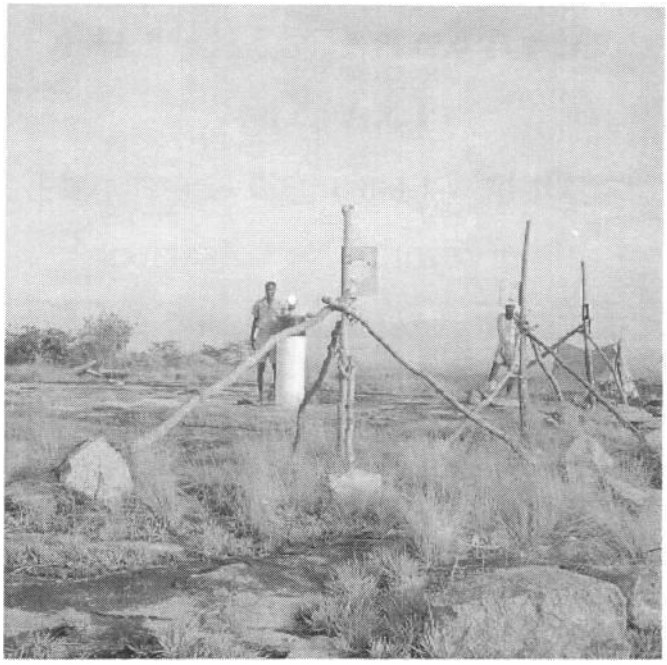
Four weeks to achieve some 3 hours' work! It seems incredibly inefficient today. It was made worse than it need have been by the inability of the organisation to supply sufficient equipment and transport. We worked sequentially; ie one surveyor would be observing at one vertex of a braced quadrilateral, another might be waiting at another vertex for him to finish while he sent his vehicle back to base to collect a third surveyor. There was no possibility of putting four surveyors on all vertices of the quadrilateral to observe simultaneously because there were not enough observing lamps to shine more than one lamp from each hill. This was not a new problem. Hotine, the Director, when a young major observing the 30th arc in western Tanganika in 1932, had conducted a running battle with his superiors (who were being advised by G T McCaw, the designer of the Macca base measuring equipment) over just the same problem:

"In the first fortnight, it was obvious that night lamps were the whole key to rapid working and that we should scrap helios altogether..... I asked the Colonel to get a dozen made up for us to take electric bulbs and nothing else ..... I told the Colonel that this was of paramount importance. Given these lamps by the end of November, we would organise to work entirely by night throughout the rains and would finish for the money next March. Without lamps we should still try but I could guarantee nothing.

"Apparently, I didn't rub it in enough. The Colonel passed it on to stores and nothing at all got done until he got another letter from me (which had resulted in the supply of Lucas Signalling Lamps). These Lucas lamps are not what I wanted but they are far and away better than acetylene. They weigh less than a fifth, cost half as much, run on cheaper and lighter fuel and will give a longer range. In Uganda, McCaw spent three weeks at every station using a mixture of helios and acetylene. Why is it criminal to try and lower that sort of chronic waste by using modem inventions?"

Six weeks later, he tells his wife of final success:

"We are apparently to get electric beacons after all. Watts, the maker of McCaw's acetylene lamps, came forward after he got the order for acetylene and offered to make a better and brighter electric model. This he did, and the Colonel took it out himself on the Hog's Back, and found it at least twice as bright. Old McCaw still disagrees - he knows what he knows. Well, well, I dare say if anyone suggests atomic energy when I'm his age I shall do the same, but I hope not." [1]



Helio operations with semaphore boards. On Nyankomba, near Mwanza, Tanganyika, 1958.

Unfortunately, the late 1940's and early 1950's were a time of rationing and shortages and it was simply not possible to commission additional equipment. It took the introduction of the Tellurometer to produce an emphasis on logistical planning. The reduction in the number of rays to be observed meant that simultaneous observing became the norm and, more often than not, a station could be completed in two days at most. Fewer books were read, less time was spent on observing the progress of rhinos through binoculars from the safety of a hilltop and boredom was replaced by a strenuous regime of continuous movement. The change was inevitable and stimulating but the passage of time leaves only pleasant memories and I am very glad that I spent my early years on the primary trig points of Africa.

Reference

[1] Hotine, M., (ed) 1992. "Letters Home", *Royal Engineers ' Journal* (106): 233-239.

MY YEAR ON THE LINK TRAINER

Or how I became a Registered Surveyor in New Zealand

Robin McLean

After three years in New Zealand my employers, the Ministry of Works, considered that it would be to our mutual benefit if I took advantage of the then reciprocal agreement between the RICS and the NZ Institute of Surveyors and became a registered surveyor. So, after the necessary letter from the RICS to say I was a suitable surveyor, the Survey Board agreed: subject to my gaining a year's experience on cadastral surveys under a registered surveyor, passing the Board's examinations in the Laws and Regulations of Cadastral Surveying, preparing and presenting six sets of plans - a rural land survey; an urban land survey; a topographical plan; an engineering plan of a street with services and specifications; a farm settlement plan complete with budgets; and last, but not least, a triangulation survey with a taped baseline 1.6 km in length. There was also a practical test in field astronomy. At this point, one might well wonder what weight was given to my ARICS.

I was seconded to the Lands & Survey Department and, in January 1962, reported to their office in Rotorua and to my master surveyor. He said that the main survey task was the legalisation survey of 17 farms, each about 150 hectares and sited on the central plateau, but before starting work I must buy a penknife. Then off we went, plus chainman, to camp in shearers' quarters. To say that they were basic is an understatement and the graffiti left by previous occupants were illuminating. One I still remember was "so-and-so is a stuck-up bitch, and fussy too". For three days we did nothing else but cut 1.5m sticks of *manuka*, sharpened with our penknives, to be sight poles; and then set out traverse points marked with galvanised iron pipes just within the angles of the fenced farm boundaries. The farms had been formed out of scrubland, fenced, grassed and had a standard hay bam. They had then been allotted by ballot to ex- servicemen with a farming background and the necessary deposit. A story in itself.

Now for survey and back to schooldays with chains, links, perches, roods and acres. The poles were plumbed over the marks, sighted towards and measured to by chain. This was a long steel band 10 chains long (200m approx.). This band had only the first 100 links marked on the 'reader', then only every chain, unlike the fully marked bands I'd used before such as Rabone, Chesterman and Lufkin. The method of measurement was that the chainman took the band forward on its drum and then held it by drum- brake on the nearest chain marking. The surveyor pulled up the band to the nearest link on the reader, clamped a brass rule with attached spring balance and handle, pulled it up to tension and read the hundredths of a link against the theodolite's trunnion axis - all in catenary, as the chainman held against the pole plumbed over the mark. In other words, the surveyor measured backwards from the mark. This sounds cumbersome but in practice it was really quick and, with the band being only 1.6mm x 0.6mm in section, a 7kg pull meant small sag corrections. Temperature and sea level corrections were necessary and, using a 20-second theodolite, the prescribed 1/10,000 accuracy was attainable.

The initial traverse had to be based on three old marks i.e. marks shown on a deposited plan which, after its approval by the Land Register, had almost the force of Holy Writ. By regulation, this origin had to be proved by checking and confirming the angle difference and a distance between the three marks and then the farm traverses began, each stacked on the previous one so they built up until they closed on a triangulation station. Fortunately, our survey incorporated parts of the Kaingaroa baseline, so there were plenty of internal checks. At the traverse comers, a short offset placed the boundary pegs. These were approx. 450mm x 70mm x 50mm of *totara*, a very durable and slow-growing timber and each had to be carved with section numbers of the adjoining farms plus a broad arrow. The main reason for the penknife now came to light. Only the surveyor or his pupil under supervision could perform this sacred but tedious task or indeed take and replace the instrument from the case.

Day's work over, back for home cooking. The boss's speciality was mince, boiled without any condiments. Once I pointed out some mushrooms. "Useless weeds" was the reply. Some weeks were spent in the District Survey Office, calculating the acreage of the farms to decimals of a perch and preparing the legal plans, standard size on linen backed paper, all carefully hand drawn with coloured inks and washes and replete with symbols for different types of survey marks. I now realised that I was a direct descendant of the priest surveyors of Ancient Egypt, with their mystic hieroglyphs whose meaning the public did not comprehend but were essential to the ownership of land.

In Rotorua I lived in a hutted camp together with other (single) survey staff, and took my turn at cooking. Carefully rehearsed and coached by my wife, I tackled the mince when my turn came and awaited comments. "What's this stuff, it doesn't taste like mince." Summer passed to winter, the farm surveys plus others were complete and it was time for my urban surveys. I farewelled the survey staff, all fine men of integrity and steadfastness but dreadful cooks, rejoined my family whom I'd only seen at weekends and travelled to Wellington. Urban surveys were mostly legalisation surveys in the new suburbs of Lower Hutt, which had been developed by the Housing Commission on a large scale; town planning with shops, schools etc and with sturdy one storey houses of standard designs but painted in many colours. Here on these sections (in NZ "plots" are what you buy in cemeteries) the Territorial Imperative came into play, bitter arguments between State tenants who had very little prospects of actually owning the

land. On private land, this reached new heights. In a street of identically sized sections, one land owner proudly claimed to have the biggest section. “You surveyors measure distances on the flat and I’ve got the steepest section.” Another complained about the slope-back of the retaining wall, the edge of the top not being on the boundary line. One particular survey was the setting out of Porirua town centre, on machine compact earth. Each peg hole had to be dug out by a jack hammer to full depth and the pegs driven flush to the ground.

Xmas came, and I’d drawn up the two legal surveys, scraped through the Laws and Regulations examination, but it was just two months before facing the Survey Board and there were four more surveys to supply - but that’s another story. Looking back over nearly 40 years, those farms I surveyed are now prosperous, competing unsubsidised with the world. Their pioneering owners have either passed them on to their families or realised a substantial asset. Also, many state houses have been sold to their tenants. No longer do people dream of owning and building on a quarter acre; less than an eighth is now the norm, expressed in square metres. Coloured plans have gone with the introduction of the metric system. The old cadet system is also gone, university graduation is essential to enter the profession but I wonder if the curriculum includes basic cooking. Many things have changed, but I still have my penknife.

TOPOGRAPHICAL SURVEYING IN MALAYA

Brian Parsons

Mcmdore Mat Adam and porters. Trengganu, Malaya, 1950.

Somerset Maugham once described Malaya as a “first class place for second class people.” Be that as it may, I have always considered myself to have been both fortunate and privileged to have been selected by the Colonial Office, after completing military service in Germany, to serve with the Malayan Survey Department, conditional upon successful completion of Long Survey Course No.3 at the School of Military Survey, which was located at the time in a dilapidated cluster of ex-US Army hospital nissen huts on the Longleat Estate near Warminster.

The sense of exhilaration experienced on arrival in Penang by sea in June 1950 at the start of what was to prove to be a long and eventful career in land surveying, soon turned to one of some considerable apprehension. On boarding the train southwards bound for the capital Kuala Lumpur I discovered it to be patrolled by heavily armed soldiers dressed in battle gear and I saw that large notices were prominently displayed in every carriage warning passengers to lie flat on the floor in the event of ambush by communist terrorists which in those early days of the bloody communist terrorist campaign, the so-called

"emergency" was a not infrequent occurrence. Although that particular journey was to prove free of terrorist incident, I was to experience more than one near brush with the terrorists in the troublesome years ahead.

The Malayan Survey Department consisted of two divisions, the topographic and the cadastral, and it was the general rule that bachelor recruits were initially attached to the topographic division. Accordingly, after a short period of familiarisation in Kuala Lumpur, I found myself embarked for sea once more, this time aboard a small coastal steamer bound for the east coast of Malaya via Singapore to the virtually undeveloped and aptly nicknamed tiger state of Trengganu where I was attached to No.l Topographic Field Survey Party as a field surveyor. Little did I imagine at the time that I would return to Kuala Lumpur some years later as the youngest ever state chief surveyor.

The few Europeans resident in the state in those early 1950s comprised mainly a small number of government officials, half a dozen or so tin miners working in the remote interior, and the sole obligatory bank manager. Not that there was much opportunity to socialise with my compatriots, since most of my time in Trengganu was spent away from station trekking through the dense tropical jungle on trig, observation trips. After spending several months in the field in Trengganu, I was eventually posted to the north-eastern state of Kelantan adjoining the Thai border, where I was to set up and take charge of for the next three years a new topographic survey party consisting of about 50 assorted personnel, most of whom were Malays. Initial responsibilities included the planning and observation of the primary triangulation network, followed, at a later stage, by field completion of the one inch to the mile series of topographic mapping of the whole state which had not previously been mapped. This so called "emergency series" was urgently required by the security forces in their fight against the communist terrorists.

Those were the heydays of the sturdy Tavistock vernier theodolites, and of the much maligned plane-tables, indian clinometers and alidades. No place yet in those pre *homo geomaticist \geomaticus*? Ed.] days for such state of the art surveying tools as EDMs, total stations, PCs or electronic calculators. If it was required in those far off days to obtain a position fix in the field by direct means, the only recourse was to observe a painstaking series of star observations, followed by lengthy and tedious calculations carried out with the aid of a hand cranked Curta calculator and a set of 5 or 7 figure trig and log tables, always assuming that the selected stars were sufficiently cooperative to make themselves actually visible at the desired time of observation. How times have changed so significantly for the better with the infinitely more reliable and accurate GPS techniques of today's generation of surveyors, a technique which I was able to employ with outstanding success during the recent demarcation surveys of the international boundaries between the Sultanate of Oman and Saudi Arabia, the United Arab Emirates and the Republic of Yemen, with which I was heavily involved.

When planning trig observing campaigns during those emergency days, it was obligatory to maintain a close liaison with the security forces, who, through their intelligence sources, generally had at least some idea as to the likely location of any communist terrorists who might be lurking in the area under consideration. If even the slightest doubt existed regarding the safety of an area it was proposed to visit or to pass through, then that particular exercise would be postponed indefinitely, often at the very last moment, until such time as the area was once more deemed to be free of danger from the terrorists. A typical jungle field trip would last for up to 3 or 4 weeks during which time angular observations would generally be taken from at least two trig stations. My working party would generally include one experienced *mandore*, Mat Adam my personal bearer and cook, at least one experienced tree- climber, and a back-up team of 5 or 6 porters, who were often recruited from the *kampong* nearest to where we planned to strike out into the jungle. The task of the porters was two-fold: first, to carry on their backs the theodolite and tripod and our very basic and minimal camping equipment plus whatever provisions would be needed to sustain us for the next 3 or 4 weeks, since the dense jungle through which we would trek would be entirely devoid of human habitation or means of supply. The porters' second main task was to fell all the trees and clear the vegetation at mountain tops where trig beacons were to be constructed, using axes and *parangs*, and also to assist in the construction of the beacons using timber from the felled trees.

The specialist task of the tree-climber was to climb the highest tree at various points along our route through the jungle from which he would lower a weighted length of rope to ground level to enable the height of the tree to be measured, which was generally of the order of 30 to 40 metres. This enabled the photogrammetrist subsequently to calculate the ground elevation by subtracting the measured tree height from the photogrammetric height of the tree canopy. The tree-climber's other special task was to take prismatic compass bearings to any prominent surrounding mountain peaks, especially to any on which trig, beacons had already been erected. This information enabled a reasonable "guesstimate" to be made of our resected ground position.

Due to the usual daytime build-up of cloud cover over the high mountain peaks, angular observations from trig, stations were often restricted to only the first hour or so after sunrise and to the last hour of sunlight before sunset, when the clouds tended to disperse, or to periods during the day immediately following a cloudburst, when observing conditions were generally at their very best. Since there was little by way of diversion to occupy one's attention whilst sitting on top of a mountain waiting for the clouds to lift, my time between observing windows was invariably spent in working through David Clark's *Plane & Geodetic Surveying* volumes one and two, and an exceedingly flimsy and dog-eared draft copy of Dowson and Sheppard's *Land Registration*, these being the only surveying text books

Brian Parsons, pocket stereoscope, aerial photographs and maps somewhere

which were available at the time, in preparation for the newly introduced RICS final examinations in land & hydrographic surveying. Unfortunately meaningful preparation was more than somewhat inhibited by the fact that there were no previously set papers to act as revision guidelines, nor were any courses of study available at that time In the event I was eventually granted a few day's leave and flown down to Kuala Lumpur to sit the examination at survey headquarters in the spring of 1954.

In addition to the normal 16 rounds of horizontal and vertical angle observations to all available trig beacons, it was also standard practice to produce a 360° panoramic sketch incorporating all visible peaks and cols, each such feature duly annotated with observed horizontal and vertical angles. Subsequent comparison of these panoramic sketches taken from different trig stations often made it possible to identify individual unoccupied peaks and to mark them on aerial photographs and hence to coordinate and height them from the observed angular data. Such points would then be used as additional photo control points for photogrammetric purposes in areas where there would otherwise be a lack of photo control.

During my earliest field trips, Mat Adam, my loyal personal bearer, took it upon himself to familiarise me with the Malay names for everything we saw and did, sufficient at least to enable me to make myself understood, albeit with a vocabulary strictly limited to surveying and jungle related topics and with a distinctive east coast accent and dialect. It was only at a later stage in my career and with the professional help of a *munshi* that I was to leam how to actually spell the words I had previously known only by sound, it being a contractual requirement of every expatriate survey officer to reach quite a high standard of spoken and written Malay in both colloquial and classical form during his first tour of duty, which, in my own case was to last 4 years. Failure to reach the required standard would inevitably lead to termination of contract, a not uncommon occurrence. Because I never entirely lost my strong east coast accent, Malays in other parts of the country could usually detect where I had first picked up the language, and on more than one occasion during the 20 years which I was to spend in Malaya I was mistaken for a fellow Malay.

Of the many trials and tribulations which so often beset the topographic surveyor, one I recall particularly well was the sense of acute embarrassment and disbelief when it became apparent that every single triangle out of a particular section of a meticulously observed geodetic network failed to close within the specified limits. A close study of the network pointed the finger of suspicion to one particular trig, station which was common to each of the errant triangles. The only recourse was to re-occupy the suspect station and to re-observe all the angles from it. On arrival at the relevant trig, station, after several days of arduous trekking, it was only to discover that the actual beacon had been nudged significantly out of its original position by a passing elephant, who, so it would appear, had seized the opportunity to make free use of the beacon as a convenient back-scratcher. Since it was now apparent that the angles originally observed from that station had been correct after all, the problem then arose as to how to readily identify those stations in the network from which observations had been made to the offending beacon after the time when its position had altered, since there was no ready means of determining exactly when the back- scratching incident had taken place.

Another well remembered incident is the excitement generated at the end of one particular observing season in Kelantan, when preliminary calculations based on recently observed vertical angles taken from a newly constructed trig, station in a remote position near the Thai border appeared to indicate that this previously un-scaled and as yet un-named mountain was a few feet higher than Gunong Tahan which at 7,816 feet had hitherto been regarded as the highest mountain in Malaya. However, as all experienced land surveyors are well aware, the vertical refraction of light rays, particularly under hot and humid jungle conditions, is highly volatile and heights can only be reliable when calculated using reciprocal rather than uni-directional vertical observations. Unfortunately any false delusions of everlasting fame were cruelly dashed at the end of the monsoon season which heralded the start of the new observing season when it was possible to observe the required reciprocal vertical angles and it became all too apparent that the newly created station proved, to our everlasting disappointment, to be a small matter of only a

few feet lower than that of Gunong Tahan. A cairn of rocks to make up the shortfall was considered, but suitable rocks are not readily found on such remote mountain tops.

Topographic folk-lore is full of gaffes connected with the art of "names collection", often considered to be the most difficult aspect of the land surveyor's craft. I shall conclude by brief reference to one such gaffe made by a rather inexperienced surveyor, who, on rechecking with his local guide the name of a mountain whose name he had already noted earlier in the day, duly annotated on his proof sheet what he assumed to be the alternative name given by his guide *"Gunong Tadf* which found its way on to the final published map sheet. What the surveyor in question had failed to realise was that *gunong tadi*, roughly translated, means "the mountain you saw before", on which droll note I shall end.

EARLY REMINISCENCES

Don Proctor

Before the formation of the Land Surveying Division (as it was then called) the routes available for qualifying as a land surveyor were few and not well publicised. The author describes the events which led to his intention to pursue this course and those which he regards as milestones along the tortuous road to achieving the objective.

There is no precise moment at which I decided I wanted to be a surveyor. The intention arose from a train of circumstances which probably started in 1938. My father was an infantry officer for the last year of the 1914/18 war and then in the Indian Army in which he was entitled to long UK leave at intervals of 3 or 4 years. One such leave was 1935 which saw the end of my life in pre-partition India; instead of returning with the family I started at boarding school that autumn, just a month after my seventh birthday. His next leave was in 1938 and it was during that summer holiday that he gave me a course in map reading and, on finding me an apt and very enthusiastic pupil, he extended it. That was his last leave and thus the last time I saw him. World War II started a year later when I was just 11 and, for various reasons, was one of four boys who returned to school two weeks before the resumption of lessons and were give free run of the grounds. I had been thinking about maps for a year, done some geometry, just started trigonometry and I decided to make a map of the school and grounds.

I mounted a protractor on a short wooden stake and fitted a bent wire such that I could sight along it and read the protractor values to deduce angles. I measured some distances with a linen tape borrowed from the groundsman and plotted with another protractor at, I think, 50ft to the inch. I have no idea now whether triangles were fully measured or how scale tied out but I suspect I would now regard most of it as hopelessly fudged, but I produced a "map" (I should say plan, there was no heighting) of the school with the grounds and playing fields, most building comers having been intersected. I expect it was disgracefully inaccurate but the Headmaster seemed pleased to have it and said I had reinvented the theodolite (a word I promptly looked up in a dictionary). Perhaps he was just humouring me but it was still on his wall in 1942 when I transferred to a senior school. He also tried to give prizewinners suitable books and obtained for me a slim volume on map-making and one on civil engineering, both of which I read several times. I was rather gratified that when I revisited in 1946 he showed me the product of "My First Survey" which, by then, another pupil had inked up rather nicely.

By the normal progression of events I took School Certificate in 1944 and started a two year sixth form course of maths and physics for Higher School Certificate (the exams which were replaced by GCE O and A levels respectively); it was probably at the start of the second year,

say autumn term 1945, that those still in doubt about careers were expected to seek advice and do some thinking. I had by then left the JTC where the map-reading was very basic, to join the ATC where they did more interesting things with Air Navigation Charts for dead reckoning using velocity triangles, rhumb lines and so on, and I became a navigation instructor. This gave me further ideas and when I saw the Careers Master I told him I wanted to be a surveyor making maps. He wrote two letters on my behalf seeking employment details and asking advice about suitable degrees for same. One was to the Ordnance Survey who replied that they only recruited at technician level and did not look for degrees nor even those with HSC; the other was to the RICS who sent some details about various surveyors, information on articled pupilships in preference to degrees, and opined that Quantity Surveying might be most appropriate for someone with a background of maths and physics. RICS then had no Land Surveying Division, perhaps discussions were in hand to form one (possibly confidential) but there was absolutely no mention of land surveying or mapping in the RICS response. There were then some enquiries to universities whence it appeared that surveying was a minor subset of civil engineering which itself sounded fairly interesting, but even so all this was rather depressing and I was duly called up for army service having very little idea of what I would do when demobbed but with HSC results which probably ruled out University.

Fortunately I saw a notice about taking regular commissions with possibly being sent to university; I applied, was accepted, went to RMA Sandhurst and after two years was commissioned into the Royal Engineers, which I had chosen in a civil engineering context. My expectation then was that I would go on a degree course two years later, spending the first six months learning about RE specialities not covered in the "all arms" instruction at Sandhurst and the remainder training RE recruits. It was during those first six months (end of 1948) that I finally discovered that RE had a survey branch of high renown and very active. I immediately expressed interest knowing that nothing could happen until after my degree course. Compared with the thriving and proactive Geomatics Division of 1999, and the routes into it from half the universities in the country, this was a tortuous approach indeed and only by good luck did I discover what must then have been the best, if not the only, route into becoming a professional land surveyor; in fact even luckier was the fact that I had already taken several steps along that route, and by then it would have been too late had I not already done so.

The next stroke of good fortune was the decision to allow some of those who had put their names down for survey to visit a survey unit for six months or so, to confirm, or otherwise, their interest. Thus my period of training recruits was shortened and in early 1950 I spent three days at the (now Royal) School of Military Survey on a brief introduction, and then off to Egypt to join 42 Svy Engr Regt. At that time the Topographic Sqn was in Jordan, the Cartographic and Lithographic Sqns (these later acquired the numbers 19, 22 and 32 respectively) were with HQ in the Canal Zone. The small group of us had no technical training at all and could not usefully contribute to any productive operations, however we each spent some time with each Sqn finding out what they did, and sometimes why, helping with the administration etc, and I recall I did a bit of cutting and laying on a slotted template.

The really valuable period was to go to Jordan and for two months be the officer in charge of the field survey base- camp of some 20 men and 10 vehicles in the middle of nowhere (the south-east comer of Jordan near the Saudi Arabian border); this was a marvellous opportunity for an inexperienced 2/Lt, albeit with nearly four years service, to have his own little unit 150 miles from Sqn HQ at Ma'an, and with no contact except our weekly supply run when about one third of the party, with a stores lorry, two of our three water trucks and perhaps a couple of jeeps, made the three day round trip to Ma'an for rations, water, fuel and other supplies, and for a film, a bath and fresh food. Of course the technical work was in the capable hands of an experienced sergeant who organised daily outings by the five surveyors engaged on single base altimeter heighting. The purpose of this was height control for 1/50,000 mapping from approximately 1/30,000 photography. I sometimes took over the base altimeters, did a few reductions (under supervision), went out with some of the surveyors and practised reading my way on the photography but never trusted myself to actually prick an identification.

I recall one memorable event when a supply party, including two full water trucks, was returning to basecamp as usual. Only some 25 miles from Ma'an our route took us across the El Jaffr mudflat, a hard flat surface about 22 miles long and 13 wide at its widest; recently better known for trials of the Thrust supersonic car before it was taken to America. Needless to say army drivers took the opportunity to put their feet down, but in a temperature near 100°F this raised tyre pressures. If bouncing got excessive they would stop to check, and, if necessary, deflate slightly. One of the water-truck drivers did stop; the other decided to do likewise and drove to pull up behind the first, applying the brakes slightly late, smashing the taps and plumbing at the rear of the target vehicle and puncturing his own radiator. One truck was no longer driveable, but towable, the other driveable but shedding its water rapidly. The stores vehicle was sent on to basecamp to warn them to go easy on what was left of the water for a day or two. We returned to HQ where after cannibalisation one water truck made the trip next day and the other was ready by the following weekend. Naturally I had to complete the dreaded Form Motor Transport 3 (always known as FMT3) Vehicle Accident Report which I duly did conscientiously giving date, time, location, dimensions (including "width of road?" .... 13 miles), driver and vehicle particulars, witnesses etc and drawing a sketch showing stationary vehicle in the middle of the mudflat and route of other vehicle. This went all the way up through Sqn at Ma'an, Regt HQ in Fayed to GHQ and a month later returned with a query from a Junior Staff

Officer asking why the stationary vehicle was parked in the middle of the road.

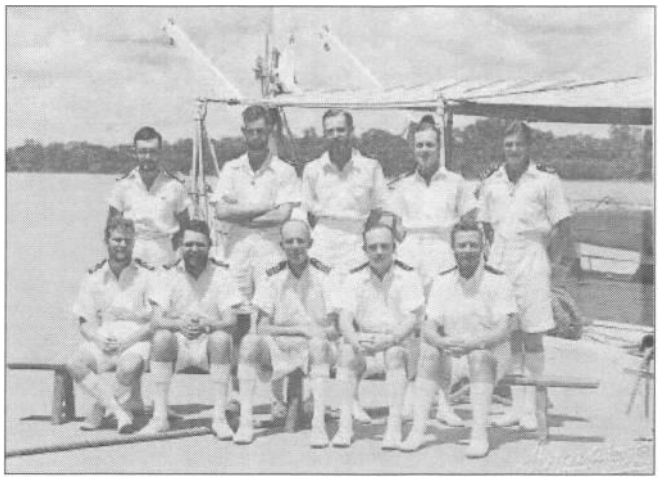
That first experience of a productive survey unit, particularly the time spent in the field, left me in no doubt that I wanted to transfer to survey in due course. I left Egypt in time to start my degree course at the Royal Military College of Science in October 1950 and spent three years reading for a London (external) engineering course. I had repeated my application for survey, but was told to get more service with soldiers before another course. It was in October 1955 that I started no. 16 long survey course, for a year, immediately followed by a year at Oxford on the first geodesy course. Now, in the summer of 1957 I was finally fit to go to a survey unit in Kenya as a "surveyor" on my first productive task. I had then been 11 years in the army and spent 8 of them on courses! This was not the end of the road. There was no pressure for military surveyors to be in the RICS, so I took my time, finally submitting task and thesis in spring 1967 and became a chartered surveyor later that year, two years after retiring from the army and joining UCL as a lecturer.

SURVEY OF THE RAJANG RIVER, SARAWAK, 1947

Steve Ritchie

On his return to Sarawak in April 1946 Rajah Brooke decided that the time had come to hand over his country to the British Government. Annexation by the Crown took place on 1st July 1946. The British government now wished to open up its new colony, and by early 1947 H.M. Survey Ship Sharpshooter was well on her way to Sarawak which at that time was a country of few roads. The many rivers, of which the Rajang was the greatest, provided the arteries of communication. In pre-war days HMS Herald had surveyed the Rajang from the sea the thirty odd miles to the small town of Sarekei. It was Sharpshooter's initial task to survey this river a further 35 miles upstream to Sibu, from where an increasing quantity of timber, rubber, copper and other commodities were to be exported. We were allotted only five weeks to complete this survey for there were other tasks awaiting our attention.

Our captain was Commander Henry Menzies, a surveyor of great experience and ingenuity. Under his direction a system that made the best use of five surveying officers, four surveying recorders, an active ship's company, six ship's boats and two folboats was worked out on passage from Singapore to Sarawak. The river varies in width from about 200 yards to a mile; most of the banks are fringed with a wide band of mangroves and *nipah* palms. Air photographs available to us showed that there was little firm coastline which meant that the necessary triangulation would have to be carried forward by single triangles, since the labour of clearing vegetation to obtain quadrilaterals would be disproportionate to the results achieved. However



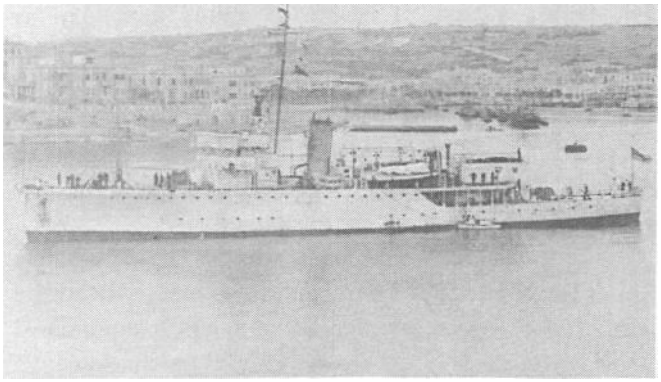
The Officers of HMS Sharpshooter on arrival at Sibu, Sarawak, 1947. L to r: sitting Surg.Lt. Eddings, Lt.Cdr. Steve Ritchie, Cdr. Henry Menzies, Engineer Officer, Boatswain, standing Supply Officer, Surveying Lieutenants C. de J. Scot, Brian O 'Neill, Rowbotham, Dixon. Photo: Anna Studio, Sibu, Sarawak.

we had been supplied with the co-ordinates of five traverse points adjacent to the river bank along the way by the Sarawak Surveyor of Lands, so that if we could locate these we could check and correct for errors of scale and slew within the triangulation as we proceeded. The shipwright was set to work making square wooden frames covered with white canvas; two of these could be slotted together at right-angles to form targets which could be hung from the nipah palm fronds to mark the observing stations of each triangle.

First, a starting baseline had to be established. Fortunately Herald had, at the termination of her 1936 survey, coordinated the western mooring dolphin off the jetty at Sarekei. From this it was possible to run a taut-wire distance by boat up the reach above the town, the azimuth being observed astronomically. From that base the system went into operation, the units involved being as follows: two motor dories each with a surveyor and ten target panels embarked; one surveying motor boat with a surveyor and recorder onboard towing a folboat for observing the angles of the triangulation; the other surveying motor boat with a surveyor and recorder to carry out the sounding; one motor skiff to recover the targets left behind, the other available for carrying the refurbished panels forward and returning to the ship with the latest observed angles. The captain, assisted by a senior surveyor, remained onboard in the chartroom as the computing team. They resolved the triangles, plotted the co-ordinated stations, sent forward field boards to the sounding boat and kept a collector tracing of the survey up-to-date. Three or four Dyaks lived onboard with their own *prahu* at the boom, and *parangs*, ready to be called forward for any necessary clearing of *nipah* or mangrove, at which task they were extremely adept.

A code of flag signals between the two marking dories was established. Each dory left its previously established mark and proceeded up river to a point roughly equal to the width of the river; on arrival whichever dory could see its last mark signalled positively to the other. If neither surveyor in the dories could see his last mark the dyaks were called forward for clearing the nipah so that at least one of the surveyors could see his last mark and a triangle was established. The angling was done from the folboat under tow from the motor boat. If the targets were suspended from the nipah a plumb-line was left hanging so that the motor boat, anchored up tide, could by judicious use of rudder and scope of cable position the angler directly beneath the centre of the targets. Great care had to be taken by the angler not to shake the foliage or he would bring down upon himself a shower of red ants which stung furiously.

It was planned that the ship would move up river within the sounded area about twice a week. Some parts of the river were not wide enough to permit the ship to swing, so the port bower anchor with its swivel piece was transferred to the 32 inch wire towing pendant reeled onto the port Oropesa sweep drum. Subsequent experience showed that this 28 cwt. anchor, when veered to about 120 fathoms, was

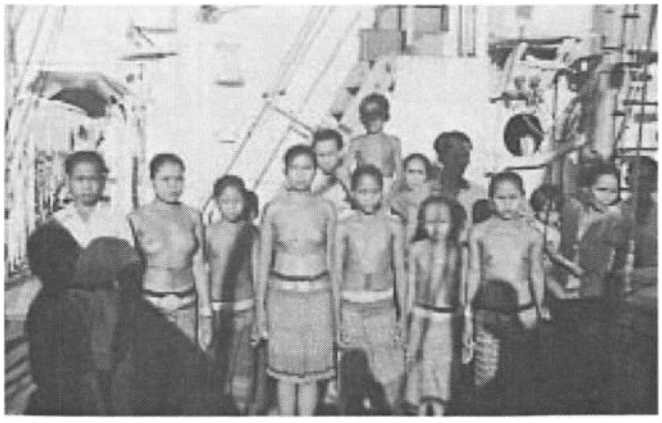


HMS Sharpshooter at Malta on her way to the Far East, 1947. Photo: The London Studio, Valetta.

adequate to hold the stem into a two knot flood tide. Progress started slowly, averaging less than a mile a day, but as the teams got into their stride we were advancing about two miles daily. After 36 miles of this routine we reached our goal, the wharf at Sibu. Two hundred and sixty nine triangles had been observed by sextant with an average closure of about 2 minutes. Checking with the Lands Survey traverse point at Sibu our terminal differed by 85 feet.

A sounding datum had been established at Sarekei by Herald in 1936 and this was transferred, first to Binatang, and then to Sibu by simultaneous observations both at springs and neaps. These operations were conducted by a Leading Seaman in charge of a tide-watching party making their own arrangements for accommodation and transport on the river by Chinese ferry launches. The party were in daily communication with the ship on Army type 22 R/T sets, as were all the boats in the operation.

We first met the Iban (the Sea Dyaks) at Sarekei, wandering through the streets buying necessities from the Chinese shops. They were of stocky build, their thick black hair cut to a fringe in front. Their throats, arms and thighs were tattooed with asymmetrical swirling designs. From Sarekei to Tanjong Leba-an we saw an Iban longhouse high on stilts every half mile or so, their inhabitants delighted to find a ship which moved up river so slowly that they might visit whenever they wished. The women, even when

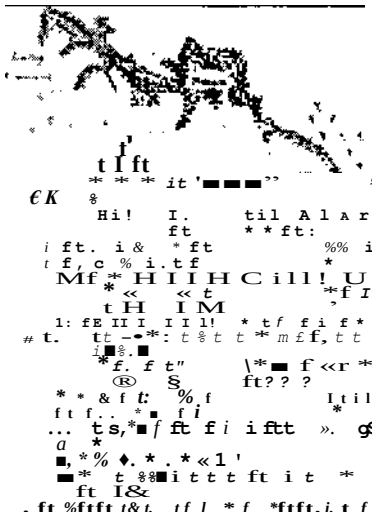


Dayak women and children onboard HMS Sharpshooter. Sarawak, 1947.

visiting the ship, wore only a sarong, an apparent immodesty which seemed strange at first; but it was not long before a bevy of beauty so attired mounting the gangway caused not a sailor's head to turn. Living as they did, communally, they had no conception of privacy and felt free to wander anywhere onboard. During four weeks we estimated that about two thousand Dyak men, women and children had visited us. Not a single article of any description was stolen during this period.

The ship-visiting reached a climax on June 12th, the King's Birthday, when Sharpshooter was moored head and stem off the longhouse at Leba-an and our captain ordered a *hari raya* (holiday) and dressed ship. By early evening a raft of sixty or seventy *prahus* were made fast alongside with three hundred or so visitors squatting on the quarterdeck awaiting our *wayang gamber* (cinema show). Later that night I joined the captain and other officers for celebrations in the longhouse. It was to be a unique experience, unused as we were to the steady consumption of *tuak*, a thick rice-based alcoholic beverage of considerable strength. An orchestra of gongs and drums paused only briefly for refreshment during the night and we were frequently called upon to join in the frenetic dancing. At last at first light the cocks beneath the longhouse began to crow and the dogs to quarrel. It was time to clamber down the slippery log ladder to the waiting prahus for a return to the ship.

As the captain took Sharpshooter down river from Sibu on our departure, with a strong tidal and river flow astern of us, he relished the way he was able to whip round the tightest river bends with only 5° or less of helm. All of us onboard, viewing for the last time the ceaseless coming and going of the river folk, realised how privileged we were to have known such friendly and hospitable people.

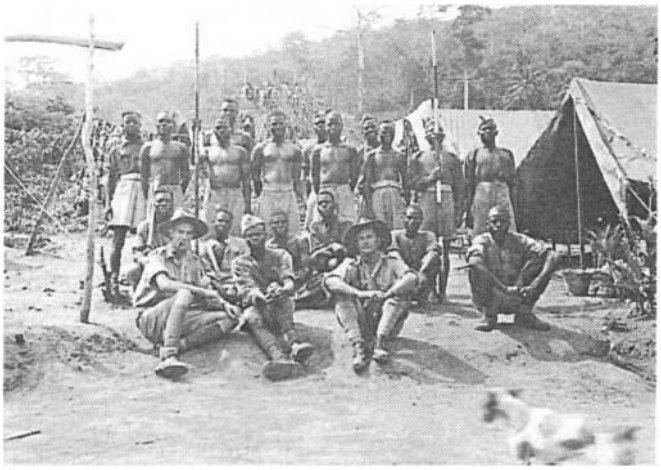


Extract from survey E8266 Batang Rajang, Borneo.
Surveyed by Commander H. Menzies RN, HMS Sharpshooter 1947.
Crown Copyright, published by permission. (Shown reduced in size)

REMINISCENCES

Alwyn Robbins

I have been privileged to have spent my working life during the biggest revolution which surveying in general and geodesy in particular have ever undergone, culminating now even in a change of name! However, as requested by the editor, I leave that to the archivists and offer some memories of personal aspects, rather than technical.



Training camp, Gold Coast, 1943. Front: Alwyn Robbins (l) Henry Towner (r).

During my war service in the army in RE Survey I spent some time in West Africa, much of it in bush. A normal day's trek was 20 to 25 miles with carriers headloading 50 lbs each, in conditions of 95°C and 95% relative humidity for 24 hours a day, 360 days a year with, of course, no air conditioning or even refrigeration not to mention mosquitoes, tsetse flies, sandflies etc. At the end of each day's trek (at a village) the 20 or so carriers would be paid off and would return to their own village, while new ones would be hired for the next day. At one village the headman told me that there were no porters available as all his young men had been called up into the army. I said I must have 20. After nightfall the drums went out and answering drums were heard in the distance. Next day my 20 porters were ready at dawn. So I now have no doubt as to the accuracy of the old story that, in pre-telegraph and -radio days, Queen Victoria's death was known in Cape Town before the ship carrying the news had arrived from Alexandria.

Many other memories of life in the bush return very readily. The harbour in Freetown is the largest natural harbour in the world and it has the overriding military advantage of being entered only through a very narrow neck, across which a boom was erected to prevent entry by enemy submarines. The harbour was full of sharks and it was not unusual for sailors, bathing from their ship, to have a leg tom off and to die from loss of blood. There were often nail-biting moments while being paddled across the harbour in a dugout canoe which had literally only one inch of freeboard: a huge triangular fin would emerge from the water and circle the canoe for what seemed an eternity before disappearing.

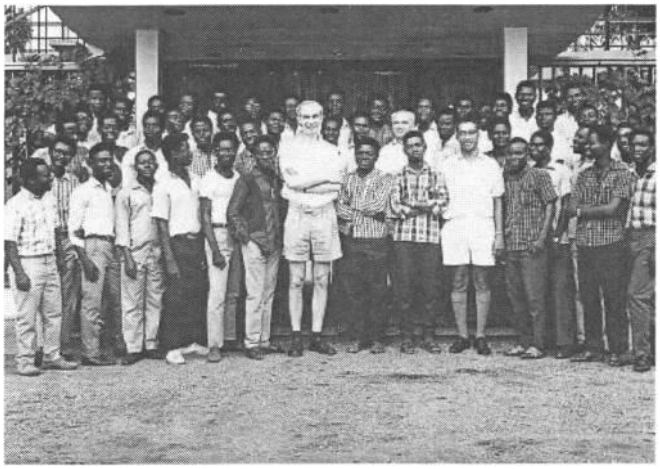
One night I was computing (with a handcranked machine and Peter's tables) in a rondavel - a circular hut with a concrete floor, mud brick sides and a pahn-thatched roof. I heard a scratching on the floor, saw a large black scorpion and trod on it. Twenty minutes or so later its mate suffered the same fate. Half an hour later there was a small gold one, whose sting was alleged to be worse than that of the black. When I went to bed I had not come across its mate but, as it was the mating season, I remembered to tell my batman in the morning to shake out my boots before cleaning them

- he found the fourth in one of them. Incidentally, earlier I had relieved a colleague who was due to go on leave. He had been stung by a scorpion the night before and one of his section - a *mallam* and knowledgeable about such matters

- went into bush and returned with leaves of the right plants. He made them into a mash, applied it to the sting and my colleague had a perfect night's sleep contrary to universal experience. Only now, well over 50 years later, are pharmaceutical companies looking seriously at the use of plants for medical purposes.

A training camp in bush. I was woken in the middle of the night by my colleague who was dancing about and swearing somewhat vigorously I found him covered with ants. A nest of driver ants had taken into its head to move, entailing passing through our camp in an endless line which was totally enclosed within sides and a roof formed loosely by ants. They were driving on the left with two or three lines each way, with much larger soldier ants patrolling outside. The only thing one could do was to dig a trench about our tents, fill it with kerosene and set fire to it.

On demobilisation I was fortunate enough to be appointed a junior lecturer at Oxford, and in 1954 to be



Alwyn Robbins (l) & Laurie Small (r) both in shorts. The Department of Surveying, University of Kumasi, 1963.

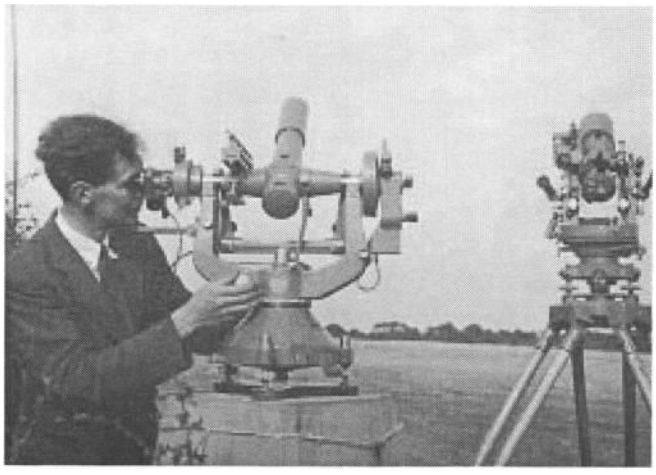
given two year's leave of absence on being requested to work in the Directorate of Military Survey at the War Office (as it was called then). I fear that not many of the faces in the photograph will be familiar to most at the Biennial Conference.

In the 1960's I was invited to lecture at the University of Kumasi, Ghana, and to be external examiner for several years. Laurie Small was in charge of surveying in the

Department of Engineering. He later became a lecturer at North East London Polytechnic (as it was then). He became a good friend, but sadly is now deceased. I also first met Vidal Ashkenazi at Kumasi, where he was a lecturer. The result was that he came to Oxford to take his DPhil with me and, as they say, the rest is history.

A little later I was involved in the development of an ETD (electronic transit detector) which was attached to a Wild T4 geodetic theodolite for the automatic timing of star transits across the meridian for the determination of astronomic longitude. Unfortunately it could not be "soldier-proofed" in the short time available and it fell by the wayside as has all geodetic astronomy after the arrival of GPS. The contrast in size, weight and transportability of the ETD with that of a modem GPS receiver is great, as is ease of operation.

For about ten years I seemed to have had very bad juju. First I had been in the USA a few months before President Kennedy was assassinated. Next, I found out after the event that I had been sitting in the airport at Accra when the first shots were fired at its President, Kwame Nkrumah. Fortunately my plane took off before the authorities had organised themselves sufficiently to close the airport. The shots missed but he was deposed not long afterwards. At about the same period I spent three weeks in Pakistan and shortly after I left, the Indo-Pakistan war broke out. Then a lull until 1968 when 1 had a week in Prague two months before the Russians invaded. Finally I was in Cyprus in 1974 testing the ETD and very shortly afterwards the Turks invaded. My friends used to ask me where I was going next so that they could avoid the area. Such are some memories of a different world a long time ago. Whether they are of any interest to any but their owner is another matter.



Alwyn Robbins with Wild T4 theodolite with impersonal micrometer and geodetic Tavistock theodolite with Hunter shutter, Herstmonceux, 1953.

1948-1950

Walter Smith

The following is an extract from a longer account written by Walter Smith for private circulation and' as he says, ' for the entertainment of my great grandchildren^. He has agreed to the present publication (unedited) as a snapshot of one surveyors life fifty years ago.

Seven o'clock, and time to search the radio crackle for the familiar Lillibolero signature tune of the BBC's Radio Newsreel, a link with the outside from the croaking of frogs and equally noisy insects around a surveyor's tent in the African bush. But tonight was different. Camped on a ledge cut by an earlier surveyor (Martin Hotine) near the conical summit of Mbeya Peak on a quiet starlit African night, even Radio Newsreel would have been an intrusion. Mbeya Peak is no Jungfrau. No more than a thousand feet above the surrounding East African plateau, it is more a prominent hill than a mountain, but it has a special sense of isolation and for me it was the start point of a chain of forty-mile sided triangles which we were to measure to Mlanje Mountain on the border between Malawi and Mozambique, five hundred miles to the south. Roughly midway between the southern end of Lake Tanzania and the northern tip of Lake Malawi, Mbeya Peak looks north to Lake Rukwa, once the scene of a flourishing gold-mining industry (locals recall how miners would visit the bar of the Mbeya Hotel, place a glass jar of gold dust on the counter and say, "let's drink until all of that is gone") south to the mica mines near the river Songwe and Mount Rungwe, with its frosted trout streams at an altitude of ten thousand feet, and westwards over the coffee farms of Mbosi and the junction at Tunduma of Tanzania, Zambia and Malawi.

On such a moonless night, however, all was dark save for the lights of Mbeya town far below and the pinpoints of electric beacons set up as sighting targets by my surveyor colleagues on four of the surrounding summits. Mbeya Town was "home" to us for a while and the source of our supplies, mail and company. Very small, astride the Great North Road from the Cape to Cairo, in 1949 it was much like any other Government boma in this part of colonial Africa. A small hospital, an airstrip, the District Commissioner's office, a few shops, a garage, an airline office and the gaol, known to local Africans as King George's Hotel, good for a week or two of adequate food and a bed! At its centre was the bar of the Mbeya hotel whose ceiling at that time still carried the scrawled signatures of troops who had passed through on their way to the fighting in North Africa during World War II.

We had arrived in Mbeya from the south, working from hilltop to hilltop, reconnoitring the survey which we planned to measure on our return south. At its beginning was a baseline at the foot of Mlanje Mountain, near the green and beautifully tended tea plantations of Cholo and some thirty miles east of Blantyre. A twelve mile length was

measured with a metal tape suspended between tripods moved continuously (and boringly) forward, each placed one hundred feet apart. It was a test of patience because the wind blew endlessly down from the mountain, requiring the work eventually to be done in the calm of night-time. This was none too popular with the thirty-odd African assistants who would have otherwise have enjoyed daytime visits to the villages en route, but at least the need to keep out of the darkened bush and fairly close to the spectacular procession of paraffin lamps as it made its slow way across the bush prevented any skiving. We marked the ends with concrete pillars (OS style) which needed to be centred accurately. Sadly this job could not completed within daylight hours and darkness found us four Europeans, hands on knees around a pillar to complete the work. Next day the District Commissioner received complaint from a local chief that white men had been practising ju-ju within his territory, but that was fortunately overtaken by the excitement of an African's having hanged himself near a neighbouring village and as the nearest European I was called to supervise the cutting down. This may have been the last baseline to be measured in Africa in this way. [Possibly the last made at night, but see Derick Bell's account here of the 1957 Isiolo base measurement (Ed.)] Shortly afterwards a new instrument was invented in South Africa which by electromagnetic methods could complete in three hours the job which had taken us six weeks.

Walter Smith on base-line standardisation. The subsequent measurement was done at night. Nyasaland, 1948.

(At about this time I received sad news from home, that our firstborn had died only a few days from birth. I set off immediately on the flight home, made especially long, not only by my anxiety to be there, but also because in those days the route from Malawi was first southwards to Rhodesia and Johannesburg in South Africa, and only there to get a slow, piston-engined flight up through Africa to Uganda, where we had a mechanical delay, and then on to London. I stayed in the UK for a few months, returning to Nyasaland in May of 1949.)

Then moving north, Nyasaland (Malawi) was revealed as a surveyor's dream - wide open spaces, punctuated by rocky outcropping hills. Some of the smaller ones had not often been disturbed and the resident wildlife resented our intrusion; some, like Bunda Hill near Lilongwe, were smooth rock and could be climbed only barefoot or in plimsolls; but all had to be visited for a latitude sunshot at noon and in the evening for direction. We had little by way of maps to help, the best being a sunprint of a missionaries' route guide which showed hills as sets of three small concentric circles, mission stations and the *ulendo*, (walking), times from the main tracks.

But I had good reason to thank the missionaries further north when my Ford pick-up broke down. After camping by the roadside and waiting two days for another vehicle to pass, help eventually arrived, unhappily without a tow-rope. My African assistants stripped bark from surrounding trees and twisted this to make a kind of rope - scarcely long enough to use, especially on a dust road. But we had no wish to spend another night in the bush and an uncomfortable tow in the quickly gathering darkness eventually brought us within sight of lights a mile or two off the road, a mission station of the Catholic White Fathers. And such generous hospitality: my Africans were taken off for a meal, I was given a room and a shower, followed by a good meal and a session of free-flowing French brandy and interesting conversation which went on well into the night. Then by day to see their Chapel and their strongly disciplined agricultural teaching programme with energetic follow-up by white-robed missionaries who on bicycle visited villages for miles around to check on progress. Impressive as a very practical example of good missionary work, maybe more lasting than the English folk-dancing which I saw being taught on another station to the west.

The country at the northern end of Lake Nyasa is high and open, but in 1948 the crops had failed and parties moving across it were required to make independent provision for food meal, *(posho*), as needed. This had to be carried and for our two week walk across the Nyika Plateau the only source of porters was to borrow prisoners from Karonga Gaol. For a while this worked well, but a single file of forty carriers soon extends itself through the long grass and only too late did we discover that many unauthorized meals were

being cooked - to such an extent that "shooting for the pot" looked like being a necessity and the prisoners guilty of *posho* theft were despatched back to Karonga on very short rations indeed.

Among the wooden boxes which were carried by headload was one which contained bottles - newly filtered water, safe to drink, whisky, paraffin and one other to which cookboy Simon devoted much attention and called his "oppus". It took me a long time to discover what this was: his bottle of continuously maturing hops for use as yeast in breadmaking.

Jock, a surveyor colleague, was working down the western edge of the plateau and from time to time we were able to communicate and check on progress by heliograph signals across its fifty mile width. It was magnificent walking down the eastern side in bright sun, with the water of Lake Malawi just off the escarpment to our left. Camp sites were readily pointed out by villagers: "where the other *bwana* camped", they frequently said, but who this was remained unknown until several years later when Laurens van der Post published his *Venture to the Interior*.

The only disconcerting incident, for me, came as we moved off the plateau to the Livingstonia Mission. As so often when things go wrong, it was late in the day; the boys were anxious to be back to more civilised conditions. I was lagging well behind and shocked suddenly to be confronted by a succession of narrow but deep and well-filled river gullies. The only way across was by wet and slippery single pole bridges, no problem for bare-footed porters, but a real obstacle for me in well-studded boots. The only way, in the gathering gloom, had to be forward. No question of risking a slip into the swirling torrent below, so it was an ignominious bottom-down and painful inching across - four times in all.

By now the rains had arrived and the remaining road miles north into Mbeya were across the grain of the country, with long slithering descents towards narrow wooden bridges, a test of nerve and driving skill, because to approach the bridges too slowly meant problems on the slippery climb-away beyond! Our last stop in Malawi was at an isolated rest bungalow at Fort Hill, for which it was at first difficult to see any purpose, except as a roadside stop. But a few hundred yards away was a very respectable grass runway, used once in a while by a Dakota of WENELA, the Witwatersrand Native Labour Association. On its journeys north from Johannesburg it brought young African men, fresh from their stint in the mines and laden with tin trunks and presents for wives and families and, waiting to be taken away, another group about to earn money down south.

Sadly, the pleasures of our high summit surveying were soon interrupted by directions to take up a swathe of mapping east to west through Mbeya, as base for a projected railway from Dar-es-Salaam to the Zambian Copperbelt. This much lower country recalled an earlier visit to our London headquarters by a government minister who on being asked later what he would remember most said, "Obviously, MMBA" This was not a familiar acronym to any of us and the minister was eventually asked to reveal

Walter Smith using a London Police car radio (five headloads in all). Mpanda Hill, southern Tanganyika, 1949.

his source. "Yes," he said, "when I looked over draughtsmen's shoulders and asked what they were doing, they all said, "Mapping miles and miles of bloody Africa!"

And the country to the east of Mbeya was not for holidays. On one occasion, camped by the roadside between two bridge crossings, heavy rain on the hills behind closed both bridges, and traffic trapped sought refuge in my camp. After five night-time hours, the strain on my desire to be hospitable was only exceeded by the consumption rate of my precious stock of liquor!

This part of the work required us to obtain very precise continuous time signals transmitted from Rugby, England and to record these on a chronograph. The aerial had to be cut to a length which matched the frequency and rotated to face in the direction of Rugby. Very much trial and error, and I wondered what our African labourers imagined that we were about as three of them were directed to move around in a circle with the aerial hoisted aloft on long poles to clear the worst of the interference from the close surrounding bush. At a signal from the radio tent they were then required to stand still for the next ten minutes as the time signal was recorded.

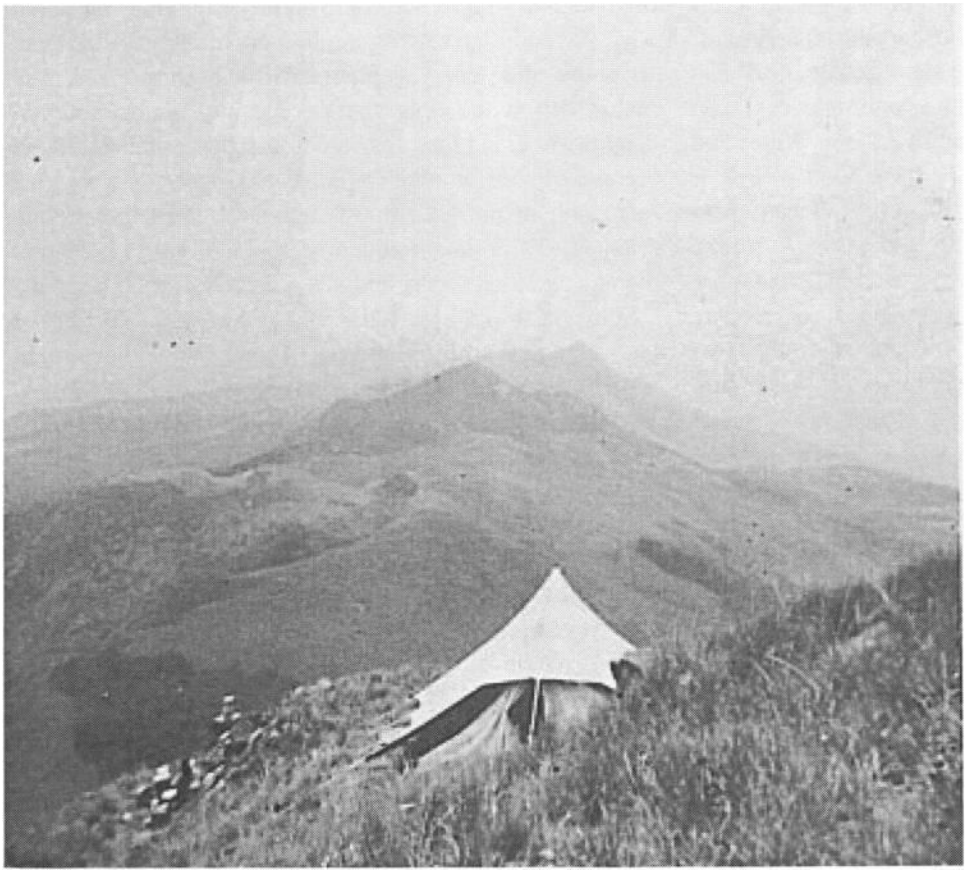
At least, here, there was no shortage of water and it was rarely necessary to use our carboy-shaped aluminium water carriers, encased within a basket protection and with a padlocked lid for use when things got really difficult. Only once did that happen to me, elsewhere, when we needed to collect water from the occasional puddle and then boil and filter for use. Some storms were truly violent that season. On one occasion, camped alone on an exposed hillside, lightning lit up the inside of the tent as if to daylight, the rain was torrential and, worst, tent guy ropes began to move alarmingly as if an animal had become entangled. After an anxious half hour, during which rifle and torch were recovered from elsewhere in the tent and brought back for reassurance under the mosquito net, the "anima" appeared to be trying to force an entry through the tent flaps (which I

had carelessly left half undone). So now was the moment of truth, safety catch off and a torch shone towards the tent entrance...to reveal a large-eyed brown cow, its horns trapped in the canvas of my colonial office issue tent!

But it was not bad tobacco-growing land. My supply came by the "debbie" (a rectangular tin canister used originally to hold four gallons of paraffin), for which I initially gave three cigarette tinfulls of salt. My cook, however, set up a more extended barter, using pages of *The Times*, which had already passed through several hands in the UK and had crosswords completed, before being sent out by my wife by surface-mail and in weekly batches, been read by me and by three colleague surveyors working some distance away...and now, finally, three pages, good for rolling local cigarettes, were traded in exchange for a "debbie" of local tobacco. A good recycling of *The Times* if ever there was one!

During this phase of the work our pressing need was for better communication, preferably by radio, and during a short visit to London which I made in November 1949 for the very happy birth of Barbara Jane on the 23rd of that month, already available police car systems were tested. My friend Jack Bentley and I worked a system from the road near Hind Head, Surrey and later stopped for lunch at a nearby pub. Our arrival, however, appeared to be followed by a rapid emptying of the bar, embarrassing for us but later explained by the landlord who pointed out the police radio aerial protruding from our car boot. It was a time of petrol rationing, when illegal usage was closely followed up by the police! But the radios performed satisfactorily and some were brought back to Africa. They were a source of wonder to our African porters but it was they also who suffered under the considerable carrying weight involved and after a year or two much lighter and more portable equipment became available.

By now, at the end of 1949, another issue had come to a head which was to change my career course, that of unaccompanied tours. The director of our organisation, the Directorate of Colonial Surveys, had taken up a very firm position that wives should never accompany surveyors whilst overseas. His view was that field conditions were unsuited to wives and families: he said, "Jobs are made to be done and not for the convenience of those who do them." He himself had done unaccompanied surveying tours as a younger man, but as a regular soldier these were interspersed with other duties which permitted a more normal family life. From our surveyors' point of view, such a rule meant that their whole professional careers would involve continuous separation. Most had already been through four years of World War II and sought something better for the future. One had already brought his wife out to Africa, without permission and others, including myself, were beginning to look around for other employment. Several surveyors left, and in due course the rules were changed. Over the next thirty years wives did frequently accompany their husbands abroad. In my case, however, an invitation had already arrived from my former anny boss, Brigadier Sandy Prain, offering me appointment as General Manager of the Air Survey Company, part of the Fairey Aviation Group, an invitation which I was happy to accept.



Camp just below the summit of Mbeya Peak, southern Tanganyika, 1949.

FROM THE SCHOOL OF MILITARY SURVEY 1948 TO J. A. STORY & PARTNERS 1959

Peter Taylor

The School of Military Survey, 1948-1949 In 1946, Brigadier Martin Hotine established the Directorate of Colonial Surveys (DCS - later Directorate of Overseas Surveys - DOS) with the stated objective of mapping 23 million square miles, using air survey methods. It would be necessary to observe 16,000 miles of primary triangulation, and 13 million square miles of secondary control. But there was a great shortage of surveyors, not only for DCS; survey departments in colonial territories were also understaffed. It was therefore decided to run yearlong courses for Colonial Office civilian students at the School of Military Survey (SMS) at Longleat. The first course started around April 1948.

After spending the years 1944-48 in non-technical anny units (King's Royal Rifle Corps and Royal Inniskilling Fusiliers) I was a pupil building surveyor with Messrs. Weatherall Green and Smith of Chancery Lane. A notice in the Daily Telegraph then led to an interview, of which I remember nothing except that I was asked my preferred books to take to bush. My answer (Charles Dickens') must have been right, because in October 1948 I reported to the SMS, just outside Longleat grounds, approximately halfway between Frome and Warminster. Course no.l had being going for 6 months, and the only names I can remember from that course are Doug Eva, Denis Willey and John Alexander.

Course No.2 was a mixed bunch, nearly all had spent several years in the armed forces, and perhaps Hotine thought that the experience would have to do in lieu of more formal academic achievements. It was said of Hotine, probably incorrectly, that he recognised only two universities, Oxford and Cambridge, but was not too sure about one of them. It must have been Hotine who decided that the very first part of the course was to be plane-tabling in the open country between Mere and Kingston Deverill. This was a brilliant idea. For young men who knew nothing whatsoever at that time about land surveying, plane-tabling undoubtedly gave a feel for the shape of the countryside. Some of the names that can be recalled include Don Devoil, Bruce Sandilands, Alex Alum, Peter Ellis, Rip Kirby, Hedley Woollet, Ken Pugh, Cunningham and Allen. I can remember Tony Bomford coming and going, Col. Harris and Maj. Taylor as instructors. The latter taught barometric heighting, and set a cracking pace between bench marks.

We were introduced to the Tavistock theodolite and triangulation. The various computations were all done on RE forms. They included braced quadrilateral, traverse,

The start of a plane table exercise for course no.2, School of Military Survey. Longleat, October 1948.

Collins point resection and semi-graphic intersection and resection computations. There must also have been a form for the various corrections to be made to catenary taping, in that in RE Survey there was a form for everything. It must have been in late 1948 that Archie Hamilton arrived as civilian instructor. He introduced us to the mysteries of cadastral surveying. He was a grand chap, we owe him much.

The long (one-year) survey course was exactly the same for those destined for DCS, as for those going into survey departments in particular colonies, and it was only towards the end of the course that we were asked for our preferences. It is easy to be clever after the event, but a lot of good men who went to DCS and left after one tour might have stayed in land surveying had the differences between DCS life and survey department life been stressed. The major difference was that a surveyor in a colonial department could look forward to marriage, and would get a house of sorts, but the DCS expected wives of surveyors to remain in the UK. It was not until 1956 that Hotine relented. DCS life frequently included weeks, if not months, working alone, and this did not suit everybody.

Some parts of the year-long course were great fun, but of less value than a refresher week of maths might have been. We spent some time at the RAF School of Photography, Wellesboume Mountford, going up, four at a time in ageing Avro Ansons, taking oblique photographs, then landing, developing and printing the pictures. One squad, on their first flight, found out the hard way that it was necessary to remove the lens cap in order to avoid a completely blank film. Another trip was to Southampton, where for a week we rowed a boat, threw lead-lines into the water, took sextant readings to shore stations and then plotted our inshore hydrographic survey using what I think was called a station pointer. We travelled to and from Southampton in an army three-tonner, but Peter Ellis who was a keen cyclist, decided to race us, and in one direction he beat us by a few minutes.

One of our course, Bruce Sandilands, had friends in high places, and arranged that we be allowed to play tennis on

the courts behind Longleat House. At that time the house and grounds were not open to the public, but during the winter of 1948/49, we often nipped over the fence into the grounds, searching for wood with which to supplement the meagre coke allowance for the Nissen hut quarters. Bruce unfortunately came to a very sad end in Sabah a few years later, when his porters deserted him.

Directorate of Colonial Surveys, 1949-1952

The course sat the intermediate examination of the very new RICS Land Surveying Division in about October 1949, then after a short leave, three of us (Don Devoil, Alex Alum and I) who had elected to join DCS found ourselves on a plane bound for Nairobi. The Kenya party was run by Chris Bere, the base camp being at Gilgil. Chris met us at Nairobi airport and gave us a couple of days in which to engage a cook each, and to buy any tropical clothing we needed. A vehicle, driver and a mountain of kit was waiting in Gilgil, plus six labourers, given the courtesy title of "chainmen". What I did not know at that time was that members of different tribes did not always get on. I engaged a Kikuyu cook, and he was very good, but on arrival at Gilgil my gang turned out to be Wakamba - very good in the bush, and they became in time very good chainmen, but there was always some lack of cordiality between Kikuyu and Wakamba. On arrival at Gilgil, we were each given a Bedford vehicle, with the capacity roughly of a current Ford Transit, a driver, and enough camping and survey equipment to absolutely fill the vehicle. The tent was 12 by 10 feet, complete with veranda, fly-sheet and semi-circular bathroom; there were heavy boxes about the size of tea chests, with crockery and cutlery for six, water filter, Tilley lamp, soda siphon, etc. There was a table, upright chair, deck chair complete with head-shade and footrest, 5 gallon water container, and a canvas bath/washbasin.

After some work in the Mau-Narok area, we moved base to Nanyuki, and camped by a trout stream. As far as I can remember, the Kenya party consisted of Chris Bere, John Birkin, Henry Smuniewski, Alex Alum, Ray Fisher, myself, and John Alexander detached and working in the Tsavo area. My task at Nanyuki was to observe control on the upper moorland slopes of Mount Kenya, between the dense forest below, and the permanent snow above. Chris detailed off some surveyors to camp at existing triangulation stations in the plains below, and gave me the happy task of observing minor control for the air photos, with the ability to call up by helio any of the stations in the plains. There was a minor inconvenience. On the day we set out with mules and my pony, my Kikuyu cook refused outright to go. The animals incidentally, were hired from one Raymond Hook, who ran a safari business. His brother, known I think as Commander Hook, ran the Silverbeck Hotel, famous for having the equator running across the bar. The Kenya party also did some work on the Aberdare Range before moving to Kisumu and camping not far from the shore of Lake Victoria.

Early in 1950 the entire party moved to Mufindi, south of Iringa, in Tanganyika, the project being to supply ground

DCS party, Northern Rhodesia, 1950. L to r: rear, Don Devoil, Ray Fisher, John Birkin, Chris Bere; front, Peter Taylor, Henry> Smuniewski, Celia Alexander (hidden), John Alexander, Alex Alum.

control for the mapping of the route of the proposed new railway from Dar-es-Salaam to Northern Rhodesia. The area was mainly low rolling grassy hills, well watered, but completely unpopulated by man, with a considerable number of elephant and buffalo. Surveyors were each given a weapon. Mine was a Mauser 9 mm and I was grateful not to have been given the enormous bore elephant gun, which had the reputation of landing any surveyor unwise enough to fire it, flat on his back. It was my first experience of foot safaris, and of purchasing tinned food to last about 8 to 10 weeks. My new cook, from Iringa, was keen enough, but I made the fatal error of not checking his packing, and found at our first camp that the had forgotten to include a tin opener! The logistics of a foot safari into an area where there is no food available for the chainmen and porters are interesting, and sacks of maize-meal have to be carried, firstly for the whole party, then for the men who are carrying the food, then for the men who are carrying the

food for the men who carrying the food.....In the event, because of a shortage of porters, a shuttle service was run bringing food out every week or so, ever so slightly complicated by the fact that I moved camp very frequently, sometimes every day.

The last base camp in Tanganyika was at Lupembe. Then the entire party moved into Northern Rhodesia, still providing control for the rail-link project. The very flat area near Mpika had man-eating lions at that time. It must have been serious because Chris Bere actually allowed two of us to work together. We were given a Lee Enfield .303 each and advised not to use tents but to build a solid hut at each camp. Allowing two DCS surveyors to work together was unprecedented, but it was probably reasoned that if the lions got one surveyor, the other would complete the work.

After about 18 months in East and Central Africa, I and two other surveyors drove back to Nairobi, a four day trip, and flew back to England for leave. During leave I was married in May 1951, and three weeks after the wedding, found myself on a plane bound for Accra in the Gold Coast, to join Peter Kowzlowski's party. The project was to

provide ground control for some rather poor quality RAF photography in order to map the basin of the Volta river, likely to be flooded after the construction of a proposed dam. The lake eventually formed covers some 3,300 square miles. The work was to be all on foot, there being no roads, but the area was well populated and getting carriers to move camp would be no problem. Plan control was to be by topo traverse, with direction controlled by astronomical azimuths observed every few miles. Wallace and Tiemam altimeters were to be used for the height control.

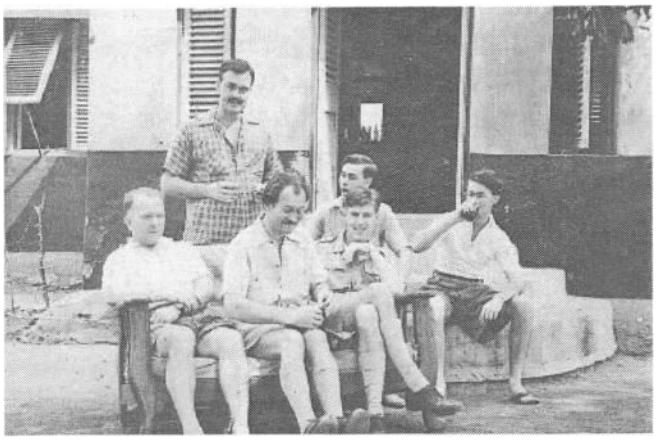
The traverse was a slow laborious process. It was about 50 miles long, connected at each end to Gold Coast Survey Department traverses. I had been working for 11 ^{x}n weeks without seeing another white face, when I met Peter Ellis's traverse, coming the other way. Peter had saved some beer, with admirable restraint, and there were the inevitable remarks about Livingstone and Stanley. Camp was moved frequently along the traverse, usually to within 3 mile or so of a village, for two reasons: labour for cutting trees for the star observations would be readily available, and the permanent gang of Survey Department chainmen preferred to lodge with villagers, having no tentage. At every fresh camp-site, the procedure varied little. The Chief would appear and bid me welcome, offering a chicken as a gift. After a suitable interval, through the cook as interpreter, I would present the chief with some tobacco. In the evening the entire village would turn out to put on a dancing display, at the end of which I would ask the cook to distribute some coinage.

Once, out on an altimetry circuit, I came across a line of pegs which led to an elderly surveyor, whose name was I think, Mullins, setting out a proposed minor road. Mullins invited me back to his camp, and over an excellent meal told me about his life in his youth in the Southern Nigerian Survey, when surveyors came out every year by sea to carry out plane-table mapping, including the famous rope and whistle technique. In later years I came across a copy of the "Handbook of the Southern Nigerian Survey" in Kaduna Junction. Two phrases stuck in my mind - something like "There will be nobody left in camp by 6.30 a.m., except cook" and "There will be two Sundays off per month on which days you will do your computing".

Life in the Directorate of Colonial Surveys was pretty good, but very difficult to combine with any form of married life. With some regret I resigned in 1952 and obtained a post in the Tanganyika Lands and Surveys Department, with passages booked by sea for me and my wife. What the Colonial Office forgot to mention was that the ship was so crowded that men and women, married or not, were to be separated into male and female cabins for what turned out to be a very long voyage to Dar-es-Salaam.

Tanganyika and Northern Nigeria Survey Departments 1952-1959

In 1952 I arrived in Dar-es-Salaam, with my wife, and was posted to Tabora. Government loans had enabled me to buy a pick-up vehicle, a kerosene fridge, and an electric cooker, but the repayments meant that we were financially



DCS party, Salaga, Gold Coast, 1950. L to r: rear, Peter Ellis, Alex Alum, Peter Taylor;front, Stan Klepaski (Gold Coast Survey Dept.), Peter Kozlowski, Mick Miles (Gold Coast Survey Department, later Northern and Federal Nigeria Survey> Depts).

challenged and therefore felt unable, at least for the first few months, to join Tabora Club. The Director of Surveys and his wife visited us, and on hearing that after a month or so in Tabora, we knew only a few people, Mrs Director instructed us to call on the houses of all the Provincial Officers, and leave each one a calling card.

A surveyor on his first tour in Nigeria, was to set off with carriers for a spell in the bush, possibly to do a triangulation reconnaissance. The first few miles of his route were along a motorable road, but when the surveyor asked permission to use a vehicle, it was refused, with the comment "You're in the Service now laddie". In Northern Nigeria, I was guilty of two minor offences, albeit unwittingly. I called upon the Resident wearing newly starched shorts, knee- length stockings, etc, but was later told that I should have worn slacks. On another occasion, I was rebuked for leaving the Province without informing the Administration. Hotine would have choked.

J.A. Story & Partners 1959-1984

The major difference found on entering the private sector after ten years as a Government surveyor was that time, and therefore cost, came a very close second to fulfilling the required technical specification. Some work was obtained on daily professional fees, but the majority of work was gained from competitive tenders.

The "time is money" consideration can lead to some quite outstanding innovations, particularly in the large air survey companies Two examples were Fairey's sight, attached to their plane, enabling the route of the adjacent strip to be sketched on a roll of paper, ensuring that the correct lateral overlap was achieved. In 1959-60 Huntings had the equally brilliant idea of training an electronic engineer to use a theodolite, and become the remote Tellurometer operator, using his evenings to maintain the equipment.

A good many years ago, there was a talk at the RICS entitled something like, "Near Enough is Good Enough". Meeting the specification is of prime importance, but the surveyor who observes spot levels in a ploughed field to 1 mm, or takes six rounds of angles where one round is

sufficient, is a liability. Surveyors in private practice could from time to time surprise one. A surveyor, renowned for his accuracy and speed as a leveller, ran a long theodolite and EDM traverse, and in the middle, in order to get past an obstacle, put in a very short leg. Another surveyor, instructed to place benchmarks in an area, ran his level circuits to a high standard, but observed all the new benchmarks as side-shots, without any checks. On the selection of field staff, ask John Wright about his one peg test, it is a delightful story.

Not all the wild animal versus surveyor incidents happened to DCS or DOS surveyors (see *Mapping the World* by Alastair Macdonald [referred to in the Introduction - Ed.]). When Storys were working in Tanzania, there were two separate events. On one, near Biharamulo, a surveyor was camped off the road, he in one tent, and his porters in another. A lion entered the porters' tent, stepped over three men, selected the fourth, took him outside and had supper. Further south, a crocodile took a chainman from the river's edge. A Story surveyor, Billy Loftus, bravely dived in, but could find nothing. The party later found one leg.

A final thought on status, and income, of surveyors in private practice. Integration with Europe seems inevitable, despite the best efforts of a few dinosaurs, among whom I number myself. My village shop informs me that sooner or later it will be an offence to sell loose sweets from those big jars, by the ounce. The continental system of definite boundaries to land may well be introduced, in which case land surveyors will have to be registered, and their status and income will rise. If and when that happens I sincerely hope to be long gone.

LAND SURVEYOR OR POLITICAL WEAPON?

Mapping the West Aden Protectorate, 1959-1960

Hugh Woodrow

Mountains and terraced fields, West Aden Protectorate, 1960.
(See also colour page 48)

The making of maps often has substantial political motivation. In 1959, the West Aden Protectorate at the south-westernmost part of the Arabian peninsula was an intriguing assembly of feudal style sultanates and sheikhdoms under which were fomenting various Islamic, nationalist and Marxist movements. To the north, the country of Yemen, occupied by the Turks until the geographical division of Arabia in 1918, had historical interests in ruling the whole of this comer of Arabia. The Protectorate was thus an incoherent and unstable entity and it was the aim of the British Government to address this by bringing together in federation the various tribal factions. Good mapping was a highly desirable aid in this exercise, and I was put in charge of a small team of military surveyors to undertake a topographical review of part of the territory.

The country consists of a featureless sand-sea on the coastal plain, north of which are dramatic jebels and escarpments punctuated by perennial and seasonal wadis. In the 1950's there was little in the way of development other than scattered small settlements, their terraced fields of millet and the donkey or camel tracks joining them. The country had been mapped by the Survey of India in the first decade of the 20th century. The highly accidented nature of the terrain meant that cartographic relief was an essential aid to navigation to any stranger to this land. This had been accomplished by plane table formline in the original survey and very good it was too when used in 1959. This must have been a formidable undertaking in such a remote and climatically hostile environment.

In 1959 because of the uncertain political situation, there was no safe access to many areas. British garrisons

stationed away from the main town of Aden were replenished by air or by armoured convoy of vehicles. Survey teams wishing to work in areas away from the influence of such garrisons had to obtain the permission of the local ruler through the Protectorate's political office. It was then left to the surveyor to establish a bond of trust with this local ruler and many agreeable hours were spent doing so in traditional Arab fashion. The mapping project thus created an additional opportunity to promote the concept of federation at all levels in the society.

In addition to military surveyors, the survey detachment consisted of Arab soldiers of the Federal national guard and included guides and escorts of the local militia, many of whom seemed to come along out of curiosity! The whole ensemble must have appeared intimidating to an unsuspecting villager. In this part of Arabia, a man's status was announced by the quality of the rifle he carried and everyone carried one. The British Army had been newly equipped with the selfloading rifle, the Kalashnikov of its day. Since we were never separated from our personal weapons they were the source of much wonderment at each stop as we toured the villages. Range days were held to try out the new rifles and drew large numbers from the surrounding area eager to participate. Empty tins of Army composite rations set on rocks made excellent and cheap targets!

The survey camp-site had to be within a short distance of the ruler's residence, since guides and guards were provided on a daily basis. There was also the problem of a safe source of water that was usually under tribal control. The military authorities required that a light aircraft strip be constructed within a short distance of a camp; the many gravel plains were ideal for this purpose. When having also to build sangars as machine gun positions for protection, the campsite took on the appearance of a small military garrison in its own right.

The local people were quite delightful and we had many a lively discussion on the rights of British imperialism and even more dangerously of popular nationalist movements! We travelled in the name of the local sultan or sheikh and this usually attracted especial hospitality from the villagers. We learnt to be patient while the goat was slaughtered and prepared. Even the poorest Bedouin would insist on milking his goat directly into his kettle to make a cinnamon flavoured "cup of tea" for the travellers.

It was not uncommon for the sons of a family believed by the local ruler to be dissident to be taken as hostages and placed under house arrest. The visit of the well-armed survey party was an ideal opportunity to effect this. Occasionally the party's Land Rovers would be loaded with sacks of com seized in lieu of taxes unpaid. Surveyors thus became swept up in local politics also! The tribal escorts sometimes refused to enter certain areas presumably due to long-standing feuds with the inhabitants and excused themselves for fear of recriminatory attacks on their families. It then became a gamble on the part of the surveyor as to whether to risk continuing with the survey without local protection. In the event, risks were taken and the required data was collected without apparent political consequences or loss of life.

Most of the survey work had to be conducted on foot and progress was hindered by the difficult terrain and the intense heat. The requirement was to collect topographical information and annotate this on aerial photographs. Altimeter height traverses were to be undertaken and similarly referenced. The whole was to be tied to the trigonometrical stations established by the Survey of India. Usually this was not possible since the reference marks of stations chiselled on rock on the summits of *jebels* had long since weathered away. The most likely position had to be selected instead although this was a matter of considerable uncertainty on the sharpedged ridges of *jebels.*

Place names had to be collected and it was useful therefore to speak a little of the language, if only to avoid recording a village as "Go away, Infidel" or words to that effect! To be able to greet a village with "May the blessings of Allah be upon you and your family" made it more likely to receive a polite reply to the question "What do you call that white mountain over there?", even if the answer was "We call that the white mountain". Eventually an interpreter was employed.

In this short but fascinating exercise, the experience gained by myself as a young survey manager was incalculable. It showed the overriding importance of careful planning and administration in a successful project and that often this could not be sorted from a real understanding of local politics. The British left the country in 1967 when it became the People's Democratic Republic of South Yemen. North and South Yemen agreed to merge in 1990.

(See also colour page 48)

SUDANESE RECOLLECTIONS

John Wright

Before the invention of electronic distance measurement (EDM) by Geodimeter and Tellurometer we had to use triangulation to establish frameworks and to determine the shape of the earth. A major task for this was the completion of the 30th arc of meridian, which in the Sudan covered a thousand miles. We could only spare one Englishman, R C Wakefield, to undertake this except when measuring a base, so it was taking several years even to get from the Egyptian frontier as far as the latitude of Khartoum. Accurate base lines were required to establish scale every two hundred miles or so.

First-order triangulation was also planned along the 12th parallel of latitude and I took part with David Munsey in a base measurement for this at Husheib, east of Khartoum. We used three lOOft-long invar tapes in catenary, with two others for three very tedious checks which entailed measuring one bay length 400 times at the start, again after measuring the eight mile long base in one direction, and yet again after measuring back to the start. We measured by night because the wind was much less. Munsey was in charge and had his new wife with him.

Two's company of course, not three; but except when they retired to their tent to sleep etc., David and I were the two, constantly discussing checks against introducing a systematic error for example parting our hair on opposite sides every ten bays to reduce bias in reading the tape through a microscope. David had a birthday, and the head light-keeper, a famous Agab Ali, conspired with me to present him with a toilet seat made in the local suk and installed secretly over the hole under a small tent which was our lavatory.

Following Hotine's classic paper on base measurement, Wakefield and Munsey on a previous base had changed from blind cord over the straining pulleys to wire. This had entailed cutting a narrower groove (like a river bed in its valley) in the pulleys using a lathe in Khartoum. Unfortunately this produced a groove not exactly centred on each pulley's axis which caused an imbalance in the tape, often sending its short scales out of the viewing microscopes. But when this was overcome by using fixed positions of the pulleys for the return measurement of the previous bay, it had introduced a systematic error. This was because the radius of the groove under the tape differed (by four hundredths of an inch) from that opposite the wire leading down to the straining weight, so that the pulleys acted like bellcranks with different lengths of arms. When David had a two day cold which stopped measurement, I investigated this, finally measuring the eccentricity by hanging the two 201b weights over each pulley, and adding small weights to balance them in different positions of the pulleys. Final proof came from observing the pulleys rotating edgeways with the geodetic theodolite and seeing the narrow groove moving up and down.

Our great care was justified in the result: the difference between the forward and back measures of the baseline was only a tenth of an inch, or 1 part in six million of the base length. As a lady in Khartoum said when I boasted of this: "The difference between an ordinary gin and a stiff one" - not very encouraging. By the time the two reference tapes had been checked against the standard at the National Physical Laboratory the accuracy was reduced to about one part in a million. This great accuracy, and the effort it required, was justified by the fact that the difference in scale (usually about one part in a hundred thousand) between the measured length of the base and that derived from a two hundred mile first order triangulation chain from the previous base was small enough to adjust the scale of the latter to the base length.

On a lighter note, this passion for accuracy by geodetic surveyors (which I was not) was illustrated by what happened on another base measured by Wakefield and Munsey. One of the rather ruder gang recruited to hold up the wind screen bit off another gang member's ear. Wakefield and Munsey spent a whole day holding court to find out precisely what insult had sparked this off so that the correct penalties could be imposed on those concerned. I would have just sacked the two.

So much for base measurement; I never aspired to better than secondary triangulation along the Nile north of Khartoum to control the 1:2,500 scale plans of the irrigated land. I used helios; and on one occasion, when the helio to which I was observing was behind the road and railway running alongside the cultivation on the opposite side of the Nile, I received a very odd signal. This was a series of dots, then a dash, and then more dots. Closer observation with the theodolite revealed that this was caused by the helio signal passing through the carriage windows of a moving railway train followed by the longer gaps between successive carriages.

If we were troubled by too many small boys when at the cultivated area, we would tell them that we were using a death ray to light a fire on the hill across the Nile; and sure enough up came the fire as the helio operator replied to our signal they skedaddled. But in England, using the Tellurometer in its early days to fix our ground position from a trig station on a block of flats, we had a young boy asking us what we were doing. Before saying it was a death ray for killing the criminals up on the flats, we asked him for his opinion. "Well, I think it's a Tellurometer" he replied. As they used to say in the old Punch jokes: "Collapse of stout party". Obviously it pays to check on your interrogator's knowledge before pulling his leg.

One of the most important features in a framework survey is the design of the monuments marking the stations for future use. For major triangulation like the 30th Arc, pillars were built. Metal cylinders were brought to the point and then filled by hand with concrete. On this was fixed a horizontal metal tribrach, with three radial grooves at 120 degree intervals so that the feet of any theodolite would

automatically place its vertical axis oyer the pillar's centre. It may have been a mistake to use metal, since this was always in short supply and made them liable to removal by the nomads who were the only people likely to visit them in the desert where most of the arc ran.

Earlier traverses in the Shendi District of Northern Province had been marked by foot long vertical iron pipes splayed at the bottom, set in concrete and covered by flattened pyramidal concrete blocks (with of course a hole in them) in case a lorry passed over them. I decided that what really mattered was the vertical hole into which could be inserted a ranging rod, used as a beacon for surveying detail from these control points. This was all that one really needed, and that simply making this in the concrete, without any metal, removed the temptation to destroy the mark. So, for each really permanent mark above the river, we filled with concrete, mixed on the spot, a 2ft deep and 1ft wide hole in the earth with its bottom enlarged, and made a one- inch wide vertical hole in it. Its top was covered by one of the precast flattened pyramidal blocks. Nobody would pinch a hole, but small boys used to fill them with pebbles. We considered putting a detonator at the bottom which would eject the first pebble dropped in but settled for the simpler solution of filling up the hole ourselves with sand, and equipping ourselves with a long spoon for removing this. Thus came a variation from the old proverb about supping with the devil to surveying in the Northern Sudan which also required a long spoon.

These were the marks in what was called *sagia* land because it was high enough to be fairly permanent and required a water wheel, or sagia, for irrigation. Below this was the *salluka* land covered by each flood and therefore liable to changes over the years. For this, I had made by Sudan Railways at Atbara, precast blocks three feet long and about six inches square with a one foot deep hole in the top for the ranging rod. They were not reinforced, but included three strands of barbed wire which would hold them together if cracked. Like all survey marks they were meant to be well dug in so that only a few inches projected; but I found that many fixed by local surveyors or chairmen without supervision were not dug in deep enough, but left with a foot or more projecting.

My last four years in the Sudan were as Chief Inspector of Surveys in the Northern Province. In effect this meant being in charge of five senior Sudanese surveyors, each based at one of the five district headquarters along the Nile north of Khartoum. These were: Ed Darner (Province Headquarters and my base), Shendi, Berber (to include the much larger town of Atbara which was the Railway Headquarters), Merowe, and Dongola. This period greatly improved my Arabic and knowledge of the Sudan and its people, as my tasks before had been either in the office or out working in desert areas with a party who understood and spoke only a simple form of Arabic.

The only large-scale surveys required were of the land which could be irrigated from the Nile. Even in those days most of the irrigation was by diesel-engine pumps; and I am told that all the *sagias* have now been replaced by electric pumps. A *sagia* consisted of a large wooden horizontal toothed wheel, with an arm to which a camel or donkey was harnessed urged on by a young boy. This wheel drove a smaller one at right angles; at the other end of its axis was a second wheel over which hung a long chain of buckets reaching down to the water. As the *sagia* rotated the buckets picked up water from the river, brought it up to the top of the wheel, and then emptied into a channel which fed the various carefully graded channels supplying the land behind. A *sagia* could irrigate about ten *feddans* and the owner would be working away on these. The gears were not greased but made a constant groaning noise; the owner then knew at once if the boy had let it stop because this groaning would cease.

The *sagia* was the smallest irrigated area; next came two- or three-inch pumps which would be moved down to the water's edge as the Nile flood passed, but a common size was a six- inch pump housed in a shed and irrigating a hundred or so *feddans.* Every now and then the pump would be stopped and the engine used to drive a mill to which local people would bring their grain and wait to collect it. A representative of my own survey party had to join this queue; and I was reminded of Chaucer's Miller's Tale in which two students from Cambridge University took the grain out to Granchester to have it ground. Finding that the miller was cheating them, they revenged themselves by seducing his wife while staying the night with him.

The pump schemes went all the way from the moveable two-inch ones to large schemes organised by the government during World War I, with two or three ten- or twelve-inch pumps installed above a concreted part of the river bank. In order to familiarise myself with the area I plotted all these pump schemes some 800 or so on our standard topographic map series at quarter-million (four miles to the inch) scale.

A History

of the origins and some other details of the Land Surveying Division of the Royal Institution of Chartered Surveyors

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JR Smith

THE ORIGINS

On 27 June 1834 six London surveyors under the leadership of William Blount decided to form a club and, on coopting three more friends, held the first meeting of the Land Surveyors' Club at the Freemasons' Tavern. The other members were Thomas Chapman, Layton Cooke, Henry Crawter, Edward Driver and James T. Tatham. They all practised in London. The other three were George N. Driver, William Webb and George Trumper. Whilst they were all experienced in chain surveying and plotting, their prime interest was in valuation and advisory functions [53 p.94]. Their definition of a land surveyor was a long one of which little more than the first two lines would be recognisable today. Thompson, [53 p.96], quotes it as "one who has learned the art of admeasuring and delineating the surface of a country, is capable of dividing, allotting and arranging for enclosure, commons and wasteland, or dividing or allotting the interests of those holding as joint tenants, co-parceners, or tenants in common, versed in the knowledge of the various products of agriculture, their values and comparative advantages, either as between landlord and tenant, lord and copy- holder, rector and tithe payer, and in the relative uses, values, and mensuration of standing or fallen timber, having at the same time a perfect knowledge of all that appertains to the value, contracts, and arrangements of property in the character of land agent."

Reading further it would appear that the body soon became more akin to land agency than land surveying [53 p.97]. Thus it would be misleading to consider that the division stemmed directly from this beginning. In 1852 the club wound up its library and the contents were sold to members. The club remained however as a thriving dining club.

There had been a surveyors' club in existence since 1792 operating alongside an architects' club, but it was from the 1834 meeting that the body we recognise today as The Royal Institution of Chartered Surveyors evolved and was founded on 15 June 1868 as the Surveyors Institution. The founders had two objectives that were eventually incorporated in its Royal Charter: to secure the advancement and facilitate the acquisition of that knowledge which constitutes the profession of a surveyor namely the art of determining the value of all descriptions of landed and house property and of various interests therein, the practice of managing and developing of estates and the science of admeasuring and delineating the physical features of the earth; and to promote the general interests of the profession and to maintain and extend its usefulness for the public advantage.

The incorporation by Royal Charter took place on 26 August 1881 and it is interesting to highlight some of the items in the Charter: members could not derive any pecuniary benefit from their membership; the Institution was aimed at improving the status of surveyors, regulating and shaping the customs and usages of surveyors, providing means of professional training and securing interchange and dissemination of practical information and thereby the better discharge of duties affecting interests of great public importance; and the Institution also charged itself with the establishment of a system of proficiency examinations for young surveyors desiring to qualify as members.

On 27 October 1930 the Institution became The Chartered Surveyors' Institution and on 3 July 1947, by personal grant of the Sovereign, the title changed to The Royal Institution of Chartered Surveyors.

From 1880 land surveying and levelling figured as examination subjects in the three divisions and were considered as the professional element common to all surveyors; but they were not exacting or advanced subjects, since there were practically no openings for independent practice in land surveying in Britain, and passing these examinations was not even intended to qualify a man for cadastral or cartographic surveying. Land surveying as a serious professional subject with a specialised qualifying examination, was not effectively established by the Institution until 1949, and was then a response to the needs of colonial surveys [53 p. 190].

The practical part of the examination of 1880 was held on a common near Willesden. A levelling exercise was carried out and marked both for speed and accuracy. Then an indoor exercise involved work on a plan and calculation of areas. The candidates were also examined on the use and adjustment of instruments. The practical tests were later held for many years in Osterley Park at the invitation of Lord Jersey [53 p.190].

In the Council Minutes for April and July 1894 is the note: "Appreciating the shortcomings of British training for colonial needs, in 1894 the Institution consulted the Crown Agents to the Colonies, and with their encouragement decided to introduce a special Diploma examination in Geodetic Surveying, specifically intended to provide a qualification for colonial appointments." Thompson commented "In the event this was more of a gesture towards recognis

ing the importance of an advanced training in land survey than a practical contribution to equipping British nationals for colonial appointments, since there were no takers for the Diploma before 1914, the first one being awarded to E. W. Hall, then in Iraq, in 1926" [53 p.268].

It is recorded that six Colonial Fellows were elected in 1907-8 [53 pp. 269-270]. Five had trained in England as Engineers. Of these, D. S. Palk became a District Surveyor in the Gold Coast, W. A. Miller was Colonial Engineer and Surveyor General of Dominica, A. A. Lermit, a Licensed Surveyor, was Chief Surveyor of Johore, E. L. L. Waring was Deputy Director of Surveys in the East African Protectorate and T. F. Firr was a First Assistant Surveyor in Nyasa- land working on the Anglo-Portuguese Boundary Commission. The Colonial Fellow grade was discontinued in 1958, by which time it was felt that every member should possess an examined qualification [53 p. 270n.26].

At a Colonial Conference in 1907 the Institution agreed that it ought to be possible to establish reciprocal recognition of land surveying qualifications with various territories such as New Zealand, Australian States, South Africa and the Canadian Provinces, but nothing happened. [53 p. 270]

In February 1935 at a meeting at the Chartered Surveyors' Institution Major General G. Cheetham, in a paper presented to the RICS in April 1950 [5], marked what could be looked upon as the point from which the Land Surveying Division originated. At that meeting Sir Ernest Dowson and V.L.O. Sheppard met Brigadier Killick, secretary of the RICS, to discuss the possibility of housing their collection of cadastral records at the Institution and the desirability of recognising the Institution's diploma in land surveying as a worldwide qualification. The meeting was joined by Brig Winterbotham. The discussion covered the whole question of the position of land surveyors in the Institution. Following from this, the Council decided to appoint a special committee to enquire into the whole matter [7].

On 11 November 1935 the Institution Council appointed a special (land surveyors') committee to consider whether and how far the Institution could extend its activities into matters specially connected with land surveying. The committee consisted of B. W. Adkin, W. R. Brackett, C. Chart, Sir Ernest Dowson, Sir Charles Gott, E. W. Hall, M. P. Hyatt, G. T. McCaw, M. N. MacLeod, V. L. O. Sheppard, C. Simpson, H. A. Steward, J. A. Story, S. L. Thacker and Brig H. St. J. L. Winterbotham. [12 p. 294], [13 p. 693]. This Committee continued after the war until it effectively became the Land Surveying Committee. From 1935 it was advising the Institution on various matters concerned with land surveying including comments on the pricing of Ordnance Survey maps.

On 31 December 1935 the Institution circulated its branches and members both at home and overseas as to their feeling about the need for a land surveying section. There was strong opinion in all branches in favour of developing the relevant section of the Royal Charter, a view reinforced by the County Branch Conference in March 1937. The same year (1935) the Institution welcomed the recognition by the Colonial Office of its Special Diploma in Land Surveying as exempting from the qualifying examination of the Department for Colonial Survey appointments [l i p . 294]. Particularly amongst older readers, the above names of the members of the Special (Land Surveyors') Committee will have considerable meaning for the major contributions they made to the profession aside from their efforts within the RICS.

The primary object for the Special Committee to consider was whether, since the objectives of the Institution included "the science of admeasuring and delineating the physical features of the earth" the Institution could usefully develop under modem conditions that portion of its Royal Charter. Three meetings were held, on 26 February 1936, 1 April 1936 and 25 February 1937 and a detailed memorandum was produced by Sir Ernest Dowson. At its meeting in April 1936 the Committee considered the responses to the circular sent to members on 31 December 1935. There was surprising unanimity that the Institution should forward the land surveying side, and several correspondents put forward their own ideas. This all resulted in the following recommendations to the Council.

(a) Appoint as from the beginning of session 1937-38 a Standing Committee of Land Surveyors to rank equal with the existing Standing Committees. This Committee would hold regular meetings and have the following terms of reference:

to advocate at home and overseas the importance, and advance the status, of land survey; to safeguard and further the interest of land surveying members of the Institution;

to scrutinise legislation, rules and orders relating to land surveying and its registration;

to disseminate a wider knowledge of the progress of land survey; and

to achieve the closer coordination of the interests of other activities served by the Institution with those of land survey.

(b) Authorise the reservation of space in the Journal for the publication of articles etc. of a land surveying character.

Other recommendations hinged on whether or not those above were accepted. These included: the setting up of a subdivision of the Institution examinations to be devoted to land surveying; expansion of the library which already held some appropriate titles; and encouragement of land surveyors overseas to obtain membership so that a viable total of land survey members would be obtained [13]. The recommendations were approved by the Council and on 5 April 1937 the Standing Committee of Land Surveyors was appointed with the terms of reference as defined in the recommendation. Sir Charles Bressey was elected first chairman of the Standing Committee that first met on 27 September 1937. [10 p. 578] Regular meetings were held thereafter until the outbreak of the war [5].

Consideration was being given to the inauguration of a fifth subdivision of the Institution's examinations to deal with land surveying and to the possibility of permitting the entry of experienced land surveyors of good standing to the Institution without passing the ordinary examinations when the outbreak of war halted all further discussions [7]. A further report from the Land Surveyors' Committee in 1937-38

decided that: the top floor of the Forestry Museum be converted and used as a land surveying centre; Capt. G.T. McCaw be appointed honorary secretary to the Committee; and McCaw be requested to prepare an article for publication in the Journal showing the lines on which the Institution was proposing to proceed in widening its activities in the field of land surveying.

On 4 April 1938 G. T. McCaw read the paper "The basis of mapmaking: survey of control" to an OGM of the Institution. The paper illustrated the wide field of land survey activity by giving a detailed history of the profession [9]. The President, in his introduction, referred to McCaw as one of the greatest living surveyors who had been good enough to undertake the secretaryship of the Land Surveying Committee and was organising a great display of plans and books on surveying in one of the rooms of the Institution [9 p. 210]. Unfortunately McCaw was not to live to see his efforts come to fruition. He died on 17 October 1942 [6].

Following from the terms of reference that emerged from the Standing Committee, the Institution "... voted a considerable sum of money for the reconstruction, furnishing and equipment of a whole floor of the Institution premises as a library, map-room and generally as a centre of land surveying information". This work was nearing completion in March 1938 and McCaw, as Honorary Secretary to the Standing Committee "... was to be in attendance at the Institution's Survey Centre on most days of the week ...to deal with technical enquiries...".

The paper concluded with "The future and development of the enterprise rest with land surveyors themselves. The facilities for cooperation are now available for the first time, and success will depend upon the extent to which they are used" [10].

In 1938 the President of the RICS said that "....the Land Surveying Committee of the Institution had been reorganised to improve the status of land surveying all over the world. It was felt that the colonies had rather relied on the Mother Country and the mother Institution for a lead, which had not always been given to them, and the Land Surveying Committee had been organised with that end in view" [13]

In a paper [10] thought to have been by McCaw, the small section of the Royal Charter of 1881 referring to ".... the science of admeasuring and delineating the physical features of the earth..." was explored over three pages. It was described as so comprehensive a clause as to make it difficult to find an upper limit to its range. The author concluded his analysis by saying that "... the aims of the Institution were to be directed to the science of admeasurement and delineation. This science would be generally described as "geodesy", but here a limitation is required..." The limitations referred to were that it was unlikely that thought had originally been given to physical geodesy. It would additionally be unlikely that the advocates had contemplated any study beyond mathematical geodesy. "But within the scope of that branch of the science there does not appear any intentional limitation". A report from the Land Surveying Committee on its work since 13 December 1937 (the significance of this date is not obvious but could have been the previous Council meeting) appeared in the Chartered Surveyor for 1938-39 [16].

Three overseas corresponding secretaries were appointed: R. C. Burgess for Sierra Leone; Capt. W. R. Baldwin-Wiseman for Australia; and Maj. E. W. Nasham for Nigeria. It is interesting to note that the committee decided to take no action on a recommendation the Ordnance Survey adopt the International metre for its grid and that the Ordnance Survey should be persuaded that in addition to showing acreages of fields on plans, there should also be the coordinates of the centre of each acreage. In July 1939 McCaw, together with Major Nesham and the Secretary of the Institution attended a conference at the Colonial Office to discuss the proposal that the Institution should provide a central Imperial examination in land surveying that would both qualify one for membership and also lead to a licence to practice in such Colonies as might be prepared to participate [17].

THE WAR AND ITS AFTERMATH

The Second World War then intervened and all trace of the Survey Centre is lost. This was no doubt hastened by the death of McCaw in 1942. Although it is recorded [44 p.8] that he was succeeded in the position at the Survey Centre by J. Calder Wood, there appears to have been an interregnum since it was not until the meeting of 11 December 1944 that Calder Wood accepted an invitation to serve as technical adviser to the Land Surveying Committee. [18 p. 359]. Unfortunately he was to die in February 1946 and there was another gap before C. A. Hart became Honorary Secretary on 13 October 1948. Thus several years of effort were lost and after the War a new start had to be made. It would be interesting to know however, just what happened to the contents of the Survey Centre described above as "a whole floor of the Institution premises as a library, map-room and generally as a centre of land surveying information". The library remains, but what of the rest?

The war drew together into the military survey organisation practically all the land surveying resources of the Commonwealth. Meanwhile at home the training resources open to land surveyors had been augmented by the creation of a School of Military Survey and by the establishment of a chair of surveying at London University [5 p.151]. Cheetham [5] suggested that the principal cause, which had, before the war, prevented more rapid development of a land surveying division, was the fear that a small body of land surveyors with specialised interests would be merged into a large professional body which would have little time to give to those special interests. The Institution, which at one time held the view that its members must be organised essentially as a single homogeneous profession, had, as the complexity of the work increased, been tending towards the idea that some measure of recognition of specialised interests within the profession should be accorded. Now (immediately post war) it appeared probable that a land surveying division could be formed and would be able to arrange its own examinations [5 p.154]. The question of examinations was also being revisited by the Royal Geographical Society since that Society gave a diploma in surveying and not only conducted examinations but gave instruction in field astron

omy and surveying. Joint meetings agreed that the better place to pursue further progress within the profession lay with the Institution [5 p.154].

At a meeting of the Land Surveying Committee on 11 April 1947 two primary questions were asked.

(a) Was there any need for a professional home for the land surveyor, to test his competence, represent his interests and provide him with a platform?

(b) If such a need existed, was the Institution, rather than any other, the professional body to fulfil that need?

In answer to the first there was general agreement of the need, and to the second there was no doubt, in the light of the terms of the Royal Charter, that the Institution was most appropriate. Other possible institutions were suggested, such as the Institution of Civil Engineers and the Royal Geographical Society. [47 p 22]. Thus it was recommended to Council that it accept in principle, subject to examination by the Finance Committee of the financial implications involved, and subject to ascertaining the reactions of surveyors overseas, our proposal that the Institution resume its efforts, which were interrupted by the war, to devote greater attention to that part of its Royal Charter covering "the science of admeasuring and delineating the physical features of the earth" and to furthering the interests of land surveyors both at home and overseas. [47 p 28].

During the session 1946-47 steps were taken to resume the movement for furthering the land surveying side of the profession. To do this a paper was prepared for the Conference of Commonwealth Survey Officers held in London in August 1947. This was felt to be an ideal opportunity to sound out those especially interested in the science of survey upon the Council's policy in regard to land surveying. As a follow-up it was agreed that a representative should also attend the International Society for Photogrammetry (ISP) Congress in 1948 [20].

In August 1947 the Director of Colonial Surveys (Brigadier Martin Hotine) read the paper that set out his own ideas on the organisation necessary for the land surveyors' profession, and the need for a professional society qualified to speak for that branch of the profession and to offer a recognised professional qualification [21]. Hotine had originally considered that the Royal Geographical Society might be the best home for land surveyors. Unfortunately it was a learned society and not a professional organisation; and it had no entry examination or other test by which the professional could be distinguished from the amateur or the technician [55]. He felt that it was generally agreed that demands on the profession at that time were greater everywhere than ever before. Was there an organisation there to serve the profession's demands? He thought not. Any organisation must make the most effective and economical use of the highly specialised scientific training and equipment involved and yet fit into the general framework of administration. Then whilst there is a need to recruit to fill the depleted ranks this should not be achieved by lowering standards. Indeed he proposed the opposite.

Any professional society formed must keep up to date, serve as a forum for discussion, be a clearing house for professional information and be a meeting place for land surveyors. It must also maintain the standard of the qualification and regulate conduct. He expands on these principles in the reference [7]. Hotine considered that the Colonial Survey Services required about 300 fully qualified land surveyors of whatever race or creed, and that the Ordnance Survey and Military Survey may require a further 200. He pointed out that rather than form a completely new society one existed already where the Charter incorporated the appropriate wording to cover land surveying, namely the Royal Institution of Chartered Surveyors. At the same time he was quick not to tread on the toes of the Royal Geographical Society which had always had many land surveyors among its Fellows. In intimating that informal discussions had already taken place he said that before anything further could be done there had to be agreement by the Conference to the way forward. The proposals in the paper were unanimously approved in principle and a resolution proposed by Sir Ernest Dowson was similarly carried [7].

The Commonwealth Survey Officers' Conference of 1947 directed various resolutions at the RICS. These were:

"The Conference

(a) Thanks the officers on both sides who participated in the informal discussions with the Royal Institution of Chartered Surveyors which are referred to in Brigadier Hotine's paper on Professional Organisation [7].

(b) approves in principle the measures outlined in that paper, more particularly

(i) that The Royal Institution of Chartered Surveyors shall be the central society in Great Britain for the profession of land surveying;

(ii) that a special series of examinations shall be introduced as qualifying for membership of that profession and of the Royal Institution of Chartered Surveyors; and

(iii) that appropriate steps shall be taken to satisfy the profession's technical needs and for its representation in the counsels of The Royal Institution of Chartered Surveyors" [5 p.155].

The need for a professional association of land surveyors was urged, both to keep themselves up-to-date and in touch with each other, and to provide a meeting place for those home on leave. Hotine was obviously thinking primarily of the members of the Colonial Survey Service and only secondarily those of the Ordnance Survey, Military Survey and other organisations at home [53 p. 269].

The Conference appointed a special committee to conclude arrangements with the Royal Institution of Chartered Surveyors. That committee consisted of Major General G. Cheetham (chairman), Brigadier R.L1. Brown, J. Clendin- ning, Sir Ernest Dowson, Professor C. A. Hart, Brigadier M. Hotine, Dr J. de Graaff Hunter, Major General M. N. MacLeod, V.L.O. Sheppard, G.K. Thornhill and Major W.W. Williams [7]. The Commonwealth Conference also considered the question of reciprocity and a resolution on this was put forward by the Surveyor General of New Zealand, R.G. Dick [7].

As a result of the deliberations of the Conference the Institution endorsed the views expressed and appointed a committee under the Institution President, R. W. Trumper, to

meet the special committee from the Conference. The first meeting was held on 5 November 1947 when the two parties merged to form the Special (Land Survey) Conference [5 p.155]. After completing its remit, this Special Conference was disbanded at the Council meeting of 1 November 1948 and all matters affecting land surveyors were taken over by the Land Surveying Committee [28].

A further topic raised at the Conference was that of the bulky nature of the Nautical Almanac. On the suggestion of Dr J. de Graaff Hunter it was suggested to the Nautical Almanac Office that a cheaper, less bulky version should be considered for surveyors. This was acted upon and the first issue for 1951 was published in 1950 [37].

As a result of the paper by McCaw [10] and its proposals for the creation of a land surveying group, and the inauguration of a special sub-division of the examinations for qualification, proposals were circulated to all corporate members were early in 1948. The proposals were further discussed at a meeting on 9 March 1948 of the Council, Branch Chairmen and Honorary Secretaries [21]. That gathering endorsed the scheme for "admission of land surveyors into the Institution and recommended the Council to give effect to it" [24]. Soon afterwards Maj Gen G. Cheetham consented to serve on the Public Officers' Committee of the Institution [25].

At its meeting on 26 April 1948 the Special (Land Surveying) Conference suggested that the title of the new division might be "The Geodetic Surveying Division" but that was considered not to be all embracing and that the title should be The Land Surveying Division. [47 p 106] The same year the Council approved the formation of a land surveyors' group within the Institution [27 p. 617]. This was announced definitively in the Journal for June 1948 where further details can be found [27]. Notice that up to this time the terms "surveyors" and "surveying" had been used randomly in the titles of the various committees but here we see a definitive version.

The first problem was that of admission of those responsible practising surveyors who were too old to sit examinations, as there was no precedent for admission without examination of large numbers of individuals. The Council however agreed to exercise its dispensing powers as authorised by the Bye-Laws in such a way that recognised members of the profession would be admitted. The procedure adopted was to have three groups of prospective members. The first was a small group of top ranking senior land surveyors who would, after election, form a Land Surveyors' Admission Sub-Committee. The second group would be 'surveyors of good standing' who could satisfy the Sub-Committee. The third group would be required to pass a new examination in Sub-Division V (Land Survey) of the Institution [5 p. 156]. Under the second criterion above, it was possible for a candidate who was unable to offer an alternative examination qualification acceptable to the Institution to be subject to a *viva voce* examination on any parts of the new syllabus for Sub-Division V [27 p. 619].

At this stage two seats were allocated on the Council for new land surveying members and these were, for 1948-49, Major General G. Cheetham, then Director General of Ordnance Survey, and Professor C. A. Hart, then Professor of Surveying and Photogrammetry at University College London [27 p. 619]. (During the time of Professor E. H. Thompson at UCL the title was turned round to Photogrammetry and Surveying so that the emphasis was on the former at the same time as making it alphabetical).

The Special Sub-Committee advising the Council on applications under the dispensating powers included among its membership the Director General of Ordnance Survey, the Director of Colonial Surveys and the Director of Military Survey [27 p. 619]. The Institution was careful to stress that although inviting prospective members from around the world it did not wish to intrude on the domains of sister institutions. On the contrary, it hoped in due course to establish closer relationships with such bodies throughout the Empire.

ELECTIONS AND EXAMINATIONS

As a first step, all members appointed as representatives at the Commonwealth Survey Officers' Conference who were not already members of RICS were elected to membership as Fellows. This happened so rapidly that the meeting of the Special (Land Survey) Conference on 26 April 1948 consisted, for the first time, entirely of members of the Institution. In addition a provisional syllabus was approved with the aim of the First and Intermediate Examinations being held for the first time in 1949 and the Final the following year.

In initiating a new Sub-Division V (Land Survey) in the examination structure it was necessary to apply different conditions to it at the outset from those then applicable to the other Sub-Divisions. For example, [27 p. 617] the need to recruit to the Colonial Survey Service was very great, owing to the war lag, and candidates were already being trained at the School of Military Survey, Warminster, so as to emerge at twice-yearly intervals. For that reason, and to avoid the difficult situation which would arise in the Colonial Survey Service if one set of officers growing up within it had taken the Institution's examinations and a second set of similar rank had taken an internal examination at Warminster, the Council agreed that a special arrangement should be made to hold the First and Intermediate examinations in Sub-Division V twice yearly in 1949 and 1950. This was not extendable to the other Sub-Divisions because of the problems that would have been caused by the sheer numbers involved. As from October 1950 it was hoped to be possible for Sub-Division V to come into line with the others [27 p. 618].

In his paper to the Conference of Commonwealth Survey Officers Hotine included a draft syllabus upon which the published version was based. In outline it was as follows, (a) First examination. The elements of chain surveying and levelling, mensuration and trigonometry, draughtsmanship, map reading, mathematics, physics, (b) Intermediate examination. cadastral surveying and land registration, topographic surveying, geodetic surveying, (c) Final examination. Any one of the following: cadastral surveying and land registration, topographic surveying, geodetic surveying.

Fuller details of the syllabi are given in the reference [7].

The Royal IttKtilution of Chartered SwvefOffs

FIRST EXAMINATION, 1957

Tuesday, 12th March

MATHEMATICS (PURE)

Mining and Land Surveying Sections.

Time allowed—10 *a.m.* to 1 *p.m.*

NOTE.—*Not more than* **seven** *questions to be attempted. All questions carry equal marks. Maximum marks* 100.

QUESTIONS.

1. (i) Prove by induction that $1^3+2^3+3^3+\ldots\ldots+n^3=\frac{n^2}{4}(n+1)^2$

Hence show that $1^3+2^3+3^3+\ldots\ldots+n^3=[1+2+3+\ldots\ldots+n]^2$

(ii) If the coefficients of the fifth, sixth and seventh terms in the binomial expansion of $(1+x)^n$ are in arithmetical progression, find n.

2. (i) If $\beta^{(x+1)}=8^{(3x-1)}$ find x correct to 3 decimal places.

(ii) If $\frac{6x^2-4x-6}{(x-1)(x-2)(x-3)}=\frac{A}{x-1}+\frac{B}{x-2}+\frac{C}{x-3}$ for all values of x, find A, B and C.

3. If $0<\theta<\frac{\pi}{2}$ solve $2\sin\theta+3\cos\theta=2{\cdot}7$. Verify the solution by plotting the graphs of $3\cos\theta$ and $2{\cdot}7-2\sin\theta$ for values of θ near the solution of the equation.

P.T.O.

QUESTIONS.

4. The elevation of a tower at a point A due South of it is 35°, and at a point B, due West of A and at a distance of 50 feet from A, it is 19° 25′. Calculate the height of the tower, and the bearing of B from the tower. Points A and B lie in a horizontal plane with the base of the tower.

5. Prove that the straight line through O perpendicular to each of two straight lines OA and OB is perpendicular to all straight lines which lie in the plane OAB and pass through O.

P and Q are two points on the same side of a given plane. Show how to find a point A in the plane such that PA+QA is a minimum.

6. Obtain the equation of the straight line passing through the points (1, 6) and (5, 7).

If this line is cut by another straight line of gradient 2 passing through the point $(-2,-1)$, find

(i) the co-ordinates of the point of intersection of the two lines,

(ii) the angle between the two lines.

7. Prove that the circles whose equations are respectively $x^2+y^2=2y$ and $x^2+y^2=8x+8y-16$ touch one another.

Also prove that the straight line $7y=24x+32$ is a common tangent to the two circles.

8. (i) Differentiate with respect to x, $\frac{\sqrt{1-x^2}}{x}$

(ii) If $y=x.\sin^2 x$ find the value of $\frac{d^3y}{dx^3}$ when $x=\frac{\pi}{6}$

(iii) If $y=\frac{x}{1+x+x^2}$, determine the maximum and minimum values of y.

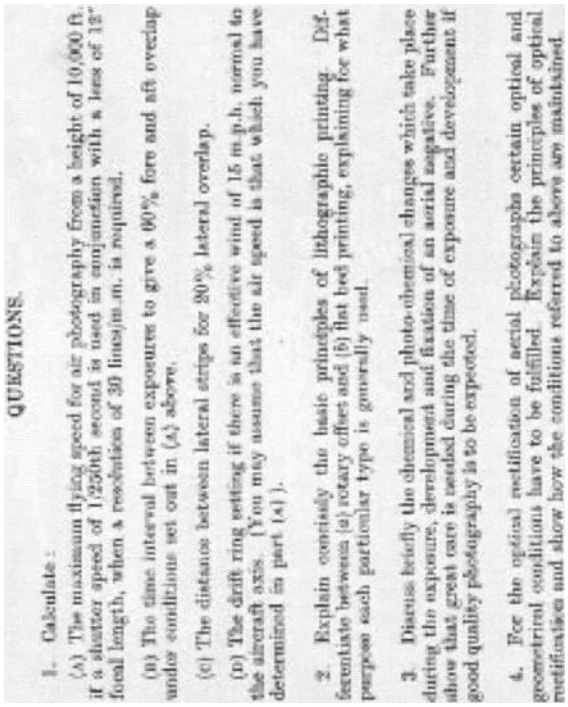
9. (i) Integrate with respect to x:

$(2x^4+3)^3$ and $\frac{1}{x^2+3x+2}$

(ii) Evaluate $\int_0^{\frac{\pi}{2}}\sin^2 x\,dx$ and $\int_0^2 x^2 e^x\,dx$.

10. Sketch the curve $y^2=x^2\left(\frac{2+x}{2-x}\right)$ showing its principal characteristics.

Calculate the volume generated by the rotation about x—axis of the area enclosed between the curve, the x—axis, and the ordinates $x=-2$, $x=0$.



QUESTIONS.

1. Calculate :

(a) The maximum flying speed for air photography from a height of 10,000 ft. if a shutter speed of 1/250th second is used in conjunction with a lens of 12" focal length, when a resolution of 30 lines/m.m. is required.

(b) The time interval between exposures to give a 60% fore and aft overlap under conditions set out in (a) above.

(c) The distance between lateral strips for 30% lateral overlap.

(d) The drift ring setting if there is an effective wind of 15 m.p.h. normal to the aircraft axis. (You may assume that the air speed is that which you have determined in part (a)).

2. Explain concisely the basic principles of lithographic printing. Differentiate between (a) rotary offset and (b) flat bed printing, explaining for what purpose each particular type is generally used.

3. Discuss briefly the chemical and photo-chemical changes which take place during the exposure, development and fixation of an aerial negative. Further show that great care is needed during the time of exposure and development if good quality photography is to be expected.

4. For the optical rectification of aerial photographs certain optical and geometrical conditions have to be fulfilled. Explain the principles of optical rectification and show how the conditions referred to above are maintained.

* The Royal Institution of Chartered Surveyors

FINAL EXAMINATION, 1965

Thursday, 25th March

GEODETIC SURVEYING (Branch 3)

(PART I)

Land Surveying Section.

Time allowed—10 *a.m. to* 1 *p.m.*

NOTE.—*Answer* **Four** *questions only. All questions carry equal marks.*
Maximum marks 100.

QUESTIONS

1. When commencing the Geodetic survey of an unsurveyed area, what initial constants must be determined or assumed? State how these may be obtained.

2. Measurements made by electronic distance measuring instruments, such as the Tellurometer and Geodimeter, require correction for meteorological conditions. What observations are required to make these corrections? Discuss the effect of errors in these meteorological observations on the measured distance. If a choice of micro-wave electronic distance measuring instruments, such as the Tellurometer, was available with carrier wave lengths of either 3 centimetres or 10 centimetres, which type of instrument would you prefer to use for short distances (less than 2 kilometres) and which for long distances (greater than 30 kilometres). Give your reasons for your preference in each case.

3. Describe the characteristics of the Transverse Mercator Projection applied to a sphere, mentioning the corrections which have to be made to field observations. Explain how the projection can be used to cover areas which extend too far in the East-West direction to be covered by a single projection.

P.T.O.

4. Comment briefly on any four of the following:

(A) Masers and Lasers
(B) European Datum
(C) Geoidal Heights
(D) Hydrostatic Levelling
(E) Stellar Triangulation.

5. For what purposes are gravity observations generally made? Describe one common method of deriving the relative value of gravity at a station. What is meant by a gravity anomaly? Define any one particular type of anomaly, showing the advantage of its use over actual gravity values for an area.

6. What is the purpose of a "least squares" adjustment? Quantities a, b, c and d have been directly observed with the following results:

$a = +1.32$ $\quad b = -2.71$
$c = +0.96$ $\quad d = -0.62$

Two condition equations have to be satisfied these are:

$$2a+b = 0$$

$$a-c+\frac{d}{2} = 0$$

Find values for a, b and c and d by the method of least squares.

The syllabus was published in September 1948 and 47 candidates sat the examinations in 1949 and a further 31 entered for those of Spring 1950 [5 p.156]. A new syllabus was published in the Spring of 1955 and the first examinations in hydrographic surveying began in the Spring of 1956 [44 p. 4].

When the inauguration of the land surveying division was announced in 1947 it was stipulated that the exercise of the dispensing powers would be only temporary. As from 31 August 1950 the open door for admitting "surveyors of good standing" without examination was closed and from then all prospective new members had to sit the examination [3b].

Hotine was asked to chair the sub-committee that would elaborate the syllabus for the examinations - a topic that he had outlined in his paper to the Commonwealth Conference. The Rules and Syllabus were published in September 1948. In outline they were as follows.

(a) To be able to sit the first and intermediate examinations the candidate had to be either a full-time student at a recognised establishment or engaged full-time in a technical capacity at an approved location where training was provided to cover the syllabus.

(b) First examination. Not less than 17 years old, hold a School Certificate or an exempting examination. From 1st March 1949 this was raised to include credits in not less than four subjects of which English and mathematics were two. Examination fee: £4 4s Od.

(c) Intermediate examination. Not less than 19 years old. Had to undertake that if successful they would enrol as a probationer member of the Institution and remain so until elected to corporate membership after passing the final or until the end of the fifth year after passing the intermediate. Examination fee: £4 4s Od. (d) Final examination. At least four years approved training and experience in either (i) cadastral and engineering surveying and land registration, (ii) topographic surveying or (iii) geodetic surveying. Examination fee: £7 7s Od.

An aggregate pass mark at each level of 55% and minimum pass marks in each subject of 40% were required. Candidates had to pass all papers except for the possibility of one falling below 40% at intermediate level, so long as the overall 55% was achieved [27 pp. 620-621].

So popular was the technical presentation given by Brigadier Hotine to the first general meeting of the Land Surveying Division, that many applications for tickets to attend had to be refused [5 p. 157]. Such was the interest from overseas that it was hoped that in due course there would be reciprocity with various countries in the Commonwealth and Colonies. Both the Director General of Ordnance Survey and the Director of Colonial Surveys expressed the hope that a pre-requisite of entry to their professional grades would be the intermediate examination [21].

Unfortunately differences of opinion between some of the members involved in defining the requirements for those gaining entry by examination, and the RICS General Council, was to lead, in 1953 to the resignation of Hotine, followed by that of Humphreys and Wiggins. However they did not attempt to discourage younger people from joining or staying in the Division [55]. Hotine's last appearance on the Land Surveying Committee was 10 March 1953 and his resignation was noted, with regret, by the General Council on 5 October that year and by the Land Surveying Committee on 13 October.

FIRST MEMBERS

In the Journal for June 1948 the Institution announced its definite intention to form a land surveying group within the membership and to inaugurate a fifth subdivision of the examination structure [29]. Initial interest was shown with 220 applications from around the world for consideration on eligibility for membership under the Council's dispensing powers. The first balloting list was issued in the summer of 1948 [29]. Those in the first group were all elected by April 1949 and it was decided that the opportunity under group two would end on 31 August 1950. By that time 425 land surveyors had been admitted out of an application list of 1688 [44 p. 2]. The first lists of elected land surveyors were published in *Empire Survey Review* in 1949 and 1950 [3]. They contained a total of 64 Fellows, 9 Colonial Fellows and 64 Professional Associates.

Seventy eight candidates sat the first and intermediate examinations during 1949 and the spring of 1950 and three sat the final, held for the first time in March 1950 [30 p. 195]. In the same issue it was reported that African surveyors who aspired to promotion to the senior service were required to pass the intermediate examination. In many Colonies the full qualifications were regarded as a promotion bar at a higher stage. In November 1950 a conference of Commonwealth and USA Authorities was held in New Zealand where it was hoped to pursue a common basis of reciprocity for land surveying examinations [30 p.195]. This did result in active reciprocity for some years but was subsequently phased out.

During the summer of 1949 the Council of the Institution, with the support of the Chairman of the Land Surveying Division, submitted a Memorandum of Evidence to the Inter-Departmental Committee on Survey Staffs [32]. This was to consider the staffing of the Ordnance Survey and of all other government survey organisations in relation to the Ordnance Survey and to recommend how it can be regulated and coordinated to the best national advantage. The Institution was particularly interested in certain aspects of the terms of reference, namely: that the supply of maps and survey data to the public generally, and in particular to members of the Institution, should be continued in the most efficient and economical manner; that recognised standards of qualification in the land surveying profession should be established and maintained, and that these should be accepted by H. M. Government and by the public generally; and that such standards of qualification should consist of the passing of examinations supported by adequate training and experience [32 p. 430].

By the autumn of 1954 the number who had sat the land surveying examinations are shown in Table 1. Examinations had been held in 27 centres around the world and 4 in the United Kingdom and Ireland.

Table 1 [44 p.2]

First		Intermediate		Final			Total	
Sat Pass Ref		Sat Pass Ref		Sat Pass Ref			Sat Pass	Ref
157 46 23		334	129 43	74	17	3	565 192	69

The first of a series of newsletters for Land Surveyors was issued on 24 November 1949 but unfortunately no copy can now be found [30 p. 195].

Some initial difficulties were experienced because the sub-division was intended for the map-maker and not for those who worked in the more limited sphere of map revision or survey work of a less advanced kind. The hope was expressed that in due course the qualification would become recognised throughout the Commonwealth [29].

It is interesting to note the total membership of the Institution at that time shown in Table 2.

Table 2 [7]

Year	Fellows, PAs etc	Probationers	Students	Housing Managers
1948	8114	1091	5043	188
1949	8657	1437	5384	205

On 3 April 1950 Maj Gen G. Cheetham read a paper at an OGM of the Institution titled "The RICS and Land Surveying". He outlined the history of the Institution, highlighting three dates as pertinent to the land surveyor 1868, when the Surveyors' Institution was formed; 1935 when the Institution began to take an active interest in the part of its charter dealing with land surveying and 1947 when the negotiations which led to the formation of the Land Surveying Division were started [29 p. 145].

FIRST ELECTED DIVISIONAL COUNCIL

In November 1953 steps were taken to have an election for membership of the Divisional Council [51]. It was noted that "...last year [1953-54] the first occasion that this opportunity existed, no nominations were received, and consequently no balloting list was issued". The Committee decided in November 1953 that "The Land Surveying Division ... being finally established, the Council have decided that the Land Surveying Standing Committee of the Council shall be appointed on an elected basis, with the exception of certain *ex officio* and co-opted members. Elected members will out-number *ex officio* and co-opted members."

At that time (session 1953-54) the agreed constitution and membership of the Committee was *ex officio*: President and Honorary Secretary of the Institution; Director General of Ordnance Survey; Hydrographer of the Royal Navy; Director of Military Survey; Director of Colonial Surveys; Representative of Licensed Surveyors in New Zealand; Member of General Council representing Land Surveying; and the chairmen of the Education and Elections Committees of the General Council. Elected members represented the following groups of surveyors: one member each for private practice, commercial concerns, local government and statutory undertakings; three members representing retired surveyors with overseas experience; four members each for those in tutorial appointments and for professional associates; and five members representing government service. This allowed for 20 elected seats, supplemented by 4 coopted. Before the ballot papers went out the numbers per category were slightly modified to give 18 seats.

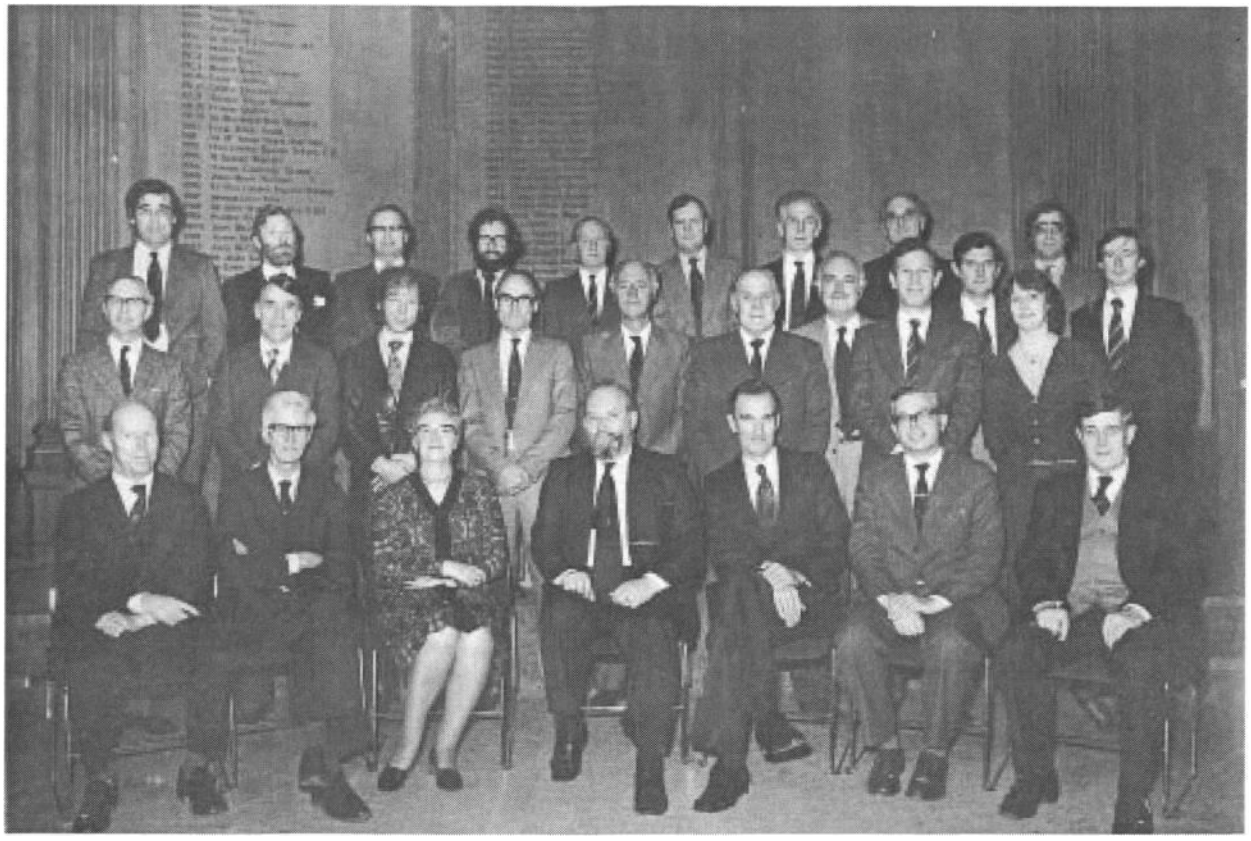
There were 23 nominations for the 18 positions. 411 ballot

The Directorate of Military Survey> (War Office and Air Ministry) July 1954. L. to r. back row: LAC W.J.Dance, Sjt A.J. Stevenson, W.H. Bonsor, F.A. White, M.J. Hughes, LACA.G. Gentry, LACD.A.Stangroon, L.J. Galashan, C.W.J. Palmer, WOIIE.R. Tinsley, L.H. Taylor, F.C. ODonnell, T.J. MacDuffi, T.E. Woolas, T.L. Cory. L.to r. 2ndfrom back: G.H.Coombes, A.S. Harbert, CplB.J. Dawson, P. St.Clair, P.R. Langdon-Davies, T.J. Jenman, R.T. Roberts, A.E. Grundy, S.G. Leathers, I. Mumford, Cpl M. Bradford, CplP.J. Hatcher, J.R. Donlevey, C.M. Child, R.B. Webber. L to r. middle: S.F. Smith, LAC D.B. Wilkinson, M.J. Callow, G.S.M. Holland, J. W. Sanderson, J.D. Peart, F.J. Wills, D.J. Davies, F.D. Ross, M.J. Beynon, J.M. Dinwiddie, K.R. Shickle, L.A.R. Willey, PK. Clark, S. W. Barron, G.J. Humphries, J.H. Matthews. L. to r. 2ndfrom front: W.F. Bullen, T.F. Hicks, E.M. Byrne, Mrs V.H. Graydon, Miss D.M. Wheeler, Mrs J.P. Hampton, Miss P.M.A. Bull, Mrs M.A.C. Nash, Mrs M.A. Day, Mrs M.K. Brett-Foreman, Miss M.J. Ware, Mrs W.K. Day, Mrs F.D. Sainsbury, Miss J.E. Campbell, Miss M.S. Robertson, Mrs R.M. Garman, Miss F. Barlow, Miss D.L. Maxwell-Cross, Mrs S.M. Long, Mrs M.L. Jacobson, H.L. Beirins, J. Clasby. L to r. front: J.D. Swanson, Maj D.L.M. Portway, H.A.G. Lewis, Maj PC. Sherwood, Lt Col J.W. Tayler, Col R.C.N. Jenney, Brig L.F. de Vic Carey, Lt Col R.C.A. Edge, A.R. Robbins, Maj H.N.F. Patterson, Maj W.L. Covington, CaptR.H. Gibson, Capt H.L. Thomas

papers were sent out (146 to 'home' addresses and 267 overseas) and 171 were returned (102 home and 69 overseas). The resulting Committee was: Chairman Brig Bom- ford; Vice Chainnan Brig A.H. Dowson; Honorary Secretary A. Stephenson; ex officio Vice Admiral A. Day, Maj Gen J.C.T. Willis, Brig L.F. de Vic Carey, Maj Gen G. Cheetham, R.E. Gilmour and C. Simpson; elected Brig R.L1. Brown, Brig M.O. Collins, Col C.A.K. Innes Wilson, Cdr A. Jones, Cdr D.H.T. Macmillan, Dr E.A. Miskin, RG. Mott, Lt Col J.D. Newman, Brig A.A. Prain, H.F. Rains- ford, R.J. Sissons, J.A. Story, E.K.G. Sweeting, Lt Col W.R.T. Taylor and Prof E.H. Thompson.

CHRONOLOGY

27 June 1834	Formation of Land Surveyors' Club
15 June 1868	Foundation of Surveyors' Institution
26 August 1881	Suggestion of reciprocal recognition aired
1907	Colonial Conference. Suggestion of reciprocal recognition aired
1926	First award of Diploma in Geodetic Surveying
1928	First Empire Surveyors' Conference
27 October 1930	Renamed as The Chartered Surveyors' Institution
June 1931	First issue of *Empire Survey Review* under editorship of G T McCaw
1935	Colonial Office recognised Special Diploma in Land Surveying, as exempting
February 193 5	Paper by Cheetham on RICS and Land Surveying
11 November 1935	Appointment of Special (Land Surveyors') Committee
31 December 1935	Branches circulated for reaction to land surveying
26 February 1936 5	First meeting of Special (Land Surveyors') Committee
April 193 7	Appointment of Standing Committee of Land Surveyors
27 Septemberl937	First meeting of Standing Committee of Land Surveyors
4 April 1938	G.T. McCaw read paper to OGM at RICS
July 1939	Meeting at Colonial Office re Institution examinations
3 July 1939	Last pre-war meeting of Land Surveying Committee
17 October 1942	Death of G. T. McCaw
11 November 1944	First post-war meeting of Land Surveying Committee
11 April 1947	Recommendation to General Council from Land Surveying Committee
3 July 1947	Became The Royal Institution of Chartered Surveyors
August 1947	Conference of Commonwealth Survey Officers. Paper by Hotine on Professional Organisation [28]



Land Surveying Divisional Council 1979/80. L. to r. back row: G.E.D. Cole, T.M. Leon, P.J. Taylor, R.S. Waters, Lt Col P.C. Sherwood, Lt Cdr W.J.M. Roberts, DrA.L. Allan, A.D. Bancroft, J.Lambert (?) Middle row: A.K. Newton, WS. Longdin, I.J. Dowman, P.J. Carmody, D. W Proctor, Maj Gen J. Kelsey, P. Ellis, Lt Col R. Wood, D.G. Constable, Karen Paton, P. Gilbert. Front Row: Lt Cdr J.C.E. White, J. W. Wright, Rosemary Rowles, J.F.D. Bell, L. Scott, J.R. Smith, Rear Adml D. W. Haslam. Absent: Maj Gen R.LI. Brown, L.H. Harland, A. Haugh, N.A.G. Leppard, W.P. Smith, J.A. Weightman, J.R. Brogan.

5 November 1947 9	First meeting of Special (Land Survey) Conference
March 1948 26	Council endorses admittance of land surveyors into the Institution Special
April 1948	(Land Survey) Conference. All members met for first time. Discussion on name "Geodetic Surveying Division "or "Land Surveying Division"
April 1948 June 1948	First elections to membership Notice in the Institution Journal of formation of
September 1948	Division First syllabus published First report of the new Land Surveying
13 October 1948	Committee
1 November 1948 3	Special (Land Surveying) Conference dissolved [28]
April 1949	First and intermediate examinations held for first time [28]
14 Novemberl949 24	Council authorised regular OGMs to be held for land surveyors [34]
November 1949 12	First of a series of newsletters for land surveyors [30 p 195]
December 1949 14	Nine-day exhibition of maps and aerial photographs at the RICS [35]
Decemberl949	First OGM for land surveyors. Paper by Brigadier Hotine on surveys for colonial development [30 p. 195]
March 1950 3	First final examination Second OGM for land surveyors paper by Maj Gen
April 1950	Cheetham on the RICS and land survey [33]
mid 1950 31	First *Star Almanac for Land Surveyors* (for 1951) published [37]
August 1950	Termination of dispensing powers for entry [30 p. 195]
November 1950	Conference of Commonwealth and USA survey authorities in Wellington, New Zealand [30 p. 195]
5 October 1953	General Council noted with regret Brigadier Hotine's resignation First elected Land Surveying Committee [51]
1954-1955	New syllabus
Spring 1955	First examinations in hydrographic surveying
Spring 1956	Grade of Colonial Fellow discontinued
1958	Introduction of "Land Survey Notes" in *Chartered Surveyor* First Biennial
July 1967 Easter	Conference. Held at RMCS Shrivenham
1968	
1970-1971	Land Surveying Committee first referred to as a Divisional Council [46] *Land, Hydrographic & Minerals Supplement* to *Chartered Surveyor Chartered Land & Minerals Surveyor (CLAMS)*
October 1973	
Spring 1979	Introduction of *Land & Minerals Surveyor (L&MS)*
October 1983	Relaunch of *L&MS* at A4 size
October 1990	Launch of *Surveying World (SW)*
November 1992	The Society of Surveying Technicians (SST) becomes part of the RICS. General Council approves change of name to "The Geomatics Division"
1998	Conference at the University of Nottingham to celebrate 50 years of the Division.
September 1999	

SO, WHEN WAS THE DIVISION OFFICIALLY FORMED?

This paper has been compiled to celebrate the 50th anniversary of the formation of the Land Surveying Division, but the question arises as to the appropriate starting date. Reference [44 p. 24] specifically refers to "the stewardship of the Institution during the seven years since the formation of the Land Surveying Division" and the title of that paper refers to August 1947 to April 1955. Thus August 1947 (which was the date of the Commonwealth Survey Officers' Conference) would seem to be the appropriate date to select. However by reading the above list, other dates might also be acceptable e.g. 5 November 1947 (formation of the Special (Land Survey) Conference) or April 1948 with the first elections to membership. Another, 26 April 1948, was when General Council, following a memo of 1 December 1947, agreed to approve the formation in due course of a Land Surveying Division. June 1948 saw the subsequent announcement in the Journal. A date around April/May 1948 would seem to be appropriate, although no one day can be specified. What is certain is that by the time of the celebratory gathering in September 1999 the Division will definitely be over 50 years old. There has always been wide use of both "Surveying" and "Surveyors' " in the name of the Division, but "Surveying" is the correct version according to [47 p 106].

APPENDIX A. PUBLICATIONS FOR MEMBERS OF THE DIVISION

In 1928 the first Empire Surveyors' Conference was held on the initiative of the War Office. It was as a result of this Conference that the *Empire Survey Review* was established under the editorship of Capt G. T. McCaw in 1931. It rapidly attracted important papers and an international circulation as a front rank journal [5 p. 150].

For many years part of the agreement with the RICS was that members of the Land Surveying Division should receive *Empire Survey Review* free in perpetuity. This continued for many years until the RICS felt that the cost of providing some 600 copies of it was too much of a burden on its finances. There was then a gradual tightening up of who should be eligible for free copies and finally a complete withdrawal. This was obviously a major financial blow to *Empire Survey Review* (now *Survey Review)* from which it took many years to recover.

With the gradual demise of the free issues, it was felt that some means were required to be developed to keep members of the Division informed of professional and technical

matters. The situation began to be corrected from 1967 as the following summary shows. Until 1967 there was no official space allocated to land survey in *Chartered Surveyor* although the occasional article or news item was fitted in as appropriate. From which time the following developments have taken place.

From July 1967 to 1979 there was a regular page or so in *Chartered Surveyor* devoted to "Land Survey Notes". Compiled by J.R. Smith in his capacity of Divisional Honorary Secretary, it ran monthly for 140 issues.

From October 1973 to Autumn 1978 A quarterly publication *Land' Hydrographic and Minerals Supplement* (to *Chartered Surveyor)* was published. Edited by John Corder it was of A4 size, averaged 16 pages per issue and comprised 21 issues. The Editorial Board included at various times A.L. Allan, C.D. Burnside, P. Ellis, D.J. Lord, W.J.A. Payne, W.J. Roberts, I. Russell, R. Sheldon, J.R. Smith, T. Smith and C.J. Whyte.

From Spring 1979 to Summer 1983, 16 quarterly issues of *Chartered Land & Minerals Surveyor (CLAMS),* A5 size, average 64 pages per issue were published, edited by Michael Schwartz. The Editorial Board varied amongst the following A.L. Allan, P. Ellis, I. Russell, J.R. Smith, T. Smith, R. Sheldon and C. Whyte.

From October 1983 to September 1990 ninety-three monthly issues of *Land & Minerals Surveying (LAMS),* A5 size, averaging 64 pages per issue were published. The editors were Michael Schwarz to January 1988, Clive Branson to March 1988 and Rita Virgo to Sept 1990. The Editorial Board varied amongst the following: P. Beaver, R. Beels, K. Bullock, D. Haslam, A. Haugh, J. Hill, B. Jones, J. Karalus, T. Leon, H. Lindsey, W.S. Longdin, R. Lowndes, R. Parry, J.R. Smith, E. Turner, P. Warden, E. Watkins, I. Watson and C. Whyte.

October 1990 to August 1991 saw *LAMS* relaunched in A4 format, with an average of 30 pages per issue. Rita Virgo edited all 10 issues. The Editorial Board varied amongst the same as for its predecessor.

From September 1991 to October 1992. No journal was published.

From November 1992 to September 1995 a bimonthly, A4 format *Surveying World* was published in colour averaging 50 pages per issue The Editor was Peter Gilbert. The Editorial Board varied amongst: R. Blow, G. Harper, A. Haugh, J.D. Leatherdale, Z. Nwosu, J.R. Smith and D.A. Wallis.

Since November 1995 *Surveying World,* edited by Stephen Booth has been published in A4 colour with an average of 50 pages per issue. The Editorial Board began as R. Blow, A. Haugh, Z. Nwosu, J. Uren, D.A. Wallis. It is now M. Coulson, A. Gerrard, A. Haugh, R. Ledger, J. Maynard, Z. Nwosu, C. Robin, G. Simmons, M. Smith, J. Uren and D.A. Wallis.

Since the publication for Divisional matters is of considerable importance in maintaining touch with the widespread membership each of the above steps in the development will now be expanded upon. In the issue of *Chartered Surveyor* for July 1967 was introduced the first ever dedicated page per issue for Land Surveyors called "Land Survey Notes". The introductory note read:

"This page sees the inauguration of what should become a regular feature, aimed primarily at keeping the land surveyor informed of up-to-date trends in his sphere, but which should appeal to members from all sections of the, Institution.

"It is intended that the bulk of the items should be abstracts of technical articles from a wide range of English and foreign language survey publications covering such topics as new instruments, new techniques, avenues of research and other items of current interest to the land surveyor. Besides abstracts, it is also hoped to be able to include features such as a personalia of appointments, transfers and retirements of land surveyors in senior survey posts.

"Any members who have the good fortune to attend a survey conference, wherever it is throughout the world, are asked to send their impressions, together with fuller details of any points of particular interest. If a novel approach to a survey task whether it be cadastral site survey or geodetic levelling is being made, let the idea be passed round by sending in details.

"Obviously if this venture of trying to keep the chartered land surveyor, wherever he may be, up to date with current trends and happenings in the profession is to be a success then voluntary cooperation is needed from all members. If anyone is willing to become a corresponding member to the extent of sending in, periodically, details of any staff movements, out-of-the-ordinary survey tasks or items of significance in instrument design or survey practice, then please let us hear from you.

"News items can cover any subject from hydrographic and cadastral survey to geodetic topics; as it is the intention to try and cater for all interests. If this page is to succeed, your help is needed with news items, suggestions as to how the format may be improved, and ideas about the type of item likely to find acceptance. J. R. Smith."

October 1973 saw the introduction of the A4 *Chartered Surveyor LH & M Quarterly* although "*Land Survey Notes "* continued in the main journal. The Introduction to this new venture included a message from the Chairman of the Land Surveying Divisional Council:

"Welcome to the new Quarterly. Together with the Chairman of the Mineral Surveying Division and the Chairman of the Hydrographic Surveyors Committee, I welcome the appearance of this new technical and scientific supplement to *Chartered Surveyor.* The work of the mineral, land and hydrographic surveyors have much in common, Maplin Airport and the Channel Tunnel being examples of where our technologies overlap.

"Development of the earth's resources depends, in the first instance, almost exclusively upon our work. The need of our society for mineral resources, the need of the developing world for effective communications and the increasing dependence upon resources from the marine environment illustrate how the importance of our roles will grow in the foreseeable future.

"I am, however, becoming increasingly concerned that the vital nature of our work is not always appreciated and

how in many respects we are better respected within the other countries of the EEC than here in Britain. A 'brain drain' on to the mainland of Europe must be expected, unless the status of the chartered land, mineral or hydro- graphic surveyor is equated to that of the accountant, architect or engineer. It may well be that this is in part our own fault. Perhaps other professions do not find their work so interesting and so they have directed their energies to improving their status. So often we spend our time in discussions of technical academic interest, rather than in playing a professional role. Probably, this is why we are better respected in Europe, where our undoubted expertise, combined with a very real sense of purpose, has always been appreciated. J.R. Hollwey FRICS."

Spring 1979 saw a change in title and format to *Chartered Land Surveyor / Chartered Minerals Surveyor* (*CLS/CMS)* and the messages from the Presidents of the two Divisions were:

"ARE-BIRTH

"A birth - and perhaps more so a re-birth - is an exciting event to those affected. In whichever way our new quarterly is seen by members I welcome its appearance and welcome also on behalf of the Minerals Division our new edi- tor-in-chief, Michael Hanson. He has taken on no mean task but his efforts will be of little avail if material to publish is not forthcoming to enable him to develop this project along with our land surveyor friends with whom we happily share the publication.

"I am sure, from the branch divisional programmes I have seen over the years, and more recently from the divisional branch meetings I have been privileged to attend during my term of office, that there is sufficient material to maintain a steady stream of suitable papers for publication.

"I hope that these will be supplemented by articles specifically commissioned by branch committees and I am sure then that members will see their quarterly not only as interesting and useful current reading, but as a source of reference particularly important because of the dearth of books and other publications dealing with the division's professional interests.

"The quarterly's big brother *Chartered Surveyor* will continue to publish 'Mineral notes' and contain divisional articles of interest to the other divisions. There is now a fresh impetus for the division to pursue its involvement in the varied professional interests of the minerals extractive industries. I look forward to the development of this venture. Donald Baxendale President, Minerals Division.

"A NEW VENTURE

"Six years of the *Chartered Surveyor Land Hydrographic and Minerals Quarterly* sadly sit in the shelf in my study: an undistinguished looking collection of paper. Yet the contents represent the thoughts of some of the most forward looking members of our profession, and a record of much of our activities during that period be it the Shrivenham conference or an ordinary evening meeting at the Institution.

"Therefore I welcome the new *Chartered Land Survey or/Chartered Minerals Surveyor* with only a small (hydro- graphic) reservation about the title. The change in style and format has been brought about largely through the perspicacity of your technical services committee under its chairman, Jim Smith. It is a style and format designed to encourage readership and also to stand on your bookshelf and stay there. As such it is our hope, shared by the editor in chief, that it will gain wide readership outside the Institution and that articles for *CLAMS* on subjects of particular interest will be commissioned in addition to the reports familiar to us in the quarterly. Lt. Commander Jerry White, President, Land Surveyors Division."

October 1983 produced another change, this time to *Land and Minerals Surveying.* The Presidents of the two Divisions wrote:

"INTRODUCING LAMS

"It is our pleasant duty as Divisional Presidents to help to introduce the first monthly successor to *Chartered Land Surveyor/Chartered Minerals Surveyor* exactly ten years after the launch in October 1973 of a divisional supplement the *Land, Hydrographic and Minerals Quarterly* to the then monthly *Chartered Surveyor*.

"Since Jerry White and Donald Baxendale (then Divisional Presidents) welcomed the first Spring 1979 quarterly issue of the more stylish looking *Chartered Land Surveyor/Chartered Minerals Surveyor*, the Editorial Advisory Group have selected 67 papers as well as a wide range of articles of interest to our two small divisions. The 16 editions, in four volumes, indeed fulfilled our expectations.

"But the circulation of the quarterly remained pretty steady at 2,400 per issue and many contributions had to be held back due to lack of space. Also, being a quarterly - officially, at least - it could never keep the 2,000 or so members of the Land Surveyors and Minerals Divisions up- to-date with either divisional or institutional news. Nor could the monthly *Chartered Surveyor* always mention as much divisional news as either Division would have liked.

"The quarterly achieved a high standard of presentation of technical and professional papers; this will continue in the new monthly journal. In addition we aim to develop the newsletter aspect (familiar to land surveyors) with law reports, professional news and intelligence, and all other professional matters. We welcome the commitment from RICS Journals in appointing Michael Schwartz editor of the new monthly, and recruiting a strong advisory panel four members from each division.

"Any new venture commences with some reservations but we commend to you the new journal with confidence and trust that it will prove to be the leading professional journal for the land surveying and minerals surveying professions compulsory reading not just for chartered surveyors but for anyone operating in these fields.

"To be successful, we must all give our fullest support. With a large proportion of our readership across the country and overseas, few can attend meetings at Great George Street but we must all contribute material. Letters to the editor, news of recent experiences, new appointments, activities (social as well as professional) and ideas to improve our

understanding of the widening range of our divisional activities all are important if we are to improve our twoway communications with each other.

"Hopefully, not only will our monthly circulation increase but material from it will be selected by our Edi- torin-Chief for *CSW* so that the larger Divisions in the Institution will be kept abreast of our affairs and activities; we are, of course, first and foremost, chartered surveyors and as such, members of one Institution whatever our specialisation.

"Finally we ought to acknowledge the many hours of groundwork that have led to the launching of this publication, particularly those devoted by Lawrence Scott and Eric Levitt, our predecessors as Divisional Presidents. It was largely they who determined that our professional journal should give us better service. Rear Admiral David Haslam, President Land Surveyors Division. W.A.M. Jones, President Minerals Division."

The Editor in Chief wrote the following Leader:

"A NEW BENCHMARK

"Five years ago, members of the Land Surveyors and Minerals divisions of the Royal Institution of Chartered Surveyors, the world's largest professional organisation of surveyors, had only a 16-page quarterly supplement to their monthly journal, *Chartered Surveyor*, in which their more technical articles and reports were published. This flimsy document was all that was available for them to produce at national or international conferences.

"When I became Editor-in-Chief of the RICS journals in July 1978, this need to have a more substantial official journal for land, hydrographic and minerals surveyors was impressed upon me. So, when the first issue of the new quarterly *Chartered Land Surveyor/Chartered Minerals Surveyor* was published in the spring of 1979, it was unashamedly modelled on the well established *Survey Review* as being an acceptable format.

"There were certain obvious differences, however, not least the full-colour cover, designed to emphasise the fact that this was one of the new family of RICS journals, whose other members were the revamped *Chartered Surveyor* (still at that time a monthly) and the new monthly *Chartered Quantity Surveyor.*

"The new quarterly was originally going to be called *Chartered Land and Minerals Surveyor,* but this was nipped in the bud at the eleventh hour by someone's insistence that there was no such animal as a "chartered land and minerals surveyor". So, at the last moment, the title had to be changed to the cumbersome *Chartered Land Surveyor/Chartered Minerals Surveyor.* From the outset, however, most people associated with the journal referred to it as *CLAMS*, which was not only the acronym of the title originally intended but also sounded appropriately marine for hydrographic surveyors.

"Over the past four years, *CLAMS* has served a useful purpose in giving members of the Land Surveyors and Minerals divisions their own technical journal. However, they still had to rely on the monthly *Chartered Surveyor* for RICS news, general information and appointments advertisements.

"With the advent of *Chartered Surveyor Weekly* last October, it was clear that this was an expensive way of meeting the information needs of members of the two divisions. So the idea was bom of publishing *CLAMS* monthly instead of quarterly, and making it contain everything of interest to land, hydrographic and minerals surveyors.

"This time, however, it was courageously decided to opt for a simpler title, *Land & Minerals Surveying*, or *L&MS* for short, to convey that it is no longer just a journal for certain members of the RICS but one for all those professionally interested in land, hydrographic or minerals surveying.

"Here, between the covers of a single well designed and produced journal, is news of general and technical interest to all practitioners, as well as institutional news for all those who happen to be members of the RICS. Here, too, are law reports, personal announcements, readers' letters, book reviews, conference reports and coming events, as well as technical articles and reports. Finally, here are the advertisements, including those for professional vacancies.

"This new monthly journal has one important difference over its quarterly predecessor: its contents are topical and therefore meant to be read as soon as possible, rather than being put to one side for reading at a later date. Nowhere else in the world, as far as 1 know, is there a monthly professional journal for land or minerals surveyors. This is therefore a benchmark in surveying periodicals. Michael Hanson."

In 1990 an A4 colour version journal was introduced with the title *L&MS.* The Editor wrote:

"The entire surveying industry has undergone a massive upheaval in recent times and probably no areas more so than land, hydrographic and minerals surveying, where modem technology has transformed the whole profession.

***"Land and Minerals Surveying* was established as a journal some eleven years ago to reflect the interests, research and activities of chartered surveyors in the relevant divisions of the Royal Institution of Chartered Surveyors.**

"But, as the image of the profession is changing, so must the traditional approach of its journal.

"The first move was to make it look good enough to read and we believe that the new, standard A4 format will give us the scope for a considerably more attractive layout, permitting good-sized illustrations and full colour.

"Now to the content. We aim to take a balanced approach every month which will interest all practising land, hydro- graphic and minerals surveyors and those in other, allied, professions such as building and civil engineering, central and local government, financial and legal institutions, utilities and planning practices who use their professional skills. Hard news will take an important slot. International, parliamentary, financial, contracts, planning and environment and legal issues will be to the fore. There will be more feature length articles on surveying technology and practice management, quality assurance, case studies and profiles.

"Important academic research and special interest papers will not be missing, but the emphasis will be on providing a greater diversity of subjects to appeal to a wider, profes

sion related audience. From October we are adopting the journal's acronym as its official title so *L&MS* it is! Rita Virgo."

That year the Institution President was a Minerals surveyor and he wrote:

"A MESSAGE FROM THE RICS PRESIDENT

"Even though I qualified as a General Practice surveyor I can claim close, if second hand, connections with the worlds of land and minerals surveying. Speaking chronologically, 1 was bom, brought up and served my articles in the heart of the Welsh mining community in the valleys. Pits were an indelible part of the first 25 years of my life. Then, in the late 1950s, as a National Serviceman, I served for almost 18 months as a field survey instructor at the School of Military Survey at Newbury.

"So I can genuinely claim to understand how important these disciplines are to the people who practise them and are served by them. That is why I welcome the new land and minerals surveying journal as it is transformed into a truly professional publication for a truly professional readership. This note covers a miniature, 'dummy' issue of the new journal. I hope you enjoy the preview it gives and that it encourages you to support *L&MS*, as it is to be known, tangibly through your readership and your advertising.

"For my part I am looking forward to the 'real thing' when *L&MS* is relaunched in October and commend it most warmly to you. Sir Idris Pearce CBE TD DL FRICS."

After a period without a journal from September 1991 to October 1992, entrepreneurial efforts succeeded in persuading a Dutch firm, GITC bv, to publish a new journal as from November 1992 to be known as *Surveying World* or *SW* for short. The prime movers in getting it established commented:

"A NEW JOURNAL FOR THE SURVEYING WORLD

***"SW* will carry quality news and articles in every issue; the first of these features the AGI '92 conference, 24-26th November, ICC Birmingham, England." Mr Peter Gilbert, Editor-in-Chief.**

"SW will serve the surveying industry and its markets worldwide. I am pleased to have played a part in its creation." David Wallis, Chairman Pyser SGI and Associate of the RICS.

The Editor-in-Chief then continued:

"This is the first issue of *Surveying World*, a new business journal for the professional surveyor, wherever he or she works and on whatever type of project, whether on land or on the oceans of the globe or in space. *SW* will cover the topical interests of anyone working in or connected with the fields of geodetic, topographic, hydrographic, oceanographic surveying and land information management. *SW* will cover projects, personalities and techniques. It will provide news and views from around the world both from those who provide surveying services and from the all important consumers the industry's clients and employers. This new journal is edited and compiled by chartered surveyors in London, but will be reporting news and information from correspondents round the world. *SW* will be a journal which is both topical and technical with reports on contracts, business opportunities, equipment and employment with a strong focus on what the client needs.

"AN INDUSTRY TO CLIENT INTERFACE

***"SW* circulation will be directed primarily at the world's English speaking surveying industry and its market. *SW* will be the information media for the practising surveyor and carry both local and international news from key parts of the globe. It will keep the readership up-to-date with every aspect of surveying that is likely to be of interest. In particular it will reflect the work of the International Federation of Surveyors (FIG). The message from the editorial team is that we look forward to welcoming you - as a surveyor, client or employer in this sector - to an expanding regular readership and to our list of contributors. If *SW* fails to bring you useful and timely information to assist you in the development of your business and career, please ask yourself if you should be helping to make sure that it does and get in touch with the Editor.**

"A PARTNERSHIP

"Why launch a new journal at the depth of a worldwide recession, more particularly one which relates to construction, one of the industries most depressed by the worldwide fall in investment? The editorial team and the European publishing partners GITC bv see a need for serious professional reading alongside *SW*s sister magazine *GIM*. The initial readership will include all 2,000 chartered surveyors in the Land and Hydrographic Survey Division of the RICS and another 2,000 professional surveyors.

"Readers wishing to supply items for publication should send them to the Editor-in-Chief. Short items, from a paragraph to 1,500 words are ideal. Full papers should be no more than 3,000 words. In all cases colour illustrations preferred." Peter Gilbert, Editor-in-Chief.

APPENDIX B. CONFERENCES

A second prime information source was soon to follow with the introduction in 1968 of biennial conferences. Until 1968 the Division had no regular gathering for technical meetings except for evening OGMs at Great George Street. At the instigation of David Munsey and Jim Smith a conference was introduced at Easter 1968 at the Royal Military College of Science, Shrivenham. The fee for the period from Friday evening to Sunday early afternoon was £7.00. The conference was accompanied by an exhibition of equipment brought along by delegates. It has continued every two years since then (except in 1998, the year of the FIG Congress in Brighton) but at a variety of venues. The Universities of Oxford, Nottingham and Bath have been used, but most meetings have been at Nottingham. Thus the conference of 1999 represents thirty-one years of almost regular gatherings, 16 in all.

Attendances have been generally over the 80 mark and have, on occasions, topped 150. This out of a total membership for the Division of around 1,500 (of which often over half have been employed overseas) is a very good percentage. Now that the Division has taken on board the land

Hunting Surveys, Ltd, Boreham Wood.
Yateley, Surrey.
Messrs. J.A. Story & Partners, London
Ordnance Survey, Bristol.
Waltham Forest Technical College,
Walthamstow.
Planning Dept., Worcestershire County
Council, Worcester.

Bunnett, A.D.
Barrett, M.W.
Bell, J.F.
Bere, C.G.F.
Bibby, G. (Probationer
Brigham, J.G. (student)
Brogan, J.R.

Payne, J.S. (Student)

Plummer, B.F.

Prescott, Major F.J.D

Pringle, K.R.

Proctor, Major D.W.

Warren, D.E.	Directorate of Overseas Surveys, Tolworth.
Whitewell, J.L.C.	Precise Surveys, Ltd. Worcester.
Williams, Colonel F.P.J.	Ordnance Survey, Southampton.
Woodrow, Major E.C.	School of Military Survey, Newbury.
Wright, J.W.	Directorate of Overseas Surveys, Tolworth.
Wright J.W. (Student)	Gainsborough, Lincs.

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survey members of the former Society of Surveying Technicians, the figures should rise further.

During the same 30 years efforts were also made to mount a national, as opposed to a divisional, conference. As a result, a four yearly conference in the style of "Survey '81" came into being using Reading University as a venue. It was the idea of Dr Arthur Allan and Jim Smith, who organised the first one in 1981 in cooperation with various kindred societies. Several further ones were successfully promoted under various directors until problems caused it to be discontinued in the early 1990s. They were timed to take place mid-way between the four-yearly cycle of Commonwealth Survey Officers' Conferences at Cambridge and were particularly aimed at those who could not get entry to the CSOC because of limited space and of the specific aim of the CSOC to cater for Government Officers.

The United Kingdom has been involved with FIG since the federation was begun in Paris in 1878. Starting with delegates from seven national professional organisations there are now nearly 70 plus 20 corresponding organisations. The activities of FIG were, until recent years, very much land surveying oriented and London hosted the Congresses of 1934 and 1968. The most recent time that the RICS played host to FIG was in Brighton in 1998. Those who recall the 1968 gathering will remember the considerable input by members of the land surveying fraternity at all levels. The main sessions were held in Church House, Westminster together with events at 12 Great George Street, together with a major trade exhibition and social events in such locations as the London Guildhall. A Congress never to be forgotten.

APPENDIX C. MEMBERS OF THE DIVISION

Honours, titles, ranks etc. shown may be those obtaining at the dates of the archives used to extract information, rather than those which a member subsequently achieved. The author and editor offer apologies for unintended errors or omissions that will have occurred in compiling the information. All honours, titles, ranks etc. have been omitted in Table 11.

Table 3. Members prior to the 1948-49 arrangements

Diploma	Name	Joined	Location
3959	Boazman,	1902	Kampala, Uganda
5680	Grogan,	1909	Nairobi, Kenya
6050	Simpson,	1910	Leeds
6448	Hall, E.W.	1912	Middlesex
9034	Lees, E.C.L.	1922	Deputy Director Surveys, Entebbe, Uganda
9179	Burgess,	1923	Canterbury, Kent
9596	Story, J.A.	1925	Upminster, Essex
9648	Ashton,	1926	Survey of Kenya
10276	Seex, A.J.	1928	Chief Surveyor, Dar-es-Salaam, Tanganyika
10928	Miller, R.G	1930	Fareham, Hampshire
10934	Thornhill,	1931	Godaiming, Surrey
11039	Hart, Dr C.A.	1931	Vice Chancellor, Roorkee University, India
11429	Stevenson,J	1932	Director of Surveys &
			Freetown, Sierra Leone
1168	Busby, G.S. 1933		Director of Surveys,
1197	Ellis, A.G. 1934		Nairobi, Kenya
1227	Browne, Lt Col W.E. 1935		Anglo-Iranian Oil Co,
1391	Spurr, G.P. 1939		Valuation Officer,
1392 7	Smallfield, E J. 1939		Auckland, New Zealand

Table 4. Honorary members prior to the 1948-49 arrangements

Date	Name	Location
1918	Arden-Close, Col Sir C., KBE, CB, CMG, Hon ScD (Cantab.), FRS	Winchester
1935	MacLeod, Maj Gen	Southampton
1940	Edgell, Vice Admiral	Ministry of Transport, London
1948	de Graaff Hunter, Dr	Sussex
1948	Lenox-Conyngham, Sir G.P., MA, FRS	
1948	Sheppard, V.L.O.	Tunbridge Wells, Kent

Table 5. First members of the Division under the 1948-49

Diploma	Name	Location
15211	Brown, Maj Gen R.L1.	Director General Ordnance Survey,
15212	Cheetham, Maj	Surbiton, Surrey
15213	Hotine, Brig M.	Director Colonial Surveys,
15214	Williams Maj W.W.	Dept of Geography, Cambridge University
15967	Biddle, Lt Col C.A.	University College London
15968	Bonnet, Lt Col RH.	Malayan Establishment Office, Kuala Lumpur
15969	de Vic Carey, Col L.F.	Directorate of Military Survey, London
15970	Dowson, Lt Col A.H.	Chief Instructor, School of Military Survey,
15971	Gardiner, Lt Col R.A.	Divisional Officer, Ordnance Survey,
15972	Gibson, G.M.	Director, Lands & Mines, Dares Salaam, Tanganyika
15973	Harris, Lt Col L.J.	Asst Director of Survey, DMS, London
15974	Heaney, Brig G.F.	Surveyor General, Delhi,
15975	Humphries, Lt Col G.J.	Deputy Director, Colonial Surveys, Surbiton
15976	Isherwood, H.	Director of Surveys, Accra, Gold Coast
15977	Jenney, Lt Col	Ordnance Survey,
15978	Mace, C.	Director, Land Registration & Survey
15979	Morley, A.J.	Deputy Director Surveys, Lagos, Nigeria
15980	Noble, Lt Col C.	Deputy Surveyor General, Kuala Lumpur, Malaya
15981	Phillips, WJ.	Cambridge
15982	Quinton, Maj. F.J.	Director of Surveys, Kingston, Jamaica
15983	Sanceau, Brig V.E.	Director of Survey, MELF

15984	Stamers Smith, H.A.	Director of Surveys,
15985	Stephenson, A.	Imperial College, London
15986	Tavener, F.E.	Director of Surveys,
15987	Wakefield, R.C.	Director of Surveys, Khartoum, Sudan
15988	Wheeler, Brig R.P.	Director Field Survey, Ordnance Survey,
15989	Wiggins, W.D.C.	Deputy Director, Colonial Surveys, Surbiton
15990	Willis, Brig J.C.T.	Director, Military Survey,
15991	Blanchflower, Lt	Assistant Director Surveys,
15992	Botha, Maj E. du R.	Ordnance Survey,
15993	Clayton, Col RA.	Deputy Director, Hirings & Disposals, MELF, Egypt
15994	Elliott, G.A.	Director of Surveys, British Honduras
15995	Mitchell, A.P.	Director of Surveys, Lagos,
15996	Petty, C.R.	Director of Surveys, Accra, Gold Coast
15997	Rothery, E.A.	Senior Surveyor, Lagos,
15998	Wilson, I.F.	Wilson, I.F.

Table 6. First members of the Division under the 1948-49 arrangements (Colonial Fellows)

Diplom	Name	Location
15999	Johnston, F.M.	Commonwealth Surveyor General, Australia
16000	McArthur-Davis, B.A.	Director of Surveys, Zomba, Nyasaland
16001	Mankin, J.H.	Senior Surveyor, Entebbe,

Table 7. First members of the Division under the 1948-49 arrange-

Diplom	Name	Location
15949	Ratzeburg, F.H.	Survey of Kenya, Nairobi,
16002	Ainsworth, H.	Lecturer, Imperial
16003	Ballantyne, A.M.	Surveying and Photogrammetry,
16004	Barnett, C.O.	Singapore Improvement
16005	Barron, C.S.	Crown Lands, Hong Kong
16006	Bentley, J.A.	Jos, Nigeria
16007	De Silva, H.B.	Ceylon Technical College, Colombo, Ceylon
16008	Gandy, Cdr G.H., RN (Retd)	Asst Superintendent Surveys,
16009	Holman, Capt R.D.W.	Ordnance Survey, Kensington, London
16010	Hughes, R.H.	Crown Lands & Survey Office, Hong Kong
16011	Johns, Maj W.H.	Deputy Assistant Director, DMS, London
16012	Loxton, J.	Superintendent of Surveys, Nairobi, Kenya
16013	Metcalfe, D.S.	Survey Department,
16014	Miskin, E.A.	Surveying & Photogrammetry,
16015	Pratley, A.C.	Senior Surveying Assisstant, Croydon
16016	Ramsey-Sqn Ldr E.J.	Office of The Surveyor Australia
16017	Rawlence, Maj	Ordnance Survey,
16018	Rusk, A.J.	Survey of Kenya,
16019	Sacks, R.	Superintendent Survey Training, Port-of-Spain,
16020	Skuse, T.W.	Superintendent of Training, Freetown,
16021	Smith, W.P.	Senior Surveyor, Colonial Surveys,
16022	Thompson, Maj	Ordnance Survey,
16023	Thompson, J.A.J.	Lands & Mines Department, Dar-es-
16024	Whittaker, B.B.	Dept of Lands & Mines, Nairobi, Kenya

Of the members whose names are given in Tables 3-7, the following are known, or thought to be, members today (January 1999): L.J. Harris, R.H. Hughes, J. Loxton, D.S. Metcalfe, W.P. Smith, C.J.P. Thompson and B.B. Whittaker. Others could be surviving, but no longer members and therefore difficult to trace. Names of the first six Honorary Members are given above in Table 4, but over the last fifty years many more notable surveyors have become Honorary Members. Amongst them are the following (British unless indicated otherwise).

Table 8. Some Honorary

Date	*Members* Name
1947-51	Sir Charles Arden-Close
1947-50	Sir Ernest Macleod Dowson
1947-62	Vice Admiral Sir J.A. Edgell
1947-68	Major General Malcolm Neynoe
1949-65	James Clendinning
1949-66	Dr J. de Graaff Hunter
1949-53	Sir Gerald Ponsonby Lenox-
1949-63	Vivian Lee Osborne Sheppard
1955-62	Major General G. Cheetham
1961-88	Prof R. Roelofs, The
1961-66	Russell Gladstone Dick, New
1968-	Prof Ir W. Baarda, The
1968-96	Brigadier G. Bomford
1974-	Prof Dr Ir Gerhard Eichom,
1976-	Prof Dr Ir Heinz Draheim,
1977-	William A. Radlinski, USA
1981-	Carl-Olaf Temryd, Sweden
1984-	Prof Dr H.J. Matthias,
1991-	Howard William Hunter, New
1992-	J. Talvitie, Finland
1997-	Grahame K. Lindsey, Australia
1999-	Rear Admiral John Clarke
1999-	Dr Geoffrey Robinson
1999-	Brigadier Philip Wildman

Table 9. Chairmen/Presidents of Divisional

Council Years		Chairman/President	
	Years	Chairman/President	
1946-	47	Trumper,	R.W.

Counc	member	Period(s) served	Total years
1948-	Cheetham, Maj	1988-89	Burnside, C.D.
1951-	Brown, Maj Gen	1989-90	Dale, Professor PF.
1953-	Bomford, Brig	1990-91	Leonard, J.P.
1961-	Dowson Sir E.	1991-92	Broome, D.
1964-	Rogers, Col	1992-93	Logan, I.T.
1967-	Smith, W.P.	1993-94	Waters, R.S.
1969-	Edge, Maj Gen	1994-95	Hill, D.A.
1972-	Hollwey, J.R.	1995-96	Wylde, R.J.
1975-	Wright, J.W.	1996-97	Coulson, M.G.
1977-	White,	1997-98	Maynard, J.
1979-	Bell, J.F.	1998-99	Shipman, Lt Cdr S.
1981-	Scott, L.	1999-00	Cooper, Professor
1983-	Haslam, Rear Admiral		

Table 10L Honorary Secretaries of Divisional Council

Years	Honorary	Years	Honorary Secretary
1944-	Calder Wood, J.	1980-83	Waters, R.S.
1948-	Hart, Professor	1983-84	Wright, J.W.
1950-	Stephenson, A.	1984-87	Cole, G.E.D.
1964-	Allan, DrA.L.	1987-91	Robin, Claire
1968-	Smith, J.R.	Since 1991	Cridland, P.

Council member	Period(s) served	Total years
Allan, A.L.	62-68; 76-8	13
Anderson, M.F.	80-81	1
Atkinson, N.	88-93	5
Ashkenazi, V.	82-90	8
Bancroft, A.D.	66-92	26
Barber, P.	95-98	3
Barrett, M.M.	83-89	6
Beels, R.E.	74-76	2
Bell, J.F.	70-82; 83-84	13
Biddle, C.A.	62-66	4
Black. A.K.	90-93	3
Booking, T.G.	46-47	1
Bomford, G.	52-62	10
Boulnois, P.K.	46-48	2
Bowden, W.D.	55-59	4
Bower, G.E.	69-70	1
Bradley, E.M.	84-86	2
Brechin, J.L.	89-91	2
Bressey, C.	46-47	1
Brogan, J.R.	76-81	5
Broome, D.	88-92; 93-94	5
Brown, R.deF.	95-96	1
Brown, R.L1.	47-53; 54-80	32
Browne, W.E.	50-51	1
Brownett, P.J.	97-98	1
Browning, D.I.	60-62; 64-71	9
Buchanan, H.	92-96	4
Burgess, R.C.	52-54	2
Burnett, D.I.	56-60	4
Burnside, C.D.	67-70; 80-92	15
Busby, G.S.	51-521	
Calder Wood, J.	46-48	2
Calvert, C.	96-97	1
Carey, L.F.deVic	49-52; 53-55	5
Carmody, P.J.	70-80	10
Cartwright, R.T.	80-81; 82-83	2
Chase, S.P	90-92; 93-96	5
Cheetham, G.	46-62	16
Cheshire, P.J.E.	87-88	1
Clendinning, J.	47-66	19
Cobb, M.H.	51-52	1
Cole, G.E.D.	74-87; 88-93	18
Cole, H.C.	46-47	1
Collins, M.O.	54-57	3
Cooper, M.A.R.	90-94; 97-98	5
Coote, A.M.	87-92	5
Coulson, M.G.	90-98	8
Craven, R.	94-97	3
Cridland, P.D.	90-98	8
Cross, P.A.	81-84; 85-88	6
Cumming, F.	87-89	2
Curley, R.A.	88-93	5
Curtis, M.J.	95-98	3
Dale, P.F.	86-92	6
Damant, D.	96-98	2
Day, A.	51-55	4
Dowman, I.J.	72-75;78-83;84-92	13
Dowson, A.H.	52-53; 55-67	13
Dowson, E.	48-50; 53-64	2
Durant, M.L.	88-90	4
Edge, P.	94-98	12
Edge, R.C.A.	62-74	4
Edwards, S.	93-97	2
Ekblom, R.	94-96	8
Ellis, P.	72-80	3
Fagan, P.F.	88-91	2
Farmer, T.W.G.	77-79	1
Farnsworth,	46-47	2
Fisher, J.P.	89-91	1
Fox, C.H.	46-47	1
Gardiner, R.A.	51-52	11
Gibbons, C.W.	63-74	2
Gibbons, R.A.	75-78	2 1
Gilbert, E.V.	89-91	10
Giles, A.R.	64-65	4
Gilmour, R.E.	51-61	2
Gimson, M.	46-50	2
Gordon, K.I.	80-82	3
Green, P.	96-98	6
Greenland, A.J.	91-92; 93-95	1 2
Gwaspari, H.C.	90-97	7
Hall, E.W.	46-47	8 1
Hall, K.	96-98	2 6
Hamilton, A.D.	55-63	3
Harland, L.H.	73-81	
Harley, I.A.	87-88	
Harris, D.	85-87	
Harris, L.J.	60-66	
Harrison, W.	59-62	

Council member	Period(s) served	Total years
Hart, C.A.	46-50; 53-54	5
Haskins, G.L.	88-90	2
Haslam, D.W.	76-87	11
Haugh, A.	63-68; 74-90	21
Hennessey,	S.J. 56-62	6
Hill, D.A.	92-98	6
Hollwey, J.R.	61-62; 66-78	13
Holmes, A .J.	88-89	1
Hotine, M.	46-54	8
Humphries, G.J.	49-53	4
Hunter,	48-62	14
Innes-Wilson,	54-55	1
Irving, E.G.	61-64	3
Irwin, B.St.G.	51-54; 66-77	14
Jenney, R.C.N.	52-54	2
Jones, A.	52-56	4
Jones, G.E.	91-98	7
Karalus, B.J.S.	85-90	5
Keiller, C.R.D.	87-90	4
Kelley, A.B.	97-98	1
Kelsey, J.	66-85	19
Kenney, RH.	57-66	9
Kennie, T.J.M.	87-88; 89-93	5
King, G.B.	55-56	1
Klein, A.J.	84-85	1
Lamoury, L.J.	95-97	2
Lamer, A.	93-97	4
Law, J.	96-98	2
Leatherdale, J.D.	69-72; 91-94	6
Lee, S.G.	46-48	2
Lenox-	46-52	6
Leon, T.M.	79-80;84-86;87-91;	13
Leonard, J.P.	89-92	3
Leppard, N.A.G.	78-88	10
Lilley, D.	95-96	1
Lindsey, H.G.A.	67-68;70-74	5
Logan, I.T.	83-85; 86-98	14
Longdin, W.S.	67-89	22
Lott, R.	82-84	2
Macdonald, A. .S	74-76; 81-83	4
Macleod, M.N.	46-53	7
MacMillan,	52-61	9
Malby, E.A.	46-49	3
Mason, S.H.	83-84	1
Maynard, J.	95-98	3
McMaster, P.	85-89	4
Millen, K.	90-91	2
Miskin, E.A.	52-62	10
Mitchell, A.P.	53-54	1
Morgan, R.S.	86-87	1
Morris, R.O.	84-87	3
Mott, P.G.	54-74	20
Mould, C.M.	89-90; 92-98	7
Munsey, D.T.F.	58-70	12
Murray, A.H.	81-82	1
Murray, I.C.	89-90	1
Myers, J.A.L.	91-95	4
Newman, J.D.	51-57	6
Newton, I.	97-98	1
Noble, C.	58-63	5
Norton, P.J.	90-91	1
Owen, R.M.	89-92; 95-96	4
Peter, A.L.	83-85	2
Phillips, M.	88-94	6
Pilditch, A.	93-98	5
Ping. B.J.R.	77-79	2
Powell, D.	96-98	2
Prain, A.A.	51-55	4
Prain, J.	96-98	2
Proctor, D.W.	72-81; 91-92	10
Raffle, J.A.	91-92	1
Rainsford, H.F.	53-63	10
Ridge, M.	78-79	1
Ritchie, G.S.	67-72	5
Robbins, A.R.	57-67	10
Roberts, A.J.	90-91	1
Roberts, W.J.M.	69-89	20
Robin, C.	85-91	6
Robinson, A.	96-97	1
Robinson, J.	91-92	1
Rogers, R.T.L.	55-71	16
Rush worth,	76-79	3
Russell, I.C.	85-89; 91-96	9
Scott, L.	72-73; 74-89	16
Seymour, W.A.	68-70	2
Sharpe, H.E.	46-50	4
Sheppard, J.S.	65-67	2
Sheppard,	48-56; 57-63	14
Shepherd,	47-49	2
Shepherd, J.	92-94	2
Sherwood, P.C.	70-84	4
Shipman, S.	94-98	4
Silberrad, R.M.	81-83	2
Simmons, G.	96-98	2
Simpson, C.	46-56	10
Sissons, R.J.	52-61	9
Smith, J.R.	67-96	29
Smith, K.W.	89-90	1
Smith, P.	95-96	1
Smith, W.P.	62-71 ;72-75;78-88	22
Sowton, M.S.	95-98	3
Stannard, J.	94-97	3
Stephenson, A.	47-68	21
Stirling, R.M.	91-97	6
Story, J.A.	47-56	9
Sweeting, E.K.G.	54-58;59-66	11
Tavener, F.E.	55-62	7
Taylor, P.J.	79-84	5
Taylor, W.R.T.	52-58	6
Thompson, E.H.	51-58	7
Thornhill, G.K.	48-54	6
Thunhurst, A.S.	95-96	1
Trumper, R.W.	46-47; 48-50	3
Wallis, D.A.	90-94	4

Council member	Period(s) served	Total years
Walmesley-White,	70-72	2
Ward, S.M.	91-92	1
Warden, P.J.H.	75-78	3
Wames, R.R.	64-66	2
Warr, G.W.	46-47	1
Warren, D.E.	66-72	6
Waters, R.S.	78-85; 89-95	13
Weightman, J.A.	79-86;89-90;92-98	14
Welsh, T.W.	72-73	1
Wheeler, R.P.	49-52	3
White, J.C.E.	72-82	10
Wiggins, W.D.C.	49-53	4
Wild, A. A.	82-85; 86-87	4
Williams, W.W.	47-54	7
Willis, J.C.T.	49-55	6
Wilson, I.F.	51-52	1
Wood, R.	79-81	2
Wright, J.W.	62-88	26
Wylde, R.J.	91-98	7

Table 12. Years of service on Divisional Council (223 members have served)

Years	Names
32	Maj Gen R.L1. Brown
29	J.R. Smith
26	A.D. Bancroft, J.W. Wright
22	W.S. Longdin, W.R Smith
21	A. Haugh, A. Stephenson
20	P.G. Mott, Lt Cdr W.J.M. Roberts
19	J. Clendinning, Maj Gen J. Kelsey
18	G.E.D. Cole
16	Maj Gen G. Cheetham, Profesor I.J. Dowman, Col R.T.L. Rogers, L.
Scott 15	C.D. Burnside
14	Dr J. de Graaff Hunter, Maj Gen B.St.G. Irwin, I.T. Logan, V.L.O. Sheppard, Lt Col P.C. Sherwood, J.A.Weightman
13	Dr A.L. Allan, J.F. Bell, Sir E. Dowson, Maj Gen A.H. Dowson, J.R. Hollwey, T.M. Leon, R.S. Waters
12	Maj Gen R.C.A. Edge, D.T.F. Munsey
11	C. W. Gibbons, Rear Admiral D. W. Haslam, E.K.G.Sweeting
10	Brig G. Bomford, Lt Col P.J. Carmody, R.E. Gilmour, N.A.G. Leppard, E.A. Miskin, D.W. Proctor, H.F. Rainsford, Dr A.R. Robbins, C. Simpson, Lt Cdr J.C.E. White
9	6 members
8	7 members
7	7 members
6	16 members
5	16 members
4	21 members
3	20 members

DIRECTORS GENERAL OF ORDNANCE SURVEY: Maj Gen R.L1. Brown, Maj Gen L.F. de Vic Carey, Maj Gen G. Cheetham, Maj Gen A.H. Dowson, Maj Gen R.C.A. Edge, Maj Gen B.St.G. Irwin, Maj Gen M.N. MacLeod, R McMaster, W.R Smith and Maj Gen J.C.T.Willis.

DIRECTORS OF MILITARY SURVEY:

Brig M. Hotine, Brig L.J. Harris, Maj Gen B.St.G. Irwin, Brig J. Kelsey, Brig WalmesleyWhite and Maj Gen R. Wood.

HYDROGRAPHERS OF THE NAVY:

Rear Admiral A. Day, Rear Admiral Sir D. Haslam, Rear Admiral E.G. Irving, Capt. R.O. Morris, Rear Admiral J.A.L. Myers, RearAdmiral G.S. Ritchie.

FOUNDERS OF SURVEY COMPANIES:

J.A. Story, W.S. Longdin and R. Craven.

PROFESSORS:

V. Ashkenazi, M.A.R. Cooper, P.A. Cross, P.F. Dale, I.J. Dowman, I.A. Harley, C.A. Hart and E.H. Thompson.

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