CADASTRAL SURVEY IN KENYA
AND ITS ROLE IN THE
DEVELOPMENT OF THE COUNTRY

by

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Degree of Master of Science in the University
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This thesis is my original work and has not been presented for a degree in any other University.

Signed ........................................

Candidate

This thesis has been submitted for examination with my approval as University supervisor.

Signed ........................................

28/10/77
Prof. R.S. Rostom

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The thesis investigates the role of cadastral survey in the orderly development and secure ownership of land. The evolution of land laws in Kenya and the ways in which they have regulated the process of cadastral survey are discussed in the context of the historical development of the country since the closing years of the last century.

The unification of the land laws into a single system of registration for the whole country is considered against the background of the three main classifications of land and the different standards of survey that have supported the cadastral system.

The thesis shows how expedients adopted to effect economies and produce quick results in one generation, have led to problems and additional expense for the next.

The role of photogrammetry in mapping over half a million smallholdings to register titles in the Trust Lands is discussed, as is the use of enlarged airphotographs in place of maps.

The progress of the change from communal tenure to individual private ownership of land is presented, and the problems still to be resolved are outlined.
CHAPTER I

CADASTRAL SURVEY AND THE CREATION OF BOUNDARIES

Cadastral survey is the defining of property boundaries; both the creating of boundaries, and the defining of boundaries that already exist.

In creating boundaries two meanings of the verb "to define" apply: first "to mark the limits or outline clearly" and secondly "to describe accurately." Where boundaries already exist the marking of the limits has already been done, and the accurate description is the task of the cadastral surveyor.

There are in essence two kinds of boundaries; the first in which continuous visible physical features on the ground show the dividing line between one portion of land and the adjoining portion, and the second in which landmarks are established and the boundary is deemed to be the straight line running from one landmark to the next, the boundary line itself not necessarily being marked on the ground. The landmarks may be natural features adopted, or artificial marks erected for the purpose.
Both types of boundary are effective means of marking the limits of portions, and each is appropriate to different situations. Where natural features do not exist or are insufficient to mark the boundary, and the creation of physical features is difficult or impossible for any reason, resort to landmarks is the obvious process. For example, the soil, or climate, or the presence of termites may make impracticable the growing of hedges such as provide so many boundaries in Europe. The size of holdings and the cost may make fencing uneconomic, or the prevailing agricultural method may render such boundary features unpractical, as in the flooded riparian lands along the Nile or the Euphrates. In these circumstances the landmark, often a monument of stone, a pillar of mud, or an iron peg set in concrete, offers the logical alternative.

Both physical boundaries marked throughout their length, and landmarked boundaries with only cornerpoints marked, can fulfil equally well the function of defining a portion of land within the first meaning of definition quoted above, just so long as the features or landmarks continue to exist.
The struggle to safeguard landmarks has a written history going back to the dawn of civilization itself. Reference to landmarks have been found on clay tablets recovered in archaeological excavations of the Sumerian city Ur of the Chaldees dating from about 3000 BC; Egyptian papyruses record a court case in which landmarks have been moved, and the Bible makes several references to landmarks and the offence of moving or destroying them. For example, among the Curses from Ebal in the Old Testament Book of Deuteronomy, chapter 27 verse 17 reads "cursed be he that moveth his neighbours landmark", and this same curse comes third in the awful order of Commination in the Anglican Book of Common Prayer when at the beginning of Lent evil-doers are denounced from the pulpit and threatened with the wrath of God.

The Laws of Kenya put it more prosaically in Section 29 of the Survey Act

Any person, not being duly authorised to do so, who takes away, is found in the possession of, removes, destroys or wilfully defaces, mutilates, obliterates or breaks any survey mark, shall be guilty of an offence and liable (a) if such act was
done with intent to defraud, to imprisonment for a term not exceeding three years: or (b) in any other case, to a fine not exceeding three thousand shillings or to imprisonment for a term not exceeding six months, or to both ...

The style may change; the meaning and intention are clear. They serve to highlight the mending problem of the creator of boundaries, which is to safeguard his defining features over the passage of years.

There are several approaches to this problem. The first is to adopt as boundaries only those features whose size or type are such that they cannot be destroyed. Such natural features are rare, and seldom exist in sufficient quantities to define any except the largest portions. A second approach is to construct such durable or solid features that they cannot be totally destroyed, for example, to build a stone wall round an estate. This can be done, but is clearly not the answer to all boundary problems. A third approach is to erect less massive and costly features but to make regular inspections of them and maintain them so that they do not become lost or destroyed. This
also can be done, and is the commonest method of
all. For many centuries no other method was used,
and today it is still the method employed in
large areas of the world.

The keys to success in this system of
safeguarding boundaries are maintenance, and
continuity of knowledge of their position.

The location of boundaries used to be
kept fresh in the minds of land owners and the
whole community by public ceremonies at regular
intervals. This is the purpose of such rites
as "beating the bounds", when a procession of
parish officers accompanied by choir boys from
the parish church armed with long canes, walked
round the parish boundary, and as the clerk
pointed it out the choir boys actually belabour­
ed the boundary with their canes, and so
impressed its position on the minds of everybody.

Similarly individual property boundaries
are still kept fresh in landowners' minds and
maintained in good repair by such established
events as Wall Days, when at the beginning of the
farming year a Cumbrian farmer will meet his
neighbour at their common boundary and together
they walk the dry stone wall, mending gaps and
rebuilding and recapping fallen sections as they
Well maintained boundaries and regular confirmation of their position are the surest protection against encroachment, trespass and dispute, and are at the heart of such country expressions as "good fences make good neighbours."

A similar process of maintenance and vigilance will serve also to protect a boundary system based on landmarks instead of continuous physical boundary features.

If then, such boundaries or landmarks can effectively define properties, and these boundaries can be perpetuated by maintenance and familiarity what need is there for a cadastral survey?

The answer is twofold: first a boundary system must exist before it can be protected, and to set out or create boundaries is one of the roles of the cadastral surveyor, and secondly such a state of idyllic simplicity requiring only personal contact with the ground by owner-occupiers is overtaken by the development of the society, and all States sooner or later find it necessary to compile a written record of ownership and other rights over land. To maintain a depend-
able record "the units of land to which entries relate must be defined so that they can be located readily, surely and unambiguously at any time on the ground", (Dowson, 1952), and this definition and relocation are further functions of the cadastral surveyor.

It should be noted that "at any time" in the quotation above must include a time when the boundary marks are no longer there, but for some reason - neglect, flood, destruction whether malicious or accidental, casual vandalism or any other reason- the defining features have disappeared and cannot be found.

The best form of description of land is undoubtedly a survey plan, on which the boundaries are depicted in correct relationship to each other and to the boundaries of adjoining properties. Physical boundaries defining properties which are irregular in shape are best depicted by a topographical plan at a scale sufficiently large to display all significant changes in direction, supported by a description of the type of feature or that part of it that forms the actual boundary line. For instance a river boundary might be annotated "boundary in the centre-line of river" or "boundary is 30 metres from the river
The scale of plotting must be large enough to plot the feature to an accuracy that will allow the position to be redetermined should it become lost, and to permit distances to be scaled from the plan for that purpose. The survey must be conducted to an accuracy to match the scale of plotting, or to an accuracy marginally better than plottable to ensure that no accumulations of small tolerances become plottable. The specification of plotting scale required would vary with the type of boundary feature, the size of plots, and the value of the land, from say 1/500 to 1/2500 which with a generous draughting tolerance of ± 0.5 mm would permit ground distances of approximately 25 cm and 125 cm to be shown, and would be suitable for urban and small rural properties.

From the plan areas can be obtained by scaling and computing or by planimeter. If other topographical detail such as buildings or roads, is also surveyed and plotted, sufficient points of reference will be available to relocate on the ground any boundary that might be destroyed, by setting out on the site dimensions scaled from the plan.
However, if the boundaries are of the landmark type where only corner points are marked the mathematical relationship between corners can be established by survey in the form of lengths and bearings or angles, or by a system of rectangular coordinates related to some suitable origin of axes. In this case the dimensions and areas can be determined mathematically and not necessarily by scaling from a plotted plan, and the limit of accuracy is that attainable in the ground measurements.

The absence of physical features between corner points is no bar to the accurate description of the property boundaries, and except for the convenience of the landowner there is no necessity for the boundary line to be measured directly, or even for corner points to be intervisible.

In a land devoid of features suitable to be adopted as boundaries, the second system is a much quicker and easier means of setting out properties than the physical boundaries method.

For either system to constitute an accurate description of land it is essential that the individual properties should be correctly related to each other and that the surveys should fit together and not conflict.
But if isolated properties scattered about the country are surveyed individually the probability of the pieces fitting accurately together when plotted on a general map is small unless extremely high standards of survey are adopted. Otherwise at the junctions of surveys apparent gaps or overlaps would occur due to the accumulations of small tolerances, leading to the sort of marginal annotation to explain away such discrepancy which is alleged to have appeared on a compilation of individual farm surveys "the area between the dotted lines does not exist" (War Office, 1965)

The proper method to prevent this accumulation of errors, each of which might be acceptable on its own, is to follow the precept of working "from the whole to the part", that is first to establish a framework enclosing all the surveys required, and then to conduct the individual surveys by reference to the framework, adjusting them to fit within the accurate frame.

The framework to control surveys is established by triangulation, trilateration, traverse, or one of the methods of determining positions on the surface of the earth, by astronomical observations or by measurements to artificial satellites. The
surveys within the frame can then be carried out by less costly and elaborate methods.

If the framework is sound, and the network of fixed points is broken down from primary to secondary, tertiary and minor control, with steadily decreasing distances between points, the amount of survey work required to set out a new property, divide an existing one, or re-locate a boundary that has become lost will be progressively less, and the certainty with which a position can be established becomes greater and greater. Since it would seem that the wit of man has been unable to devise a landmark or beacon that is immune to malicious vandalism or equally destructive simple curiosity, and that neither curses nor legal sanctions have fully succeeded in safeguarding boundaries, the alternative approach of having a large number of fixed points of which a proportion can be expected to survive, and from which the others can be (re-fixed), offers the best possibility of satisfying the fundamental requirement of the dependable record already quoted, that "the units of land ... can be located ... unambiguously at any time on the ground."
With a sound cadastral survey (whether of topographical features or landmarks) to known tolerances with a good supporting system of records and qualified men of integrity conducting the surveys, the re-establishment or re-location of boundaries is removed from the lottery of the law courts, dependent on the skill of advocacy and on that sometimes marketable commodity evidence, and replaced by impersonal, verifiable applied mathematics.

Only in the case of bad survey and inaccurate maps, where unresolvable ambiguities and inconsistencies exist so that the position of a boundary depends upon which parts of the inconsistent data are used as the basis of determination, should it be necessary to resort to a court of law to hear and weigh the evidence and opinions, and make a judgement on where the boundary is most likely to have been.

The decision on how boundaries are to be defined should balance the costs of establishment and relocation, against the likelihood and costs of loss and dispute, in the circumstances existing in the country under consideration. Bearing in mind that conditions change as development occurs, and the conclusion on the appropriate method reached three-quarters of a century ago may not be valid today.
Having considered the general case of boundaries and cadastral survey, the particular solutions adopted in Kenya and the role of cadastral survey in these solutions may now be investigated.
CHAPTER II
EVOLUTION OF THE BOUNDARIES OF KENYA

The cadastral history of Kenya begins at the coast where successive waves of colonisers landed and settled, and follows the opening up of what was always referred to in explorers' accounts as "Darkest Africa." To understand the origins of the various land laws and the areas in which they are applied it will be of assistance, and interest, first to look briefly at the origins of the country of Kenya and the evolution of its boundaries.

The modern state of Kenya in its present borders is a 20th Century invention, the name itself having been officially adopted only in 1920, and even today not all its boundaries have been permanently marked on the ground.

For many centuries before the division of East Africa into countries, Arabs from the ports of the Red Sea and the shores of Arabia, and particularly from Oman and the Persian Gulf had established themselves on the East African coast, building flourishing cities and communities such as Lamu, Malindi, Mombasa and Zanzibar. Each community was under a Sultan, and latterly most of them gave allegiance of
Zanzibar in 1832 many countries saw the possibilities of trade and commerce in East Africa through Zanzibar, and followed Great Britain in establishing treaty relations with the Sultan.

The United States of America set up a Consulate in 1836, and treaties with France, Italy and Portugal followed until, in 1885, Germany the last of the main contenders for influence in East Africa signed a commercial treaty with the Sultan.

These events in East Africa were part of the general movement for the exploitation of the resources of Africa by the industrial Powers of Europe which took place during the second half of the 19th century. The accelerating pace of exploration and discovery and the establishment of trading posts and missions by so many countries in the scramble for African concessions, protectorates and colonies would inevitably lead to conflicts between rival claimants, so at a conference in Berlin in 1884-5 an attempt was made by the European Powers to regulate their claims by negotiation between the contenders.

From the Berlin Conference came the Act of Berlin which covered many aspects of the division of Africa, from agreement to abolish the slave trade to territorial claims over a vast area stretching from
one sort or another to the Sultan of Zanzibar and Oman, who claimed sovereignty of the coast from the northern borders of Mozambique almost to the Horn of Africa, and of the hinterland as far as the "Great Lakes", that is Lake Victoria and Lake Tanganyika, but excluding the ancient Kingdom of Abyssinia.

This claim to the hinterland was not supported by permanent occupation nor by any formal administration, and only in the coastal area was there any machinery of government and an intermittent acceptance of the sovereignty of the Sultan and recognition of his right to rule and make grants of land to his subjects.

Inland, beyond the de facto administration of the Sultan, the land was occupied on a family, community or tribal basis, at varying stages of evolution, culminating in the west with the Kingdoms of Uganda at a relatively advanced stage of formal development.

Thus, at the beginning of the nineteenth century, the Sultanate of Oman and Zanzibar represented the only organised State in East Africa which was in regular communication with other states and governments beyond the African continent, and when the Arab Sultan, Seyyid Seid, moved the capital of his dominions permanently from Muscat in Oman to
the Sahara in the north to the southern borders of modern Angola and Mozambique, and from the Atlantic to the Indian Ocean. Where territorial claims were not supported by evidence of occupation or settlement, the signatories recognised the establishment of "spheres of influence" in which the priority of claimants' future interests were agreed between the claimants themselves.

In the following year, 1886, Great Britain and Germany signed an Agreement to define the limits of their adjoining spheres of influence in East Africa, and also to define the limits of the sovereignty of the Sultan of Zanzibar.

The Sultan's sovereignty over the islands of Mafia, Zanzibar, Pemba and the Lamu Archipelago was recognised, but his claim to the hinterland was conceded only for a distance of ten nautical miles inland from the high water mark, a considerable reduction from the many hundreds of miles to the Great Lakes. This narrow strip stretched from the Ruvuma River (the Mozambique border) in the south to Kipini at the mouth of the Tana River in the north. The coast between Kipini and Manda Bay opposite Lamu was recognised as the Sultanate of Witu, which was at that time in revolt against Zanzibar. Beyond Lamu the coastal ports of Kismayu, Brava, Merka, Mogadiscio, Warsheik and Mruti were accepted as parts of the Sultan
of Zanzibar's dominions. Oman was no longer included, having been formally confirmed as a separate state in 1861.

The dividing line between the German and British spheres of influence followed closely the present border between Kenya and Tanzania starting from the Umbe River mouth, skirting to the north of Kilimanjaro and thence to the intersection of latitude 1° South with the eastern shore of Lake Victoria, but west of Lake Victoria and north of the Tana River the line was left undecided.

Within their spheres of influence both countries regarded themselves as free to operate, negotiating treaties, trading concessions and land purchases with whatever authorities they found locally.

By 1872 the British India Steam Navigation Company had established a regular mail steamer service linking Zanzibar, India and Europe via the new Suez Canal, thus beginning the long association of the B.I. Line with East Africa. The advantages of this association and the increasing pressures of German expansion into East Africa lead Sultan Barghash in 1877 to offer to Sir William Mackinnon, Chairman of the B.I. Line, a concession of a 70 year lease of his mainland dominions, with all rights of
sovereignty. Lacking support from the British Government, Sir William had declined. Now in 1887 the offer was renewed, and the Sultan granted to Sir William's newly formed British East Africa Association a concession for 50 years, delegating to the Association all his powers on the mainland from the Umbe River to Kipini, including the right to levy taxes, dispose of public lands and administer justice and government generally, in return for the customs duties from the concession area.

By 1888 the Association had obtained a Charter of Incorporation from the British Crown and become the Imperial British East Africa Company.

Among the declared objects of the Company were:

- to undertake the administration of the territory conceded by the Sultan;
- to acquire territory from native chiefs in the British sphere of influence, by treaty, by purchase or otherwise;
- to establish civil and judicial administration in the districts under the Company's rule;
- to levy taxes, customs, etc., to grant licences, to construct roads, and public works, to coin money and generally to exercise all the rights pertaining to sovereignty over
acquired districts; and
to undertake trading operations.

Within the year the Company had concluded twenty one treaties with native tribes in the hinter­land which secured sovereign rights for a distance of 200 miles inland.

This process of expansion into the interior continued in both the German and British spheres of influence, until rivalry lead to friction over conflicting claims to influence over Uganda and the sources of the Nile. These were settled in 1890 by a further Anglo-German treaty which put Uganda into the British sphere of influence, and the Company continued its expansion westward into the lake regions.

The northern and eastern limits of the Company's territory were agreed in the Anglo-Italian Protocol of Rome in 1891. The boundary followed the Juba River from the coast to its intersection, with latitude 6° North, thence westwards to the 35° East meridian, which was followed north to the intersection of the meridian with the Blue Nile.

However the cost of these activities (which included the suppression of religious civil wars in Uganda) supported entirely by porter caravans from
the coast over 1000 kilometres away brought the Charter Company close to bankruptcy, and in 1893 all the Company's interests in the Kingdom of Uganda were taken over by the British Government which declared a Protectorate over the small Kingdom.

Implementation of the declared objects of the Company over such a vast territory even after the British Government had taken over the most westerly part of the area, was draining the financial resources of the Company. The British Government was reluctant to get involved in backing financially the construction of a railway to the lake that had first been proposed in 1885 and that was essential to replace the slow and costly porter caravans, and after a period of uncertainty when the Company was financed by the Church Missionary Society and the Anti-Slavery Society, the Imperial British East Africa Company withdrew its administration to its trading post of Dagoretti near the site of modern Nairobi, and finally ceased operations and surrendered its Imperial Charter in 1895.

The British Foreign Office formally took over all the territories acquired by the Company, and negotiated a new treaty with the Sultan of Zanzibar to lease the ten mile coastal strip of the mainland north of the Umbe River, and the former
Protectorate of Witu, and to declare the islands of Zanzibar and Pemba a separate Protectorate.

The former Company lands were now divided into two new Protectorates; the new Uganda Protectorate which absorbed the 1893 Protectorate and all the British sphere of influence inland of the eastern wall of the Great Rift Valley some 30 miles west of modern Nairobi, and the East Africa Protectorate whose extent was described in a Foreign Office Notice of August 31, 1896 as

This Protectorate includes the territories bounded on the north by the River Juba, on the east by the Indian Ocean, on the south by the German sphere, on the west by the Uganda Protectorate and also all the adjacent islands between the mouths of the Rivers Juba and Umbe.

The situation is illustrated on Map 1, page 23
Map 1 - East African Boundaries in 1895.
In 1896 construction of the Uganda Railway was begun at Mombasa against a background of fierce Parliamentary opposition to the whole enterprise as summed up in Mr. Henry Labouchere's epithet "a lunatic line." By the beginning of 1902 the railway had reached Lake Victoria at Port Florence, now Kisumu.

Also in 1902 the British Government altered the boundary between the two Protectorates by an Order-in-Council that prescribed that the Eastern Province of Uganda should become the Kisumu and Naivasha Provinces of the East Africa Protectorate. One curious result of this boundary change was that no part of the Uganda Railway was in Uganda, as can be seen from the map on page 27. The boundary now followed the Sio River from its mouth in Lake Victoria to Mount Elgon, and the Turkwell River from that mountain to Lake Rudolf (now Lake Turkana).

In 1907, when Italy had been defeated in its first attempt to occupy its claimed sphere of influence and colonise Abyssinia, an agreement was made with that country to replace the 1891 boundary of the Protocol of Rome with a new line. This line was modified, demarcated and surveyed in 1950-1955.
The East Africa Protectorate was formally annexed by the British Government after the First World War when in 1920 it was declared a Colony, and renamed Kenya Colony and Protectorate. The Protectorate being the coastal strip leased from the Sultan of Zanzibar.

In 1925 a treaty between Italy and Great Britain transferred most of the Province of Jubaland together with the port of Kismayu to Italian Somaliland, and a Boundary Commission surveyed and demarcated the new boundary with pillars and a cleared line in 1925-26.

The Rudolf Province of Uganda was transferred to Kenya in 1926 and the Turkana people, who had been divided by the adoption of the Turkwell River as the boundary in 1902, were reunited. This new boundary was not finally defined, demarcated and surveyed until 1960 from Moroto northwards to the Sudan border, and 1974 from Moroto south to Mount Elgon. The northern boundary of Turkana country was agreed with Sudan, and temporarily defined on the ground in 1938.

With minor modifications of the line of the boundary with Ethiopia and the abolition of the Protectorate and the British Colony in 1963 these
remain the boundaries of the independent Republic of Kenya today.

Map 2 - The Boundaries of Modern Kenya
CHAPTER III

THE LAND LAWS OF KENYA

Within the boundaries of Kenya as they developed in the manner just described ownership of land fell into three principal classifications.

First there was the land occupied by the indigenous inhabitants, second the land in the coastal area occupied under the authority of the Sultan of Zanzibar, and third land not apparently occupied by anyone.

To control and organise the development of the country the new colonising power passed a succession of laws regulating dealings in land and the demarcation of boundaries. These laws were intended primarily to deal with the last category of land, that apparently not occupied by anybody.

The concession of 1887 from the Sultan of Zanzibar to the Imperial British East Africa Company included the "right to dispose of public lands", that is lands that did not already form the subject of a grant from the Sultan, or a legitimate purchase from local inhabitants or lands that were not already in occupation by the local inhabitants, but the treaty made no specific provision as to how
these disposals were to be made or recorded.

The Company made some grants of land, and various traders and settlers negotiated purchases of land with the local inhabitants until 1891, when to discourage land speculation particularly on the main route to Uganda, the Company issued a proclamation forbidding all dealings in land outside the Sultan's domains.

East Africa Land Regulations 1894

Despite this ban it was recognised that large areas of vacant land existed, and in 1894 the Company published a set of Land Regulations which provided for "country lots" to be let on leases not exceeding twenty one years, but renewable. Grazing leases of up to 20 000 acres, agricultural leases of up to 2 000 acres, and homestead leases of up to 100 acres were offered to would-be settlers. Again no method of survey or of recording leases was specified.

The Company's Land Regulations remained in force after the territory was transferred to the British Government in 1895, and in 1896 an order was published declaring that no transaction in land that had been made in the chartered territory outside the districts effectively administered by the Company would be recognised unless the transaction
was now registered before the newly appointed Commissioner, as the Governor of the new Protectorate was then called. All claimants to possession of such purchased land were required to submit details to the Administrative Officer of the District for scrutiny.

**Boundary Marks Regulations 1897.**

Next in the formalisation of land matters, appeared the Mombasa Boundary Marks Regulations, which stated that:

... whereas inconvenience has arisen with land claims owing to inadequate marking out of boundaries, (the Commissioner rules):

1. The boundaries of all land situated within the island of Mombasa must be clearly marked by substantial masonry pillars not less than 3 feet in height to be erected at every angle of the property.

2. In addition to the aforesaid boundary marks, a patch not less than 2 feet wide must be kept clear of vegetation along the boundary line of every property. (E.A.P 1899 a)

At this time much of the Island of Mombasa, now almost wholly built over, was bush covered, and such substantial pillars were necessary to locate the scattered small farms and plantations. The town was confined to the present Old Town, clustered round
the harbour and dominated by Fort Jesus.

**East Africa Land Regulations 1897.**

In 1897 the Company's Land Regulations were formally repealed and replaced by new East Africa Land Regulations. The first version of these in January 1897 offered similar twenty one year leases, but a second version enacted in December of the same year gave notice that

The Commissioner may, if he thinks fit, grant to any person a certificate authorising him to hold and occupy the portion of land described in the certificate for a term not exceeding 99 years. (E.A.P., 1899 b)

The form of certificate was set out in a schedule to the Regulations, and the terms and conditions were included in the certificate.

Regulation No 3 provides the first definite requirement for a survey of the portion of land to be leased;

Every certificate shall be accompanied by a plan of the land, prepared or approved and signed by a Government Surveyor, or other officer appointed for the purpose by the Commissioner.
A further Regulation, No 9, set the fee for each certificate together with:
such sum as the Commissioner may certify to be the costs of preparation or approval of the plan. The Travelling expenses (if any) of the Government Surveyor may be included in such costs, not exceeding the rate of 2 rupees per mile travelled by him.

These regulations imply a survey organisation to conduct the required surveys and prepare the title plans, but in fact there was no such organisation, and any plans must have been prepared or approved by the Sub-Commissioners, as the District Officers were then called, among all their other duties.

None of these plans exist in the records of the Survey of Kenya today.

The Regulations also mention registration of documents, and although the wording could be construed as referring only to the transactions already mentioned in the 1896 order and to other grants and concessions that already existed, it does imply that a register of some sort had been established:
Land shall not be deemed to be lawfully held ... under a documentary title unless ... the document has been duly registered in accordance with the provision for registration of documents
relating to real estate ... in the Protectorate ...

Appropriation of the Railway Zone 1897.

The year 1897 also brought the Notification of Appropriation of Land for the Uganda Railway, published in the Gazette, under which

All lands on the mainland beyond Mombasa situated within one mile of the Uganda Railway whenever finally constructed are appropriated for public purposes, subject to any right of ownership that may be proved ... (E.A.P. 1899 c)

A further notice in 1900 proclaimed this railway zone in the Uganda Protectorate also.

The construction of the railway greatly accelerated the opening up of the country, and the Railway Administration now looked to sales of land within the railway zone to recoup some of the cost of construction, and to the output of this land to provide paying traffic. Before such sales could take place it became necessary to define more clearly the status of land outside the coastal zone, that is, beyond the recognised suzerain ty of the Sultan.
An East Africa (Lands) Order-in-Council 1901 declared all public land in the Protectorate to be subject to the control of the British Crown, and in 1902 a law was passed to regulate all dealings in this Crown Land.

Crown Lands Ordinance\(^1\) 1902

The Crown Lands Ordinance was enacted to permit the alienation by sale, lease and licence of Crown Land to new settlers.

The boundary provisions of the Ordinance itself were very simple, "the Commissioner may require a purchaser of Crown Land to erect reasonable boundary marks ..."

Crown Land Rules enacted in October and December 1902 provided for the administration of the Ordinance, in particular by the appointment of a Land Officer, to supervise the demarcation and maintenance of the boundaries, and the survey of any Crown Land alienated.

1. Laws passed by the Colonial Legislatures were entitled Ordinances, and those referred to here as Ordinances are no longer on the Statute Book. Laws passed or taken over and confirmed by the independent state of Kenya are called Acts, and those so referred to are current Kenya Laws.
The rules were based on the Canadian "homestead" laws that were at that time regulating the opening up to settlement of the vast north American prairies. An applicant for land could buy or lease a "homestead" of 160 acres, and was granted at the same time a pre-emptive right to a further 480 acres adjoining, that is a total of one square mile. When he had fulfilled the development conditions on the homestead area he could take up the pre-empted land.

The rules also allowed for outright sale of Crown Land on freehold terms for agricultural purposes, and for 25 year or 99 year leases for building plots in towns.

Registration of Documents Act 1902

Transactions under the Crown Lands Ordinance 1902 were to be recorded by the registration of documents under the Registration of Documents Act passed in the same year. Registries were opened at Mombasa, Nairobi, Malindi and Naivasha to register the deeds relating to sales and leases of Crown Land and subsequent transactions.

Land Titles Act 1908

The 1887 concession, the 1894 and 1897 Land Regulations, and the 1895 Treaty, all accepted that existing rights to land in the Sultan of
Zanzibar's domain in the coastal strip were to be recognised and respected, and the Crown Lands Ordinance 1902 did not include these lands as Crown Land. But in proposing to alienate Crown Land it was necessary to find out what land was legally occupied and what was Crown Land available for alienation in the coastal strip.

The object of the Land Titles Act was stated to be "to make provision for the removal of doubts that have arisen in regard to titles to land and to establish a Land Registration Court". The Act called for the appointment of a Recorder of Titles who presided over the Land Registration Court which was to carry out an adjudication of all claims to land in the Coastal Strip. A Certificate of Title was issued to the successful claimants, and a surveyor was attached to the court to define the boundaries of adjudicated claims. Any land unclaimed or unsuccessfully claimed was deemed to be Crown Land.

**Government Lands Act 1915**

By 1915 it had become apparent that the Crown Lands Ordinance with its six pages of fairly simple provisions was inadequate to maintain the firm control of land matters that was desirable as the country developed, and the Crown
Lands Ordinance 1915 was enacted to "make further and better provision for regulating the leasing and other disposal of Crown Lands and for other purposes."

When Kenya became independent in 1963, the former "Crown Land" was renamed "Public Land". This was open to misinterpretation, and was changed to "State Land" for a short period, and finally to "Government Land", and the Crown Lands Ordinance 1915 was redesignated the Government Lands Act of the Laws of Kenya, and this is the name which will now be used.

The Government Lands Act repealed the Crown Lands Ordinance 1902 and authorised the Commissioner of Lands to cause land in townships to be divided into plots for lease for any term up to 99 years, and for agricultural land to be surveyed and divided into farms for lease for a term of 999 years.

The Act contains specific survey requirements: Section 110: states "A document ... to which there is attached a map or plan which is not signed by the Director of Surveys shall not be accepted for registration."
Section 111 states

Every document for registration shall contain ... an accurate and clear description of the property ... its boundaries, extent and situation ... if such property consists of a divided portion of land ... such portion shall be clearly and accurately defined by its particular boundaries and extent, and accompanied by a plan signed by the Director of Surveys.

Registration of grants and transactions was compulsory and unregistered documents or deeds had no validity in law. The Registries at Malindi and Naivasha, set up under the Registration of Documents Act were closed and their Registers combined with those of Mombasa and Nairobi.

Grants of land made under the East Africa Land Regulations or the Crown Lands Ordinance 1902 could be surrendered in exchange for a grant under the Government Lands Act 1915.

Registration of Titles Act 1919

In 1919 the Registration of Titles Act was introduced "to provide for the transfer of land by registration of Titles." This Act supplemented the Government Lands Act and replaced the system of registration of deeds by substituting compulsory registration of title.
This is the Torrens system whereby the rights and interests in a carefully defined portion of land are summarised in a Certificate of Title which is registered and issued to the proprietors. Unregistered titles or transactions have no standing in law, and thus the register at any time shows the only legal owner(s) of the title. Any dealing in this land is conducted by transferring the Certificate of Title and registering the new owner who then becomes the legal owner.

Any sub-division creates a new title, which must also be carefully and accurately defined by survey and deducted from the original title, after which the new subdivision is provided with a Certificate of Title" as valid and effectual in every respect as (an) original (grant)."

The Registration of Titles Act also provided for the first time for a Government guarantee of title. Section 23 states that the Certificate of Title issued by the registrar to any purchaser of land ... shall be taken ... as conclusive evidence that the person named therein as proprietor of the land is the absolute and indefeasible owner thereof ...
This guarantee is backed up in Section 24 by a Government indemnity to any registered owner deprived of his land by fraud or error or misdescription to which he is not a party.

The definition of each portion of land is by survey, and the description of the land is given in the original document of grant as:

... All that piece of land situate in (place) in the (...) District of Kenya containing by measurement (...) hectares or thereabouts, that is to say Land Reference Number (...) which said piece of land with the dimensions abuttals and boundaries thereof is delineated on the plan annexed hereto and more particularly on Land Survey Plan Number (...) deposited in the Survey Records Office, Survey of Kenya, Nairobi ...

An example of this Land Survey Plan or Deed Plan, but without the embossed seal and authenticating signature of the Director of Surveys, is illustrated in Fig. 1, page 41. The original remains in the Records, a print is annexed to the grant.

Survey Act 1923

The land laws mentioned so far have all required a survey plan to identify the portion of
A N Other
Licensed Surveyor

REPUBLIC OF KENYA
DISTRICT OF NAKURU
Locality North of Bengai Station
Reference Map South A 36 - 5

Land Reference No. 49723/129
(Orig. No. 49723/616)

Subdivision No. (Orig. No.)
of Section No.

Total Area 793.2 Ha. (Approx.)
Less Road Reserve 6.5
Net Area 793.2 Ha. (Approx.)

Distances shown are in Metres

Fig 1 - Registration of Titles Act Deed Plan
land being dealt with, and the specifications for the survey were contained in Rules and Regulations made under the various laws.

In 1923 the survey aspects of these rules were consolidated, amended and expanded into the Land Surveyors Ordinance, "to provide for the Registration and Licensing of Land Surveyors; to control the Practice of such Surveyors, and for other purposes incidental thereto."

The Ordinance was published together with "Regulations for the Direction and Guidance of Land Surveyors, Examination Regulations and Syllabus, and a scale of survey fees." A Land Surveyors Board was to be established with the Director of Surveys as Chairman, and among its duties were the examination of candidates for a Licence, and the control and discipline of Licensed Surveyors.

All surveys for the purpose of preparing a plan required under any Registration of Land or Titles law in Kenya were controlled by this Ordinance which gave far reaching powers to the Director of Surveys now that titles were guaranteed under the Registration of Titles Act and owners indemnified against loss by error or misdescription.
The Land Surveyors Ordinance was replaced by revised versions in 1951 and 1961, and this last edition is now the Survey Act of the Laws of Kenya. The Survey Regulations were revised in 1951, 1961 and 1969, and contain the full technical details and specification for all aspects of cadastral survey, from the class of instrument to be used, to the elements of the figure of the earth and the\textit{map} projection to be employed in all surveys. Regulations set out the rights and duties of a Land Surveyor, the penalties for tampering with survey marks, the standards of accuracy to be achieved, the type of beacons to be used in cadastral survey, and every aspect of the surveyor's work, including a minutely categorised scale of fees which is obligatory.

The Act gives to the Director of Surveys such tight control over the cadastral survey profession that protests have been raised against "the Tyranny of Survey Regulations" (Hartog, 1961).

The 1969 version of the Regulations specified the change from imperial units to metric for boundary data and introduced the Universal\textit{map} Transverse Mercator projection to supplement the Cassini-Soldner projection on which most of the cadastral surveys in Kenya have been computed prior to 1969.
The land alienated and surveyed under the land laws discussed so far has been either Government (Crown) Land, or land of which ownership under a title from the Sultan of Zanzibar had been successfully claimed.

The remaining classification of land in Kenya is the land in the occupation of the indigenous inhabitants. This was defined in the Native Lands Trust Ordinance 1938 (now the Trust Land Act), and called Native Lands and the Special Areas.

In accordance with the existing policy land in Native Areas was administered by the tribal authorities under customary law, and apart from defining the perimeter of each tribal area no survey or registration of ownership had taken place in the Native Lands until 1949, when the beginnings of a programme of consolidation and registration was instituted in Nyeri District.

This was followed by more land reform conducted under the Native Land Rules 1956 until new substantive legislation, the Land Registration (Special Areas) Ordinance was introduced as a result of the report of the Working Party on African
The legislation was to implement a recommendation of the East Africa Royal Commission 1953-55 that African landholders in town and country should receive individual titles to land occupied under customary tenure.

The Ordinance set up administrative machinery for the ascertainment of rights and interests in, and for the consolidation of, land in the native lands; for the registration of title to, and of transactions and devolutions affecting, such land and other land in the native lands; ...

An Adjudication Officer was appointed to superintend the ascertainment by a local Committee of the rights and interests in parcels of land. Where fragmentation to uneconomic sizes of plots had occurred the Adjudication Officer appointed Demarcation Officers to demarcate the reparcelling of the land into units, each representing a consolidation of fragments of land into an equivalent area, in accordance with the Committee's decision, as shown on a Demarcation Plan.

The Demarcation Officer was responsible for the marking of the boundaries of the parcels, either by ordering the owners to carry out the demarcation or
by doing it himself, and the manner of demarcation was that most suitable to the type of land, either "fences, hedges, stones, pillars, walls or other boundary marks" as appropriate.

Each parcel of land was described by reference to its registration section and its number on a Registry Map on which the approximate boundaries of each separate parcel were shown. This Registry Map was the Demarcation Plan in the first instance, and neither the description nor the map were "conclusive as to the boundaries or extent of any land but shall indicate the general boundaries only." This is the first mention in Kenya of the English concept of "general boundaries", which "is a euphemism for uncertain boundaries" (Dowson 1952). The term refers to the undefined relationship between the boundary line - a Euclidian line having length but no width - and the physical feature indicating the proximity of the boundary. The expression "general boundary" was dropped from later legislation, and boundaries were said to be "approximate".

The Registered Land Act 1963

Consideration of the foregoing legislation leads to the conclusion that there are now five different laws under which little in Kenya could have been held. Although it was the legislators'
hope that each new law would absorb and displace those that had gone before this had not happened, and only the care with which the registers had been maintained prevents chaos in land transactions.

In an effort to provide a single substantive law for all land tenure in Kenya a new Act, the Registered Land Act was introduced in 1963 "to make further and better provision for the registration of title to land, and for the regulation of dealings in land so registered ... "

The Act is intended to be the definitive Registration Act and land law for the whole of Kenya. It may be applied to any area by order of the Minister and then abolishes whatever previous land law was operative in that area.

At the time of enactment the Registered Land Act superseded the registration provisions of the Land Registration (Special Areas) Ordinance, and the registers of this Ordinance have been completely taken over.

The Act is administered by a Chief Land Registrar with Assistant Land Registrars in charge of the Land Registry Offices now decentralised to District level.
Upon application of the Act to an area the Director of Surveys prepares and thereafter maintains a map or series of maps, called the Registry Map, for every registration district. Where no map exists the Registrar may cause a map to be prepared, and such a map shall be deemed to be the Registry Map until the Director of Surveys prepares and delivers a map for the area.

The individual parcels of land are identified by a number within a named registration section, within a named registration district. A plan may be filed in respect of a particular parcel to augment the information available from the registry map, and the filing of the plan must be noted in the register.

The Registrar may correct the line or position of any boundary shown on the registry map with the agreement of every person shown by the register to be affected by the correction, but such corrections may only be made on instructions from the Registrar in writing by means of a mutation form which must be filed.

The Registrar may cause a survey to be made for any purpose connected with the Act, but, where the Director of Surveys is maintaining the Registry Map such survey may be used to amend the Registry Map only if it is approved by the Director of Surveys.
Sections 21 to 26 of the Act set out the form of the boundaries, the way in which lost or disputed boundaries are to be relocated, the provisions for "fixing" boundaries, and for the maintenance of boundaries, together with the penalties for interference with boundaries.

21(1) Except where it has been noted in the register that the boundaries of a parcel of have been fixed, the Registry Map and any filed plan shall be deemed to indicate the approximate boundaries and the approximate situation only of the parcel.

21(2) Where any uncertainty or dispute arises as to the position of any boundary, the Registrar, on the application of any interested party, shall, on such evidence as the Registrar considers relevant, determine and indicate the position of the uncertain or disputed boundary.

If the Registrar determines a boundary as above he is required to make a note in the Register, and file any plan or description necessary to record his decision.
21(4) No court shall entertain any action or other proceedings relating to a dispute as to the boundaries ... unless the boundaries have been determined as provided in this section.

The Registrar has the discretion to allow or to order the precise position of the boundaries of a parcel or any parts of them to be ascertained and "fixed".

22(2) The Registrar shall, after giving all persons appearing by the register to be affected an opportunity of being heard, cause to be defined by survey the precise position of the boundaries in question, file a plan containing the necessary particulars and make a note in the register that the boundaries have been fixed, and thereupon the plan shall be deemed to define accurately the boundaries of the parcel.

As the Act is applied to areas formerly registered under the Registration of Titles or Land Titles Acts provision is made to retain boundaries already established, by a subsection reading:

22(3) Where the dimensions and boundaries of a parcel are defined by reference to a plan verified by the Director of Surveys, a note shall be made in the register, and the parcel
shall be deemed to have had its boundaries fixed ...

The maintenance of boundary features is the responsibility of the owner of the land and he "shall maintain in good order the fences, hedges, stones, pillars, walls and other features which demarcate his boundaries" under whatever law they were established. The Registrar has the authority to order the proper maintenance of any boundary and to order which owner shall maintain any boundary common to two owners.

The usual threat of a fine or imprisonment for interference with boundary features follows, with the addition that a person convicted of such an offence shall be liable for the cost of restoration, recoverable as a civil debt by any person responsible for the maintenance of the feature.

The boundaries are illustrated approximately on the Registry Map and Section 148(1) reads as between the Government and a proprietor, no claim to indemnity shall arise and no suit shall be maintained on account of any surplus or deficiency in the area or measurement of any land disclosed by ... any subsequent survey or (differing) from the area or measurement shown in the register or in the Registry Map.
Similarly after six months from the date of registration of a purchase the proprietor cannot claim any indemnity from the seller for any surplus or deficiency in area or measurement.

Land Adjudication Act 1968

Land Consolidation Act 1968

These two Acts regulate the procedure for the adjudication of rights in Trust Land in order to register individual titles under the Registered Land Act. The Land Adjudication Act is invoked for areas where fragmentation has not produced uneconomic holdings, and the Land Consolidation Act where fragmentation has occurred, requiring the reparcellation already mentioned in discussing the Land Registration (Special Areas) Ordinance, which these Acts supersede.

The Adjudication process determines the boundaries on the ground. These are demarcated if they are not already physical features, under the supervision of a Demarcation Officer, and a plan is prepared by a Survey Officer (who is not necessarily a Surveyor within the meaning of the Survey Act). This plan becomes the Registry Map when, after the correction of any errors reported during the sixty days period allowed for objections to the adjudication register, it is delivered to the Chief Land Registrar appointed under the Registered Land Act.
There are no specific provisions on the form of survey to be used, nor for the qualifications of the surveyor. "The Demarcation Officer shall prepare or cause to be prepared a Demarcation Plan of the Adjudication Section showing the separate parcels into which the same is divided".

Summary of the Survey requirements of the Land Laws

The East Africa Land Regulations 1897 and the Crown Lands Ordinance 1902 required the parcels of land to be defined on the ground by physical features such as fences or streams, or "reasonable boundary marks" and required a plan to be made of the parcel. There were no specifications on the accuracy of the survey apart from it being "a sufficient description to identify the land", or the qualifications of the surveyor except that he could satisfy the Chief Surveyor, and pay the licence fee.

The Land Titles Act 1908 dealt with the adjudication of existing claims in the coastal strip, and required the demarcation of the boundaries adjudicated and the survey of these boundaries by a qualified surveyor. A general cadastral plan of the area signed by the Director of Surveys was prepared and the particular plot referred to in the Certificate of Title was outlined in red and the Certificate was registered by the Recorder of Titles. All subsequent
dealings were also required to be registered, and if a sub-division was involved it too had to be described on a separate Deed Plan signed by the Director of Surveys, after its boundaries had been defined on the ground and surveyed.

The Government Lands Act introduced an improved form of registration, and required a plan signed by the Director of Surveys containing an accurate and clear description of the property, its boundaries, extent and situation. Any sub-division required a similar Deed Plan signed by the Director of Surveys to define its boundaries.

The Registration of Titles Act provided an improved system of registration to permit dealing in land to take place securely by the registration of a Certificate of Title. This defined the title, that is the land and rights in it, and stated who was the legal owner of it without any need to check every transaction since the initial grant to ensure the validity of the claim to ownership. The Act also introduced a Government guarantee of title, and an indemnity against loss of land by fraud, error or misdescription.

The Survey Act divided the survey aspects of land law from the registration law, and provided the Director of Surveys with the powers necessary to
support the new guaranteed titles. The Act specified in great detail the manner in which surveys were to be conducted, and by whom, and how surveyors were to be licensed, and how disciplined if they ceased to satisfy the new requirements. All the technical aspects of survey were assembled in and governed by the regulations under the Act.

The Land Registration (Special Areas) Ordinance introduced approximate boundaries in place of precise mathematical boundaries, and like the Land Titles Act dealt with existing rights instead of the establishment of new rights over Government Land. The consolidation into a single economic unit of the areas over which the rights were exercised by each proprietor was principally intended as a step to improved agricultural practice, but the security of tenure offered by the issue of individual titles in place of the customary tenure was an important part of the process.

The Registered Land Act superseded the registration provisions of Land Registration (Special Areas) Ordinance and expanded the area of application, to cover eventually the whole of Kenya. The Act can be applied to any area on the order of the Minister, and then obliterates whatever Act previously governed
that area. If boundaries were previously precisely defined by beacons with bearings and dimensions they became "fixed boundaries" under the Registered Land Act, and the original Deed Plan becomes the filed plan, backed by the surveyor's plan in the Survey Records Office. If the original boundaries were "general boundaries" defined on the ground and depicted on a registry map, they become "approximate boundaries" and the map continues to show their approximate situation as before.

The Registry Map is maintained by the Director of Surveys, and amended by him to reflect any mutations on receipt from the Registrar of written authorisation on a completed mutation form, which is filed.

The Registrar may authorise reparation by the combination and division of plots, and every plot the boundaries of which are changed is allotted a new number and a new folio in the register. The original numbers are cancelled and a new edition of the Registry Map, reflecting the new parcellation and numbers, is sent to the Registrar. The superseded edition is destroyed. If the reparation is a subdivision the Director of Surveys will only amend the Registry Map if he approves the survey on the mutation form.
Similarly the Director of Surveys will not accept a fixing survey to convert approximate boundaries to precise boundaries defined by survey data unless the survey is performed by a surveyor within the meaning of the Survey Act.

The Registry Map thus reflects the register and the ground, and provides an index to the parcellation. It is however the boundaries that exist on the ground that define the parcels, not the approximate depiction on the map nor the area figure written in the register, both of which can be amended by the Registrar if it is shown to his satisfaction that they are wrong.

Land Classifications.

Thus it may be concluded that land in Kenya falls into three general classifications, that were controlled by different ways, and will all eventually be brought under the Registered Land Act.

The three classifications are illustrated on Map 3, page 58 and are:

1. **Government Land**

   The areas where land was vested in the Government by treaty or occupation and was available for sale or lease. At various periods this was called Crown Land, Public Land and State Land, and is now Government Land.
Map 3 - Land Classifications in Kenya
throughout the country. The Land within the boundaries defined by the Kenya (Highlands) Order - in-Council 1939 was also known as "the Highlands", and the "Scheduled Areas".

2. Coast Land

The ten mile strip of land leased from the Sultan of Zanzibar under the 1895 treaty, which became the Protectorate of Kenya in 1920, and an integral part of the Republic of Kenya in 1963. Land not successfully claimed under the Land Titles Act became Government Land, or Trust Land.

3. Trust Land

The former Native Lands or Special Areas which were defined by the Kenya (Native Lands) Order-in-Council 1939, and augmented by the declaration of Special Reserves and Native Leasehold Areas, and also the vast semi-arid lands of the nomadic pastoralists covering the north eastern half of the country which were Communal Reserves. Under the Constitution of independent Kenya all these areas were vested in the County Council of the District and administered by customary law under the Trust Lands Act.
In the next chapter we will consider how the cadastral survey in each of these classifications of land is treated.
CHAPTER IV
CADAstral SURVEY IN KENYA

Cadastral Survey of Government Lands

In Kenya when the government decided at the turn of the century to sell and lease grants of Crown Land to settlers and needed a record of what land had been granted, defined units did not exist, nor did sufficient features that could be adopted as boundaries. In many cases a stream could be adopted for part of the boundary of a plot but for the other parts recourse was had to landmarks to define the boundary on the ground. At first these were stout wooden posts of local hardwood usually "pencil cedar" (juniperus procera) for farms, and dressed stone blocks for town plots. In Mombasa masonry pillars were tried but proved both too costly and too vulnerable. Within a few years wooden posts gave way to lengths of angle-iron, and stones to pieces of iron pipe or iron pins (lengths of half inch metal rod) set in concrete. Whatever type of mark was used it is referred to in Kenya as a boundary beacon, a corner beacon, a survey beacon, or simply a beacon.

The first Crown Land Rules invited settlers who wanted to buy or lease Crown Land for agricultural or building purposes to select an area of land on the
ground and to apply to the Land Officer to have the proposed boundaries agreed. The Land Officer was required to decide the boundaries "having regard to the wants of other settlers, the lie of the land, the direction and proximity of watercourses and other matters of a like nature". The Rules go on, "the purchaser shall within six months ... mark out the boundaries of his selection ... (and) every land holder shall reside continuously on his holding ..." (Gazette, 1902).

The physical demarcation would provide the necessary definition, and the occupation would ensure the maintenance and continuity of knowledge to safeguard the boundaries. The accurate description for the purposes of recording the grant in the register would be provided by the survey that was also specified in the Rules.

However, the "Land Officer shall be such person as may be from time to time appointed to perform the duties of Land Officer", and as with the 1897 Regulations these duties and those of Government Surveyor were left to casual ad hoc appointments, or to that Jack-of-all-trades the District Officer. Not unnaturally this led to very casual control of land alienation and to a very varied standard of survey.
Survey Department Founded

The Protectorate Government was at this time advertising widely for settlers to come and take up land, and start an agricultural industry which would develop the sparsely populated country and provide paying traffic for the railway. It was not long before the demands for supervision of selections and survey overwhelmed such casual arrangements, and in April 1903 Government appointed a Chief Surveyor, Mr. R. Barton-Wright, to head a Survey Section of the Public Works Department. Barton-Wright was a senior engineer with the Uganda Railway and remained an Inspector of Railways and Engineer-in-Charge of Nairobi Public Works Department. He was also appointed Land Officer in May 1903.

The staff of the survey section consisted of the Chief Surveyor and an Indian clerk until July, when a second Railway Surveyor Mr. E.L. Waring was recruited as Assistant Chief Surveyor.

It is from this modest beginning in the wood and corrugated iron offices built for the Chief Surveyor in 1903 that the national survey department, the Survey of Kenya, has arisen, and the headquarters are housed in the same wood and corrugated iron building today. 1981 Now at 4240.
In 1904 five more surveyors and one draughtsman were recruited for the Department, but it is clear that this tiny band under a Chief Surveyor whose survey duties can reasonably be described as part-time could not hope to deal with a demand for surveyed plots from all over the country. It must not be forgotten that the railway at this time provided the only mechanical transport in the country; there were few roads, and horse, mule cart, or walking were the normal methods of travelling.

The Chief Surveyor's recommendation in 1903 that a proper triangulation should be undertaken to control the scattered surveys was ignored, and the process of surveying isolated selections individually continued. Those properties that were close to the Uganda railway were tied to the centre-line of the rails as a base and referenced by compass bearing and measurement to one of the numbered telegraph poles. Properties that were not adjacent to the railway clearly relied almost entirely on the hope that the beacons and boundaries would be preserved by the occupying owner. A cadastral plan from this era is before me as I write, on which the survey consists of four corner beacons (type unspecified) with magnetic bearings and distances between them, the acreage, the name of the Province in which the land lies, and
a note at one corner beacon which states that a
certain railway station lies "approximately eighteen
miles in a south west direction."

It is hardly surprising that the Crown Lands
Ordinance 1902 offered no guarantee of title or of
boundaries.

To supplement the efforts of the Survey
Department, an Official Gazette notice dated February
13th 1904 invited "unofficial surveyors" to apply to
be examined and registered as land surveyors, at a
licence fee of 375 rupees, about £25, at 1904 values
when a Staff Surveyor's salary was approximately
£300 per annum. Eight names were gazetted early in
the following year as "Surveyors having been admitted
to Practise under Licence."

Further Rules under the Crown Lands Ordinance
brought to an end the casual surveys performed by
District Officers and "such persons as may be from
time to time appointed to perform the duties ..." by
stating that "no surveys other than those performed
by the Survey Department or by a (registered) land
surveyor ... will be recognised by the Land Office
for the purposes of a conveyance, lease or licence ...
of Crown Land."
At the same time regulations and "Specifications for Diagrams" were published by the Chief Surveyor. These required the following information:

1. True relative bearings of all boundary lines to be given on plans.
   (a) Magnetic in case of surveys connected to the Uganda Railway centre line.
   (b) True north or fixed meridian in the case of surveys which cannot be connected with existing surveys or to the centre line of the Uganda Railway.

2. Length of all boundary lines in feet and inches.

3. Scale to be drawn upon every plan.

4. Approximate delineation of topographical features shown on every plan.

5. Traverses in original along river and other natural boundaries, together with offsets and details of area calculations to be supplied at the request of the Chief Surveyor.

6. In every case for sufficient information to be given, to enable the plan to be redrawn and the area calculated.

7. This latter information to be confined to one copy of the plan only. (Williams, 1931a).
No surveys of Crown Lands were to be conducted without the written consent of the Chief Surveyor. All fees payable to a licensed surveyor were to be paid by the Chief Surveyor.

During this period surveys were conducted after the selection of land by settlers. No attempt was made to set out farms and offer them to the public with the exception of a block of eighty one farms in the Rift Valley for which a contract for triangulation and mapping was let to a Licensed Surveyor, Mr. A.A. Ortlepp, in March 1905. The contract involved establishing a tertiary triangulation, with heights, including two base lines of not less one and a half miles each, measured not less than three times, covering an area of approximately 1500 square miles. A triangulation chart at a scale of 1 inch to 1 mile was made, and in addition the area was topographically mapped at a scale of 6 inches to 1 mile showing all topographical features, the existing boundaries of all lands let or sold, and those boundaries newly surveyed by the contractor. This survey was accomplished on foot in eight months, and the triangulation was later tied to the major network when it was started.
Not all the Licensed or Government surveyors were so competent, and as settlers continued to arrive, surveys fell rapidly into arrears. The utter inadequacy of the survey arrangements was made plain by a Land Commission in 1905 which reported "the necessity of seriously, and at once, dealing with the question of survey." (Williams, 1931b). This report confirming what the Chief Surveyor had been saying since his first appointment led to a further investigation, which in turn led in 1906 to a re-organisation of the Land and Survey Branch of the Public Works Department into a Survey Department under a Director of Surveys, and a separate Land Section, both departments under the control of a Commissioner for Lands.

The long needed triangulation control was started in the same year under a newly instituted Trigonometrical Section, and work on it continued until 1921. The standard aimed at was, in view of the constant demands for economy, "a triangulation of just sufficient accuracy to form the base of topographical mapping and cadastral surveys."

(Williams, 1931c)
Kenya Major Triangulation

The Kenya Major network consisted of several chains observed in the separate "series" shown on Map No.4 (page 71), which were connected to the Anglo-German Boundary chain at four points, and were scaled by three measured bases; at Kisumu on Lake Victoria, at Athi near Nairobi, and at Malindi on the coast.

While the triangulation was being observed the cadastral surveys continued, and were based on the preliminary values of the triangulation without waiting for completion or adjustment of the whole net. This led to problems at the junctions of series, when cadastral surveys fell partly under one series and partly under another. For example when the Laikipia series observed in 1909-11 joined the Athi-Lumbwa series to the Athi-Nyeri series, both observed in 1907-8, by a chain round the northern end of the Aberdare range, a good deal of cadastral survey had already been based on the two earlier chains, and rather than upset it the whole misclosure at the junction was adjusted into the Laikipia series, creating a scale error of about 1 in 16 000 and ignoring an azimuth swing of 3°.7. By this sort of expedient the three chains would remain consistent within themselves, but any surveyor working across from one chain to another would encounter a substantial
### Key to Map 4

#### The Kenya Major Triangulation

<table>
<thead>
<tr>
<th>No.</th>
<th>Series Name</th>
<th>Year Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Anglo-German Boundary Chain</td>
<td>1904-06</td>
</tr>
<tr>
<td>2.</td>
<td>Lumbwa-Sotik</td>
<td>1906</td>
</tr>
<tr>
<td>3.</td>
<td>Athi-Nyieri</td>
<td>1907</td>
</tr>
<tr>
<td>4.</td>
<td>Athi-Lumbwa</td>
<td>1907</td>
</tr>
<tr>
<td>5.</td>
<td>Athi-Mombasa</td>
<td>1908</td>
</tr>
<tr>
<td>6.</td>
<td>Mombasa-Malindi</td>
<td>1908</td>
</tr>
<tr>
<td>7.</td>
<td>Malindi - Sabaki River</td>
<td>1909-10</td>
</tr>
<tr>
<td>8.</td>
<td>Kitui</td>
<td>1910</td>
</tr>
<tr>
<td>9.</td>
<td>Laikipia</td>
<td>1910-11</td>
</tr>
<tr>
<td>10.</td>
<td>Uasin-Gishu</td>
<td>1910-11</td>
</tr>
<tr>
<td>11.</td>
<td>Mombasa-Vanga</td>
<td>1910-12</td>
</tr>
<tr>
<td>12.</td>
<td>TransNzoia</td>
<td>1911-12</td>
</tr>
<tr>
<td>13.</td>
<td>North Rift Valley</td>
<td>1911-12</td>
</tr>
<tr>
<td>14.</td>
<td>Machakos</td>
<td>1912-13</td>
</tr>
<tr>
<td>15.</td>
<td>Kitui</td>
<td>1912-13</td>
</tr>
<tr>
<td>16.</td>
<td>Mumias</td>
<td>1912-13</td>
</tr>
<tr>
<td>17.</td>
<td>East Kenya</td>
<td>1912-13</td>
</tr>
<tr>
<td>18.</td>
<td>North Kenya</td>
<td>1913-14</td>
</tr>
<tr>
<td>19.</td>
<td>Malindi-Kipini</td>
<td>1913-14</td>
</tr>
<tr>
<td>20.</td>
<td>Kisii</td>
<td>1913-14</td>
</tr>
<tr>
<td>21.</td>
<td>Lamwia-Elemborasha</td>
<td>1913-14</td>
</tr>
<tr>
<td>22.</td>
<td>Kipini-Lamu</td>
<td>1910,1919 &amp; 1922</td>
</tr>
<tr>
<td>23.</td>
<td>Voi-Taveta</td>
<td>1910-20</td>
</tr>
</tbody>
</table>

Note: The colours serve only to separate the series.
positional displacement, of the order of 4 to 5 feet.

The Kenya Major network was never closed and adjusted as a whole. The bases, and the azimuths observed at them, controlled the series emanating from each base, and the other bases were used merely to confirm that no gross errors had accumulated in the chains. When they checked onto a second base any misclosure was not distributed.

The cry was always for speed and economy, and "no unnecessary refinement of accuracy is to be attempted". (Williams, 1931d)

Given the attitude of Government that triangulation was non-productive and therefore unprofitable, but maps and farm surveys were useful and even revenue producing, it is difficult to see how any Survey Department could have done better than the Kenya Major network.

**Economic Recession**

The final blow to any hope of completing a full coverage of the country by control or a breakdown to second order came when in 1921, during the world economic recession, the Trigonometrical and Topographic Sections of the Department were abolished altogether. The only triangulation conducted from 1921 until 1950 was tertiary breakdown for cadastral...
purposes in very limited areas.

The cadastral survey problems that resulted from this policy cause trouble even today, since the majority of beaconed boundaries are related to the Kenya Major control and to extensions from it. The gaps were frequently filled by a minor triangulation scheme breaking down from a few Major points in one series, carefully observed and properly adjusted, but not closing across to another series that would require the surveyor to distort his good work to adjust between chains. Another surveyor in an adjoining area might conduct his survey by a similar extension, but from the other chain, so that within a short distance of one another possibly even overlapping or using the same hills are two perfectly sound triangulations which are mutually incompatible. To carry out a subdivision survey or the re-establishment of a missing beacon it is essential to know which "system" of triangulation had controlled the original work. These separate "systems" all based apparently on the same Kenya Major control, cause problems which cannot be solved by mathematical transformations as the differences between adjoining triangulations are often too great to be accommodated.
In 1950 a start was made by the then Directorate of Colonial Surveys to observe a new geodetic triangulation of Kenya. This work is still continuing, with Directorate of Overseas Survey parties and Royal Engineers surveyors extending and strengthening the net by primary traverses and Doppler satellite fixes.

The triangulation was at first computed on the Cassini-Soldner projection, but using a different datum from the Kenya Major, as a base for urgent cadastral surveys in western Kenya. Subsequently a whole new network was observed as an integral part of the East and Central African primary coverage, with three new measured bases in Kenya, and tied to the Arc of the 30th Meridian in western Uganda. This triangulation included the primary traverse from north of Mount Kenya down the Tana River valley to Malindi which was planned in 1908 to close the Kenya Major network, but had to wait until 1958 for the invention of the Tellurometer to make it practical.

Coordinates were computed on the Universal Transverse Mercator Projection, and are the control for all new cadastral surveys in Kenya.

Whenever possible old Kenya Major stations and existing cadastral surveys are connected to the U.T.M.
network and the Cassini-Soldner coordinates are transformed, but to adjust the various Kenya Major systems to the new primary work which now covers most of the country will require an immense amount of work in field connections between boundary beacons and the new control unless it is to be another paper exercise of manipulating figures, resulting in coordinates that do not relate to the actual positions of beacons in the ground. This point is not always appreciated when old minor triangulation charts are transformed to compile overall control charts for a survey district. The inconsistencies show when field observations are made and further adjustments merely add a new and arbitrary system to those existing.

The same retrenchment that killed the Trigonometrical Section in 1921 caused all staff below the rank of District Surveyor to be dismissed. However, the virtual stagnation of development due to the economic slump, brought little call for new cadastral surveys, and permitted this handful of remaining staff to keep pace with some of the demand, but not, of course, to do any triangulation or maintenance of topographical mapping nor to prepare for the day when the economy recovered and surveys of all kinds would be needed instantly.
The cadastral survey work conducted prior to the existence of any triangulation was of very mixed quality. Much of it was conducted by obsolete methods with poor instruments, and virtually no records now exist other than the deed plans or the copy of the surveyor's plan that did not contain the data (see item 7 of Specifications for Diagrams, page 66). The Land Office required a plan for the purpose of defining the portion of Crown Land leased or sold but was not able to supervise the quality of the work that was presented, and provided the elementary requirements listed in the Specification appeared to have been complied with, virtually any plan was accepted.

From 1906 when the Survey Department was reorganised and enlarged with Trigonometrical and Cadastral Branches, the quality of work improved and as surveys began to be based on the triangulation control even properties some distance from the Uganda Railway could be accurately positioned relative to each other.

The standard method of survey was by triangulation to break down from the second order Kenya Major network to minor orders and then, depending on the terrain, either triangulation or traverse to coordinate the corner beacons.
Survey Instruments

The instruments employed were the usual micrometer transit theodolites of the day; heavy bronze and gun metal instruments with opaque circles and graduations to 10 minutes of arc engraved on German silver insets. These were read to a single second by micrometer microscopes, two for each circle.

The instrument illustrated in Plate 1, page 78, is from the museum of the University Department of Surveying and Photogrammetry. It has a 5½ inch diameter horizontal circle, and was made by Troughton and Simms of London for the East Africa Protectorate Cadastral Branch in about 1910. This was the standard instrument in the Department until about 1935. The 5 or 5½ inch circle model was used for minor triangulation and traverse, and the 8 inch version for the observation of the Kenya Major triangulation.

The earliest modern glass arc theodolite introduced into Kenya was in 1927, a Zeiss Th 1 illustrated in Plate 2 page 79, which is from the same collection of representative instruments. By the outbreak of the war in 1939 more surveys were being observed with Zeiss or Wild instruments than
Plate 1
5½ inch Micrometer Transit Theodolite
by Troughton & Simms London 1910
Plate 2 - Zeiss Th 1 Theodolite 1927
with the opaque circle theodolites, although the last of these old instruments were still in active use for production cadastral surveys by several elderly Licensed Surveyors as lately as 1953.

The breakdown of triangulation by tertiary and minor networks was normally computed by the Direction Method of semi-graphic adjustment. This method was brought to Kenya by surveyors from South Africa in which country such triangulation has been brought to the state of a fine art. Indeed a former Director of Surveys has observed that some South African surveyors were so addicted to their art that they would lay out a tennis court by triangulation (Baker, 1924)

The Direction Method is ideal for cadastral survey for adjusting small networks and coordinating farm beacons under field conditions. The computations are very simple, and the spread of orientation corrections in the bearing sheet, and the error figure graphs of each station, provide a continuous check on the observations, the quality of the datum used, and the validity of the new coordinates.

The method as used in Kenya has been the subject of a number of published papers, in particular Atkinson (1958), Dixon (1959), Williams (1961), Dyus (1962) and Halliday (1962), and will not therefore be
discussed in more detail here.

**Traversing Standards**

Traverses were measured by 300, 500 or 700 foot steel bands, tensioned by spring balance and checked for standard length against a 300 foot base laid out in front of the Survey Office in Nairobi, and corrected for temperature, slope and sag where necessary, and reduced to sea level. This latter correction in the highlands of Kenya where the highest farms are over 9000 feet above sea level can represent a correction of 0.05%. The first standard of closure permitted in traverses between fixed points was 1/2000 but normally 1/5000 was achieved. The permitted misclosure was reduced by successive Survey Regulations as the standard and density of control increased.

In 1908 the maximum misclosure allowed in "rigorous farm traverse" was 1/2000. In 1923 the requirement was 1/3000, and in townships 1/4000. By the 1951 Regulations, closures of 1/5000 between previously fixed points, or 1/7000 when closing back onto the starting point were demanded for rural work, and 1/6000 and 1/8000 in townships. The latest regulations, 1969, specify that all third order traverses in built-up areas "shall be double-chained, and field operations shall be appropriate to a
standard of accuracy of not less than 1/20 000."
All other control traverse "field operations shall be appropriate to a standard of accuracy of 1/10 000, but computational misclosures shall be allowed to the same degree of accuracy as the datum supplied by the Director."

To support this call for accuracy, a 300 foot standard base was constructed in 1954 in a special calibration chamber at the new Field Headquarters of the Survey Department where all steel bands used for cadastral surveys, whether by government or licensed surveyors, must be checked at regular intervals.

The standards of field accuracy appeared unrealistic to surveyors trained in the British tradition of ground taping and marking with arrows, but to the Kenya surveyor familiar with catenary traversing procedures, and using a band of 500 or 700 feet length, 1/16th or 1/20th inch width, in 27 gauge steel (approximately 1/64th inch thickness), they are very commonplace accuracies. The long band was brought to Kenya by Australian and New Zealand surveyors, but since the refinements of the method are not normally considered in English publications except as base line techniques, and are not explained in such local publications as the Survey of Kenya
Manual it is perhaps worth outlining the essentials of the technique.

The band itself is light, weighing approximately 0.30 lb/100 feet or 0.15 kg/30 metre length. The dimensions are as given above in imperial units, but the same gauge of steel is now supplied in 180 metre lengths. The band is wound on a brass drum fitted with a leather hand loop and a friction brake on the revolving portion.

The method of graduating the band is a key to the simplicity and speed of operation. It is similar to the drawn scale line on a map. The zero is 100 feet from one end of the band and the graduations run outwards in both directions from the zero. On the reader side, from 0 to 100, each 10 foot graduation is marked on a numbered brass sleeve. Between these graduations plain brass tabs mark each foot, with the 5 foot marks a different shape and slightly larger. In the other direction sleeves mark only the whole hundred feet points, numbered 1 to 4 on the 500 foot band, 1 to 6 on the 700 foot band.

The metric version of the band has a 10 metre reader length with numbered metre marks and plain 20 centimetre tabs, and in the other direction each 10 metre point has a mark numbered from 1 to 17.
In measuring a traverse line AB, the theodolite is plumbed over the mark at station A, and the traverse angles are observed while the chainman goes forward to station B unreeling the band from the drum as he goes. If B is more than a band length away he places a traverse tripod near the end of the band. The surveyor directs the chainman to place his tripod on line to B, and then aligns one or more assistants at whole 100 marks to give roughly equal sag bays. They support the band on a finger moved up or down a ranging rod as directed until the supports lie on the line from theodolite to tripod measuring mark. Fifteen pounds tension (7 kg) is applied by spring balance attached to the band by a grip while the forward chainman holds his 100 mark against the point of the traverse tripod. The interval from the band graduation on the reader short of the theodolite to the trunnion axis end mark is measured by a scale. Plates 3 and 4, pages 85 and 86, illustrate the general appearance of the procedure.

After booking, a second tensioning and measurement is taken. The chainman signals his number of hundreds, the catenary supporters do likewise, and these are booked to give the total measurement and the information needed to ascertain the catenary
Plate 3 - Catenary Traversing With Long Band
Plate 4 - Catenary Traversing with Long Band (detail)
bays for the sag correction. The vertical angle is measured while the band is wound up by the forward chainman. A traverse tripod is plumbed at A for the angular observations from B and the theodolite is carried forward to B or another band length beyond the front tripod, the position being determined by the tensioning chainman taking forward the reader end of the band as he passes the chainman at the first intermediate tripod.

The process is rapid and trouble free with a well trained team which in Kenya is usually the surveyor, two chainmen and two labourers. In New Zealand the team is frequently the surveyor and one chainman, in which case intermediate catenary supports are omitted.

Experiments by the author have shown that no significant improvement is made in ordinary work by the substitution for the finger of a knife edge, a pencil or a roller bearing as an intermediate catenary support, so long as the finger does not trap the band against the ranging rod support.

Finn (1951) has shown that standards of 1/30 000 - 1/40 000 are common in normal good class catenary taping in Kenya.
The varied terrain of Kenya gives ample scope for both traverse and triangulation techniques, whether using theodolite and steel band or modern E.D.M. apparatus.

Various models of E.D.M. equipment are used in Kenya both long and short range. The Tellurometer is extensively used in extending the control network and in supplying ground control for photogrammetric mapping, and a number of the short range infra-red instruments, such as the Kern DM 2 000 and Wild Distomat, are in use for traversing, but the very high capital cost and servicing problems serve to ensure that most small cadastral survey parties use the old established labour intensive methods for much of the time.

Subdivisions

Surveys of subdivisions of a registered property are conducted under the same regulations and by the same methods as have been described here for original alienations, with the added constraint of the boundary data of the authenticated deed plan of the title. Both subdivision and any portion remaining in the head title must be beaconed as separate entities.
The survey of any subdivision is subjected to the same checking process and authentication by the Director of Surveys as is an original alienation.

Subdivisions of alienated land are not normally conducted by Government surveyors, but by registered Licensed Surveyors. Regardless of this, all survey records become Government property, and the field notes, computations and plans are filed in the Survey Records Office, where they are available as survey data for all other cadastral surveyors.

A deed plan of each subdivision is prepared and authenticated as before, and no sale or transfer of the title to the sub-division will have any legal validity until it is registered.

Re-establishment of Lost Boundaries

The process of locating or re-establishing a lost boundary or beacon is undertaken by a Licensed Surveyor at the owner's request. It is conducted by using the original survey data and any convenient control to place new beacons in the identical positions to the original.

The restoration of an old survey when the original control and beacons have disappeared sometimes involves a process of reconciliation of inconsistent survey data but it is normally possible
on any post-1919 property when the standards were raised on the introduction of guaranteed titles in the Registration of Titles Act.

Land owners are usually satisfied with the surveyor's re-establishment and disputes over boundaries are very rare indeed.

Any re-establishment survey must be submitted to the Director of Surveys for checking the same as subdivision or original alienation surveys. The field notes and computations are filed with the records of the original survey.

**Summary of Procedure in Government Lands**

To summarise the methods of cadastral survey of Government Land for alienation, and subsequent mutations.

Each property is beaconned at every corner, the beacons being set out to give a specified area, or to fit between given limits, in accordance with an approved development plan from the Commissioner of Lands, or, before 1915, after the boundaries of selected land had been approved by the Land Officer.

These beacons are coordinated in terms of the best available system of national control by triangulation and traverse. Any natural boundaries
such as rivers or the railway are surveyed by traverse and offsets, or tacheometry. When aerial photographs are available rivers can be surveyed from them by a simple radial line plot confirmed by field checks.

Areas are computed from coordinates, and portions enclosed by curvilinear boundaries are measured by planimeter from a plotted river plan at a minimum scale of 1/5 000. The area derived by planimeter is reduced to not more than ten per cent of the total by the use of scaled coordinates of subsidiary points. The area was quoted to four decimals of an acre for plots of less than one third of an acre, and to the nearest acre for plots of over 500 acres with other decimal specifications between these extremes. Metric areas are now quoted to four decimals of a hectare below one hectare, three decimals between one and ten hectares, two decimals between ten and one hundred, and a single decimal for areas over one hundred hectares.

The survey is plotted on a plan at a scale specified by the regulations according to the area, and showing the final adjusted coordinates of all the datum control stations used, all the new control established, all the datum boundary beacons, and all the new boundary beacons. The lengths and bearings of every boundary were given to one decimal of a
foot in rural surveys, and two decimals in urban plots. In the metric system all dimensions are now given to 0.01 metre.

Survey Records

A photo reduction of a surveyor's plan is given as Fig. 2 page 93.

Any control survey that cannot conveniently be plotted on the surveyor's plan is plotted on a separate Triangulation Chart or Standard Traverse Chart and submitted at the same time.

The plan together with all the field notes, computations and surveyor's report are submitted to the Director of Surveys for check and verification, and when the survey has been approved all the records become the permanent possessions of the State and are filed in the Survey Records Office of the Survey of Kenya, where they are available for use as data by all Government and Licensed Land Surveyors.

After approval of the survey by the Director of Surveys a Deed Plan (Fig. 1 page 41) is prepared. This is on linen and is traced directly from the surveyor's plan and shows the boundary dimensions and directions, and the area of the plot, and its unique number assigned by the Survey Records Office. The Deed Plan is checked and a copy is sent to the
Fig 2 - Registration of Titles Act Surveyors Plan
Commissioner of Lands for inclusion in the Deed of Grant of the land to the new owner. The registration of the grant before issue by the Commissioner validates the whole process.

Application of Registered Lands Act

When the Registered Land Act is applied to any area already surveyed in the manner just described each plot will receive a new number in accordance with the Registration Section and Block system used in that Act but the boundaries of the plots will remain as on the original Deed Plans, which now assume the status of a filed plan, and the plots are noted in the Register as having "fixed boundaries" under Section 22(3) of the Act, as described in the previous chapter.

Settlement Scheme Surveys

Before leaving this account of the cadastral survey of Government Land under the Government Lands Act and the Registration of Titles Act, some consideration must be given to the surveys for Settlement Schemes.

The Settlement Schemes were introduced in 1961 as Kenya approached independence and entailed the purchase by Government of hundreds of productive mixed farms in the Kenya Highlands, the alienated
Government Land just discussed, for the purpose of settling many thousands of African families.

Because the Scheme proposed the planned subdivision of groups of existing farms into small holdings for some 60,000 families at the rate of 200,000 acres a year for five years, it became known as the Million-Acre Scheme. The first million acres were to be followed by a second million, as finance was provided to purchase farms and implement the process of settlement.

As the land was registered under the Government Lands Act and it was originally proposed that settlers would get individual titles under this Act, cadastral survey of the boundaries was involved and can be discussed here.

The organisation and implementation of the Settlement Schemes is a vast subject, a whole new Department of Settlement was set up by the Government to organise the process, and this thesis must confine itself to the survey aspects alone and in particular to the cadastral survey.

In brief the stages of settlement are:

(i) The selection, valuation and purchase of suitable blocks of land by Government.
(ii) The planning, on agricultural criteria, of either high density or low density small holdings, together with the necessary villages to provide services and social centres for the new settlers.

(iii) The layout on the ground of the plots and villages so planned.

(iv) The cadastral survey of the properties created.

The planning was carried out by the Agricultural Department on topographical base maps made for the purpose by the Survey of Kenya. The maps were prepared by photogrammetric methods at a scale of 1/2 500 with contours at 10 feet vertical interval.

The ground control necessary for the photogrammetric mapping was surveyed mainly by Tellurometer, and at the same time additional control points were fixed by both E.D.M. methods and traverse to assist in the laying out of the plan and in the subsequent title survey.

The plots were designed on sound agricultural principles, and were intended to give subsistence and a cash return, at various levels according to the density of plots and the capital available, to a settler and his family. The boundaries were demarcated by the Soil Conservation Service surveyors. These
boundaries were cut-off drains, conservation ditches and roads put on the ground by earth moving machinery, and drainage lines and streams.

Included in the Settlement Loans made to the new farmers was money for fencing, and a condition of the grant of land was that boundaries should be fenced. Thus the boundaries would eventually be physically demarcated on the ground, and it was logical to consider registration under the general boundaries provisions of the Land Registration (Special Areas) Ordinance rather than by coordinating beacons under the Survey Act to register under the Registration of Titles Act.

The result was that each area bought for settlement was excised from the Scheduled Areas and brought under the Special Areas, and the Land Registration Ordinance was applied. After 1963 the Registered Land Act automatically superseded the Land Registration Ordinance.

The original Demarcation Plan became the interim Registry Map, and a new air survey at 1/2 500 of the boundaries as finally established by the settlers will become the final Registry Index Map.
The procedure is thus very akin to the mapping under the Land Consolidation Schemes to be discussed in the next section, even though the one hundred and thirty Settlement Schemes were established in Government Lands areas.

Cadastral Survey of the Coast Lands

The second classification of land in Kenya is the Coast Land, the ten mile strip leased from the Sultan of Zanzibar by the Treaty of 1895. Within this strip ownership of land subsisting under the rule of the Sultan was to be accepted as valid by the new Protectorate Government.

However, in the early years of the century a number of purchases by settlers from ostensible owners had proved to be based on fraudulent claims, and a general feeling of insecurity existed with a consequent unwillingness to undertake any development of the land until the uncertainties had been resolved.

The Land Titles Act 1908 was introduced "for the removal of doubts that have arisen in regard to titles to land." The process would also serve to disclose what land was not legitimately occupied, and was therefore Government Land and available for alienation.
The doubts arose from the numerous ways in which title to land could be claimed under the Islamic law recognised by the Sultan and the Arab population, and from the different laws of inheritance existing among the nine tribes of the coast by which title could be transmitted, compounded by transactions between new comers and proprietors whose claims to ownership were disputed.

Land could be claimed in any of the following ways:

(a) Direct grant from the Sultan
(b) Open occupation of vacant land and demarcation of boundaries, under ordinary Islamic Law.
(c) Intermarriage with indigenous occupants of land under tribal customary law
(d) Purchase from any of the above owners
(e) Inheritance from an owner who had acquired land by any of the above means.

The investigation and determination of claims to land was entrusted by the Act to a Land Registration Court presided over by a Recorder of Titles. A qualified surveyor was a member of the court with the duty of surveying the adjudicated claims prior to the issue of freehold Certificates of Title.
The Act was applied by proclamation to an area of convenient size and the Recorder received the claims to ownership and lesser interests in the area during a set period of time. The surveyor then took a team of demarcators into the field and arranged for all claims to be demarcated on the ground and a sketch plan made by prismatic compass and tape survey.

If there were no disputes in the following six months a normal cadastral survey of the demarcated boundaries was made in the manner already described for the alienation of Government Land.

There were almost always disputes, often over the ownership of single coconut or mango trees, usually arising from the complications of the differing laws of inheritance among the coast tribes. These disputes were settled by an Arbitration Board and the resulting boundary changes were demarcated by adding more corner beacons to the already irregular pattern of plots.

When the disputes had been settled the survey team moved in to make a cadastral survey of the now agreed boundaries.
Control Survey

The survey was controlled by the Kenya Major Triangulation which reached the coast in the Athi-Mombasa Series in 1908, and was continued north and south of Mombasa between 1908 and 1922 (Map 4 page 7). Coordinates of the Kenya Major were computed on the Cassini-Soldner projection in two degree panels referred to the Equator and to the odd numbered degrees of longitude as central meridians. However, the surveyors employed on the Coast Lands Title surveys broke down the Kenya Major net into minor triangulation schemes to control the various adjudication blocks as they were proclaimed, but computed the coordinates of these minor schemes by plane trigonometry, no doubt in the interests of speed and economy which were constantly being demanded. (It is perhaps not irrelevant that no simple correction tables for the Cassini-Soldner Projection were available in the Survey of Kenya until 1960).

Much of the coast lies near the edge of the panel referred to 39° East Longitude, and the scale distortion at Mombasa is already approximately 1/10 000, increasing as the coast tends further from the central meridian of the panel. In order to maintain internal consistency of the minor schemes computed on the plane between Major Stations computed on the projection, the surveyors produced a "local
solution" which paralleled the makeshift already mentioned when junctions occurred between different series of the Major network. They produced "revised local coordinates" of any Kenya Major Stations that did not fit their local scheme.

The result was that some Kenya Major Triangulation points acquired several "local values" differing from one another by several feet, each value being appropriate to surveys in different directions from the station.

The control traverses between minor triangulation stations were conducted by standard 5" micrometer transit theodolites and steel bands with appropriate corrections for temperature and slope, which would permit measurement of the order of accuracy of 1/20 000, as previously mentioned. The Survey Regulations of the day however permitted misclosures of 1/2 000. The insidious effect of this disparity between capability and allowable misclosure was that gross traverse errors were not infrequently concealed by a poor but allowable misclosure.

The control was thus not all that it could have been, and the coordination of the demarcated plot beacons was sometimes inconsistent with their ground positions. However, while control points and
corner beacons were permanently marked by iron pegs in cement, as was the case on Mombasa Island, no serious problems resulted from this doubtful reliability. The ground evidence of demarcation remained to prevent disputes arising.

Economies Introduced
The pressure for economy increased and the method of coordinating property beacons by theodolite traversing was found to be too slow and costly, and quite out of proportion to the value of the land or to the survey fees recoverable under the Act. The fees had deliberately been set at a low level for several reasons, including the value of the land, the apparent poverty of the Arab and African owners, and the fact that the whole process was considered to be merely a confirmation of existing ownership. But even these low fees could be remitted or reduced on claims of hardship.

Cheaper methods were called for, and the first of these was to conduct the survey of property beacons by prismatic compass surveys between sparser theodolite traverses. The compass surveys were not computed and checked, but plotted directly by protractor and scale at a plan scale of 1/2 500, and then adjusted graphically between the plotted control points. With the small plots and many corner beacons this practice was
wide open to error and drawing inaccuracy.

But one last economy was enforced. The beaconning of corners with iron pins in cement continued for some distance away from Mombasa Island, but as the less prosperous areas were reached the use of wooden posts instead of iron pins for corner beacons was introduced. In a tropical land of termites and rapid decay this was a policy that could only lead to future trouble, and within a short while, in some cases even between the adjudication demarcation and the title survey, the posts had disappeared, leaving a cadastral survey on paper, and that of problematic reliability, without a corresponding array of defined plots on the ground.

To add to future confusion many land owners replaced the wooden posts with coral blocks or distinctive trees, but not always in the original positions as they were not averse to correcting "errors" in the demarcation.

The process continued, and on the basis of these cadastral plans properties were registered and Certificates of Title issued to successful claimants. In 1920 the Registration of Titles Act was applied to the Coast replacing the registration provisions of the Land Titles Act, and the indifferent plans were
now deemed sufficient to support indefeasible freehold titles backed by the Government indemnity offered by the 1919 Act.

Abolition of Recorder

In 1923 the Office of Recorder was abolished and it was claimed that for all practical purposes the work in the main areas of development had been completed.

There followed the retrenchment of all surveyors below the rank of District Surveyor, and work came virtually to a halt. Several thousand plots had been registered, and the process disclosed what land was unclaimed and was therefore Government Land, available for alienation. But at the time it was also estimated that approximately 4,500 claims remained unresolved throughout the coastal strip, and that between 15,000 and 20,000 acres of government land could not be alienated due to unresolved claims in the area.

The world recession that caused the retrenchments also acted to restrain development and the demand for the alienation of new plots, but could not prevent further complication of titles and claims by deaths and inheritance and private sales, which remained, together with the legacy of low standard survey and
bad ground definition, to bedevil future develop-
ment at the coast and serve as an awful warning that
cheap expedients prove more costly in the long run.
This is not however a lesson that commends itself
to Treasuries; as Dowson and Sheppard put it
... the basic necessity ... that the units
of land ... should be so defined that they
can be located ... at any time on the ground
... too often presents itself (to administrators
and their legal advisers) as a tedious and
costly refinement ... (Dowson, 1952)

Despite the strong recommendation of the
Kenya Land Commission 1933 that the work of adjudi-
cation should be continued and proceed energetically,
survey of Coast Land Titles was not resumed until
1955 when the Office of Recorder was again filled.
Adjudication, demarcation and survey continued for a
further four years but this time without false
economies. The demarcation was by permanent beacons,
either iron pins in cement or small precast concrete
blocks, which were surveyed by subsidiary theodolite
traverses to a modest standard of accuracy, but
controlled by surround traverses with permanently
marked stations, properly computed and adjusted
between triangulation stations. The triangulation was
the new primary and secondary network, not the original
Kenya Major series.

The adjudicated plots were registered under the Registration of Titles Act 1919 as previously. In 1959 the Recorder of Titles resigned, and as no replacement was appointed adjudication again came to a halt.

**Application of Registered Lands Act**

By the time a new Recorder was appointed in 1964 much experience had been gained of more rapid adjudication of claims than the Registration Court procedure of the Land Titles Act. In Central Province the massive land consolidation programmes had been conducted, and new legislation introduced to speed up and simplify all stages of the process both of adjudication and survey. The Registered Land Act 1963 offered a simpler method with the aid of aerial photography of mapping the adjudicated claims and of registering title than did the Land Titles Act.

The remaining unadjudicated areas of Coast Land principally the Island of Lamu and the extreme south of the coastal strip were completed by 1972, using a mixture of photogrammetric mapping for the rural areas, and ground survey for the villages and towns.
Re-establishment of Lost Boundaries

The re-establishment of the guaranteed boundaries in areas where the bad beaconning and poor surveys had occurred before 1923 remained a major headache for all coast surveyors and land owners, and the disputes and uncertainties delayed sales and subdivisions and held up development in the area for many years. A major problem of illegal squatting on Government Land and private property in some coast areas, directly attributable to uncertain boundaries became a regular feature of the Coast Province in the years approaching and following independence.

Direct re-establishment of beacons by survey data in the manner described in the previous section was seldom possible. The regulations allowed surveys by prismatic compass for subdivision and re-establishment where the original survey had been by compass, but even so a purely survey solution seldom agreed with the development on the ground.

In many places what was referred to as "Private Re-demarcation" - the process of replacing wooden posts mentioned earlier - had become accepted in the intervening years and had acquired the status of boundaries by prescriptive right, but other areas were almost devoid of boundary marks of any description.
A District Surveyor at Mombasa summed up the situation by saying: "It is very unlikely now that any honest surveyor can re-establish any plot in this area and feel 100% certain of having reproduced the original ..." (Dalgleish 1953).

Cadastral Survey in the Trust Lands

The lands occupied by the native inhabitants of Kenya as defined by the Native Lands Ordinance 1938 and known as Special Areas and Trust Lands were administered on the basis of customary law. All land matters were dealt with by the tribal elders or the African Courts.

Ownership and transactions were maintained without any form of registration or survey except for those very limited areas which Government had permitted to be sold, leased or given away for some purpose that would be of benefit to the local inhabitants. These were usually religious missions which set up churches, schools and hospitals, and the land on which they stood was "set apart" from the tribal land and brought under the Government Lands Act. The plots were then surveyed and leased in accordance with the provisions of that Act, and up until the 1950's were the only cadastral surveys performed in the Trust Lands.
After the Second World War the need for agricultural reform to conserve the soil and increase food production in the crowded Central Province became pressing, and the process of land consolidation began tentatively at first in 1949 in Nyeri, and in earnest in 1955 throughout Central Province.

The intention was to ascertain the ownership of every small fragment of land in an area, and gather each owner's scattered fragments into a single plot. The new larger plots were then to be marked out on the ground and defined by planting hedges, and a register of each owner's holding and the size of his plot was to be prepared.

The plots thus created could not be registered under existing legislation without a cadastral survey. However, cadastral survey of the kind prescribed under the Survey Act for titles to Government Land, with beaconed corner points positioned by accurate survey using ground methods, was quite patently not a practical solution to the problems of describing many thousands of small irregularly shaped plots in a reasonable period of time, even if enough surveyors could have been found. Other methods were essential.

As it was the intention that all plots should be physically defined on the ground by hedges or
fences, without coordinated corner beacons, it was now proposed that the boundary features themselves should define the boundaries, and that any survey should be for the purpose of providing only an index to the Register, and a rough guide to where on the ground would be found a physical boundary feature. The relocation of any boundary, should the physical feature be lost or destroyed, would be by the Land Registrar employing oral or physical evidence on the site, such as consulting neighbours or the demarcators of the plot at the time of original consolidation.

The size and shape of plots as shown by the simple surveys used in the fragment measurement and demarcation stages for the preparation of the Register would be sufficient to provide an index map under such a system.

New legislation was proposed to permit this change from authoritative accurate survey to what were referred to as "general boundaries," and the consolidation programme began under temporary Rules proposed for the Native Lands Ordinance while substantive legislation was being prepared.
A New Ordinance

From 1959 the programme was conducted under the Land Registration (Special Areas) Ordinance, already outlined in a previous chapter, and from 1963 the registration aspects of this Ordinance were replaced by the Registered Land Act, while the adjudication aspects of the Ordinance were put under either the Land Adjudication Act or the Land Consolidation Act as appropriate.

The legislation recognised that the size and shape of plots as roughly surveyed might be found by the owner at a later date to be in error, and so arranged for the register to be rectified if a later survey revealed any differences in area or measurement, and for a better map to be substituted for the one found to be faulty.

It was argued that any such alteration in the Register was only a book keeping correction, and that merely to obtain a more accurate determination of the size and shape of the plot physically demarcated on the ground, and accepted by the landowner under a certificate of agreement in exchange for his fragments, could not alter in any material way what he possessed.
For this argument to have any validity, clearly the original survey of the fragments and the demarcation of the re-allocated plots must be of reasonable accuracy, and be of a standard that could ensure that no significant errors of demarcation occurred. The simple surveys conducted by the minimally trained Administration "fragment gatherers" clearly could not guarantee this standard.

The Survey of Kenya proposed air survey to provide topographical base maps both for providing checks on the total area in a consolidation unit, and as a guide for the planning of the re-allocation and for the demarcation of the plan on the ground.

A second photogrammetric mapping of the re-planned area when the new boundaries were established would provide an accurate representation of what existed on the ground and could be used for rectifying the Register and to provide additional independent evidence for the re-location of lost boundaries.

The first photogrammetric mapping was termed "base mapping", and the second "refly mapping."

The evolution of the land consolidation process in Kenya has been minutely described in a number of papers by Ratzeburg (1959), (1967) Warren (1963)
and Sorrenson (1967) and it would be tedious to recount all the methods tried and discarded before the accepted practices were formulated. For the purpose of this thesis it will suffice to summarise the main steps to title survey.

Title Mapping for Land Consolidation

The various stages in the process of survey for title in the Trust Lands, and the division of responsibility among the Government Departments involved are as follows.

(a) Triangulation and the provision of control.
   Survey of Kenya.

(b) Declaration of a Consolidation Area and publicity of the intention to consolidate and register land. The appointment of Adjudication Officer, Local Committee, Demarcation Officer, and Arbitration Boards as required by the law.
   Administration.

(c) The determination and recording of rights by the Local Committee. Appeals against the record and finalizing of the Record of Rights.
   Administration.

(d) Measurement of the fragments - the individual pieces of land comprising each right holder's land. The simplest of chain survey methods were used by junior survey assistants with a minimum of training.
   Administration.
(e) The marking and clearing of the perimeter of the consolidation unit ready for air photography.

Administration

(f) Air photography of the area, and the survey of the ground control.

Survey of Kenya.

(g) Production of base maps by photogrammetric mapping of all relevant topographic detail, with form lines, at 1/5000 scale. Enlargement by photography of the machine plots to 1/2 500 scale. Computation of the planimetric area of the consolidation unit.

Survey of Kenya.

(h) Reconciliation of the summation of the fragments with the area of the consolidation unit computed in (g) above. A percentage reduction from each owner's total holding to provide land for roads, village, schools and service sites for the local community. Preparation of the Demarcation Plan, the design on the base map of the re-allocation of land. The demarcation of this design on the ground. The planting of hedges along the agreed demarcated boundaries.

Administration, Local Committee, Demarcation Officer and land owners.
(i) Fair drawing of the field Demarcation Plans showing boundaries only, and incorporating any changes made and surveyed by the demarcation team during the demarcation in the field. Computation of areas by planimeter.

Survey of Kenya.

(j) Preparation of the Land Register. Plots are identified by a number within a named Registration Section within a named Registration District.

Administration.

After an interval of time to allow hedges to grow and become visible from the air:-

(k) New air photography and "refly mapping" by photogrammetry for production of Registry Map at 1/2 500 scale, without contours, and showing cadastral boundaries only. Computation of areas.

Survey of Kenya.

(l) Substitution in the Registry of the final Registry Map for the Demarcation Plan.

Administration.

(m) Once this substitution has taken place the Survey of Kenya assumes responsibility for the survey of mutations and the production of new editions of the Registry Map to reflect these mutations.
The Survey of Kenya has always referred to these maps as the Demarcation Plan and the Registry Index Map (R.I.M.). This is to emphasise that the Demarcation Plan is not an accurate survey but only a diagram of what it was intended should be marked on the ground. The use of the word "Index" is to emphasise that both maps, however accurate they may be, are not authorities on boundaries under the Registered Land Act. Only if boundaries have been "fixed" under Section 22 of the Act is the map any more than an index to what the Registrar determines is the boundary on the ground.

Fundamentals of Consolidation Mapping

Clearly for a system of cadastral mapping to be based on topographic survey of fences and hedges by photogrammetry, these boundary features must exist on the ground, and appear on the air photographs for identification by the plotting machine operator. Physical enclosure of the plots is thus of fundamental importance to the whole mapping and registration process.

The re-allocation of land and the siting and demarcation of the new holdings is a very public process, with the Local Committee making its decisions in the presence and with the agreement of all the
landowners. Similarly the demarcation of the boundaries by the African surveyor on the basis of the agreed demarcation plan is carried out in the presence of the landowner. If the owner accepts the boundaries as demarcated on the ground he must sign a certificate of agreement, in which he signifies his acceptance of the plot as demarcated, that he can see in front of him, in exchange for his fragments. This is an important certificate.

If the final survey reveals a plot of a different size and shape from that appearing on the demarcation plan the Registrar may rectify the Register to reflect the final figures, but "as between Government and the proprietor no claim for indemnity shall arise and no suit shall be maintained on account of any surplus or deficiency in the area or measurements of any land disclosed by a survey ... " (R.L.A. Section 148). The Registrar cannot alter the situation that exists on the ground, he can only rectify the Register to reflect what is on the ground.

From this it can be seen that if wholesale discontent is not to arise such differences, between the intention at demarcation and the reality revealed by the subsequent survey, must be kept small. The quality and the integrity of the fragment surveyors and the demarcation surveyors and the supervision of
these processes are critical in this respect.

When the Registry Map and the Demarcation Plan are compared before substitution, any boundaries that are missing because they have not appeared on the refly photographs must be located on the ground and added by ground survey. Similarly any misidentification of a non-boundary feature that has been plotted as a boundary by the photogrammetrist must be checked if possible.

The number of these "refly queries" is a function of the quality and completeness of the ground demarcation. The intention of the Survey of Kenya has been not to undertake the refly photography until 90% of the boundaries are hedged. This has been very difficult to ensure and has seldom been achieved. However, because the overall cost of mapping increases alarmingly when many refly queries must be resolved by ground survey, the Survey of Kenya now employs a team of hedge inspectors to ensure maximum visibility of hedges immediately before refly photography is taken. The inspectors have achieved a substantial reduction in refly queries.
Preliminary Index Diagrams in Enclosure Areas

Not all Native Lands in Kenya have suffered the excessive fragmentation that existed in Central Province. In many districts no consolidation is necessary, only an adjudication of existing rights and the mapping of the boundaries of the plots so confirmed. These areas are referred to as Enclosure Areas.

In such areas the boundaries are identified on an enlargement of the airphotograph as the adjudication takes place.

The Land Adjudication Department is responsible for the administrative decisions such as selecting the area to be adjudicated, establishing the necessary Local Committees, and preparing the adjudication register. The area selected is divided into Adjudication Sections and the perimeters of the Sections are marked on the 1/50 000 topographic map.

Air photography of the sections is taken at a scale of 1/12 500 or 1/25 000 depending on the size of the plots in the district. A representative enlargement factor is derived for the whole section by comparing a selection of distances between detail points on the 1/50 000 map and their images on the prints, and enlargements to an average scale of
1/2 500 or 1/5 000 are made to give complete coverage of the section in pictures of convenient size to handle in the field.

These prints are unrectified enlargements to an average scale, and of course contain all the scale distortions due to tilt and relief that are inherent in aerial photography.

In the field a photo-interpreter identifies on the enlargement the boundaries that are pointed out to him by the adjudicator. In areas of good enclosure this will be a simple matter of identifying a feature visible on the photograph and marking it with chinagraph coloured pencil. If the boundary is not physically marked the position is plotted by simple map reading supported, if absolutely essential, by measurements for which the local scale of the photograph must be derived from comparison of distances between ground objects and their photograph images.

Boundaries are marked with various colours and symbols to show the following information:
(a) boundary defined on the ground and appearing on the photograph - the ideal case,
(b) boundary defined on the ground, but not appearing on the photograph - perhaps planted after photography,
(c) boundary not defined on the ground and not appearing on the photograph - its position is decided during adjudication, and the owner should plant a hedge,

(d) boundary defined on the ground but can only be approximately identified on photograph - a line in bush or very open country,

(e) the perimeter of the adjudication section,

(f) the limit of identifications on the particular photograph,

(g) the number of each plot, in agreement with the adjudication register.

The enlargements making up each section are checked to ensure that no plots in the register are omitted, nor have any been identified on more than one photograph, and that the identified line marking the section perimeter is the same line as that marked for adjacent sections. These lines may not look alike on different enlargements but they must follow the images of the same features on both.

The lines are then overwritten by a coloured marking pen, and together with the adjudication register are put on public display for the sixty day
period allowed for objections to the register.

When objections have been resolved by the local committee the photographs are sent to the drawing office and a tracing on astrafoil is prepared showing all the boundaries. Areas are taken from these tracings by planimeter.

The photographs are filed and are available if required by the local Land Registry.

The tracings are annotated with the details of the Registration District and Section, and the plot numbers, and they become the initial Registry Map. Because it is distorted and not true to scale it is called a Preliminary Index Diagram.

To obtain a true map to scale and with undistorted boundaries, the same photographs can be plotted in a photogrammetric plotter once ground control has been established, and become a final Registry Map.

An example of a Preliminary Index Diagram is given as Fig. 4 page 126. The pecked lines are boundaries not defined by a physical feature on the ground, solid lines are boundaries defined and visible on the photograph. The Note and the word "Approx" after the scale differentiate the Preliminary Index Diagram from a final Registry Map.
DISTRICT TESO
LOCATION MARA
MABALE REGISTRATION SECTION
DIAGRAM No. 6
SCALE 1:2,500 (APPROX)

NOTE:
THE BOUNDARIES ON THIS PRELIMINARY INDEX DIAGRAM, WHICH IS PREPARED FROM UNRECTIFIED PHOTO-ENLARGEMENTS, HAVE BEEN IDENTIFIED BY THE LAND ADJUDICATION DEPARTMENT UNDER THE SURVEY OF KENYA SUPERVISION.

Fig 3 - Preliminary Index Diagram
Base Mapping in Enclosure Areas

In certain areas where enclosure is almost total such as Kericho District the adjudication process has been conducted on the 1/2 500 topographical base maps plotted from fully controlled photography. The boundaries thus show as topographic features on the map, and are easily identified by ordinary map reading.

The method is not however as successful as it had been hoped. The map must be prepared before adjudication, and any boundaries not then plotted must be added to the map by ground survey during the adjudication. The adjudication process is often the cause of boundaries being established, so that although the map is immediately ready for use as a final Registry Map, too much ground survey by chaining or plane table renders the total process slower, and more costly.

In the opposite case where there is no enclosure, usually because land is held communally and is only now to be distributed in individual plots, the planning of the allocation is best performed on such full base maps and demarcation can then follow in the same manner as in the Consolidation Areas. Initial registration takes place on the evidence of the Demarcation Plan and a later refly map is substituted when the boundaries have become established.
Range Land Mapping

The ranch lands of the pastoral tribes such as the Masai and Samburu are also part of the Trust Lands but are not suited to individual small plots as are the arable farming lands of the highlands. The inhabitants of these areas nevertheless wish to register their rights of ownership of the land, and adjudication of the range lands has taken place.

To meet the case of many right holders of a large ranch the Land (Group Representatives) Act 1968 was passed, whereby the land is registered as the property of a Group all of whom are named in a Group Constitution but only between three and ten elected Representatives are named in the Land Register.

The boundaries of each ranch follow natural features such as rivers where possible and are otherwise beaconned with substantial monuments. These are coordinated by survey and plotted or identified on the 1/50 000 map, and the Registry Map is prepared at the same scale. The survey is more akin to the Government Lands Act cadastral survey with coordinated beacons but is registered under the Registered Land Act, and coordinates are given to the nearest whole metre.
Survey of Mutations

As noted earlier when considering the various provisions of the Registered Land Act the Registry Map may be amended by the Director of Surveys to reflect any mutations on receipt of written authorization from the Registrar on a completed mutation form. The Director will only amend the Registry Map if he approves the survey on the mutation form.

An example of a completed mutation form is given in Figures 4 and 5, pages 13/1 and 13/2 and may be compared with the surveyor's plan in Fig. 2, page 93. The Act requires the mutation form to be filed.

With the physical boundaries required under this Act whose approximate position is indicated by the Registry Map, the new mutation boundary should first be put onto the ground in the position required, and then surveyed by the minimum method that will enable the line of the boundary to be added to the Registry Map.

Where a final Registry Map exists this is a simple matter of elementary chain survey or a similar method to locate the new boundary in relation to the existing ones, based on scaling between points of detail appearing on the map. The final Registry Map should be to plottable accuracy at 1/2 500 scale, allowing
tolerances of approximately 1.25 metres.

Where the Registry Map is a Demarcation Plan or a Preliminary Index Diagram such scaled dimensions may bear little resemblance to what exists on the ground, and if no boundary demarcation exists either, the line of the mutation boundary can only be added by estimation and guesswork.

Provided that the mutation boundary is physically demarcated at the time on the ground the amended Preliminary Index Diagram will be no worse than the original.

The mutation form illustrated refers to a subdivision of a plot on the Preliminary Index Diagram, Fig. 3 page 126 but would look no different if the Registry Map were final.
Form R.L. 29

**Mutation Form**

*Front*

**Title No.:** Maalse/1117

**Registry Map Sheet No.:** N.6

**Registrar's Instructions to Director of Surveys**

1. Present boundaries of parcel are shown on the sketch below.

2. (a) The proprietor wishes to subdivide as shown by the dotted lines on the sketch.

   or

   (a) The proprietors wish to change their common boundary as shown by the dotted lines on the sketch.

   (b) The new parcel numbers will be:

      Relevant approximate acreage

      2 3 4 7

      2 3 4 8

   (c) Consent of divisional land control board below.

   (d) The persons interested, and their addresses, are:

      **MACHARIA**, **Nkendo, Teso Village**.

      They will meet the District Surveyor on the land at a time appointed by him.

   (e) Please advise when survey effected and registry map amended.

**Sketch**

[To be completed by Registrar]

---

**Date:** 20/4/1976

Assistant Land Registrar.

**Teso** District.

Application approved. Referred.

**Chairman.** **Date:** 30/5/1976

**Divisional Land Control Board.**

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Fig 4 - Registered Land Act mutation Form (Front)
Fig 5 - Registered Land Act Mutation Form (back)
CHAPTER V

AN ASSESSMENT OF CADAstral SURVEYS

In order to assess whether the cadastral survey conducted in Kenya has served and will in the future serve the purpose for which it was intended it is necessary to return to the definition of that purpose.

In the opening chapter the purpose of cadastral survey was related to the construction and working of a dependable land record by defining the units of land "so that they can be located readily, surely and unambiguously at any time on the ground."

This definition assumes that a land record is necessary. The Kenya Government's view is that the advantages of a land record by the registration of titles system are proved, but that registration will not be introduced in any area of Trust Land until a large majority of the holders of rights and interests in the land are sufficiently convinced of those advantages to request adjudication and registration in their area. Registration in alienated Government Land has of course been compulsory since 1915.
Land transactions in unregistered land in Kenya are conducted under customary law, which suffers from all the disadvantages that go with private conveyancing in England, with the added complications of being mainly oral tradition, and of varying from tribe to tribe. The resulting volume of land cases before the African courts was one of the reasons for starting the land consolidation programme.

The Accuracy Required

The Lawrance Mission Report (1966) considered particularly the role of the Registry Map and concluded that it should be sufficiently accurate to allow

(i) the identification of plots
(ii) the computation of areas
(iii) the re-location of boundaries

and (iv) the survey of subdivisions

This definition of the role of the Registry Map was in reference to the Registered Land Act system of physical boundaries, but is in accord with the purpose of cadastral survey already given, and will serve to test the surveys under any of the Acts.
Government Land

Surveys of titles conducted before the Registration of Titles Act were not guaranteed, nor did they carry a Government indemnity. In the early 1950s landowners were offered the opportunity to convert their 99 year leases to 999 years on condition that the survey of the plot was up to the standard of the post 1919 surveys.

The survey of every applicant's farm was investigated and in many cases was not considered sound, mainly due to inadequate survey of river boundaries, and to the original boundary beacons being wooden posts. Resurveys to modern standards, at the land owner's expense, were carried out before the Commissioner of Lands would accept the surrender of 99 year leases and grant 999 year leases.

Surveys conducted to the standard of the 1919 Act which guaranteed title, whether conducted earlier and found to be satisfactory on investigation, or carried out after 1919, are said in Kenya to have "guaranteed boundaries." This expression does not appear in the wording of the Act, but when used by a cadastral surveyor in Kenya it implies that the boundaries have been so defined by survey that at any time they can be re-established in their original
position, to within the known tolerance of the original survey, without recourse to any evidence other than survey data and the ground, by any Surveyor within the meaning of the Survey Act.

To a cadastral surveyor the term "guaranteed boundaries" does not imply that the dimensions on the plan are perfect, nor even that the dimensions are those that will be found by direct measurement between beacons on the ground. In Kenya the dimensions shown on the plan are consistent with the coordinates, and therefore represent the horizontal projection of a portion of the irregular surface of the earth onto a non-existent but mathematically defined curved surface at mean sea level.

From the definition of guaranteed boundaries above it follows that the original survey data must be available to the surveyor. It has been a source of some surprise to the writer to learn while reading for this thesis that some countries consider cadastral survey data and control data private property. In Canada until very recently each Licensed Surveyor kept his own coordinates, and control data is a marketable commodity. South Africa has a similar system, and exchange of data between Surveyors varies from Province to Province.
(Barratt, 1963). This system must lead to much duplicated work, and explains the calls for "integrated surveys" that have been made lately.

The Survey Regulations of Kenya require the permanent deposit in the Survey Records Office of all survey records resulting from any completed cadastral survey, and the Director of Surveys "... shall furnish all technical information in his possession to the (Licensed) surveyor free of charge, ..."

"Guaranteed Boundaries"

By applying the criteria set out above of what constitutes a guaranteed boundary, the writer contends that all cadastral surveys that reach that standard will satisfy all four conditions given by the Lawrance Mission.

The only exceptions that might have to be made are those Coast Land Title surveys to which the Registration of Titles Act was applied from 1920 to 1923 when the adjudication was stopped, where wooden pegs were used as beacons.

Thus all surveys of Government land since 1919 together with the pre-1915 surveys that were tested and found satisfactory will meet the four requirements.
As has been pointed out when considering the surveys for Coast Land Titles, it would not be true to say that all the surveys of adjudicated freehold coast titles conducted before the abolition of the office of Recorder of Titles in 1923 would fail to meet the conditions, but the majority would fail. Titles of the post 1955 adjudication period until the application of the Registered Land Act to coast areas would meet such the requirements.

**Registered Land Act Surveys**

Considering plots registered under the Registered Land Act, can they be said to be defined to meet the requirements?

If boundaries are fixed under Section 22 of the Act they differ from Registration of Titles Act boundaries in minor ways only, for instance it is possible that only part of the perimeter of a plot has fixed boundaries the rest being general, but it may be said that a Registered Land Act plot with a full perimeter of fixed boundaries does fulfil the requirements.

Where boundaries are not fixed but are depicted on a final Registry Map to the standard of plottable accuracy at 1/2500, the plots may also be said to be locatable in the same way as
a fixed boundary provided that the Registrar, who determines boundaries under Section 21(2) of the Act on such evidence as he considers relevant, regards survey evidence as relevant. Most Assistant Land Registrars ask for the assistance of the District Surveyor in boundary determinations, but some do not.

Again if the plots are demarcated by established physical boundaries which are not in dispute, they may be considered to fulfil the condition, regardless of how they have been depicted on the map.

But if the Registry Map is a Demarcation Plan or a Preliminary Index Diagram of unknown accuracy, and the boundaries are either not physically demarcated or are in dispute, then the plots can not be said to be locatable readily, surely or unambiguously.

The Fatal Combination

Examining those surveys or plots that do not satisfy the four conditions, and ignoring for the moment the difference in precision between the surveys by ground methods to 0.01 metres and to plottable accuracy at 1/2500 scale by air survey, what conclusions may be drawn?
The common factor to all the failures is the fatal combination of disputed or missing ground demarcation and bad maps - maps of an unknown standard of accuracy.

It may be concluded that any expedient that produces this fatal combination, will not satisfy the stipulated conditions for a satisfactory cadastral survey.

From the Ground to the Air

In Chapter I it was suggested that the solution to cadastral problems proposed in one era might be inappropriate in another.

It has been shown that both Registration of Titles Act surveys and the Registered Land Act surveys can satisfy the four conditions but at different standards of precision.

Registration of Titles Act surveys provide a very high standard of security, but are open to criticism as being too accurate, too expensive and too slow, and there is some truth in all three contentions, although the first can be relaxed, the second regarded as value for money, and the third is a function of the number of surveyors available.
Between 1905 and 1955 approximately 60,000 titles had been surveyed. When the land consolidation process began it was anticipated that somewhere in the region of 60,000 plots would result in each of the Districts of Kiambu, Fort Hall and Nyeri, with many more thousands of plots in Embu and Meru, and the time scale envisaged for granting individual titles was not fifty years but five. The decision to provide title at this rate was a political one, and it was the duty of the Survey of Kenya as one of the technical services of the Government to advise how best the decision could be implemented without material loss of security of title.

The Survey of Kenya proposed air survey of physically demarcated plots. The standard postulated was plottable accuracy at 1/2500 scale, which was considered a proper correlation between the value and use of the land, the refinement to which boundaries should be measured, an economical mapping scale, and a standard that would be perfectly acceptable to the vast majority of landowners in Kenya, who are small scale farmers.
The two essential elements are present in this scheme to satisfy the requirements of a cadastral survey, ground demarcation and mapping of a known accuracy, and registration is now under the Registered Land Act with a Registry Map.

As a temporary expedient to bring land onto the register quickly, first registration is taking place on Preliminary Index Diagrams and Demarcation Plans, but the Kenya Government on the advice of the Survey of Kenya is wisely resisting the temptation to accept such expedients as good enough alone.

The suggestion that the ground definition will in any case prevail over any map by the action of prescription is another argument against making an accurate map.

The Limitation of Actions Act prevents any action for recovery of land after twelve years of peaceful overt occupation as of right. No doubt this is a sound method of regularizing minor discrepancies between ground and map, but it does not qualify as a method of solving re-establishment or re-location problems and genuine disputes. The very fact that a dispute exists prevents prescriptive rights being acquired in any case.
With recent experience of having to deal with the politically delicate and costly task of removing and resettling large numbers of squatters in the Coast Lands the Government has no intention of allowing the fatal combination of no demarcation and bad maps to repeat the Coast Lands problem in other parts of Kenya.

**Progress of Registration**

The progress to registration of individual titles in the Trust Lands is illustrated in Map 5 page 144 which should be compared with Map 3 on page 58.

The establishment of Registries at District level ensures the close contact between Registry and land that is an essential feature of registration under the Registered Land Act. At the end of 1976 there were 24 Land Registries operating in Kenya.

The state of registration, and whether the titles are surveyed on final Registry Index Maps, or identified on unrectified air photographs and traced onto Preliminary Index Diagrams, is set out below.
Legend

Trust Lands: Unadjudicated
Adjudication in progress
Registered Titles

Government and Coast Lands: Unalienated
Registered

Gazetted National Parks
Gazetted Forests

Map 5 - Progress of Registration in Trust Lands
Registered Private Freehold Titles in Former Trust Lands

On Registry Index Maps 147,290 plots
On Preliminary Index Diagrams 501,160 plots
On 1/50,000 scale maps 945 ranches

Total 649,395
Total area 3,728,000 hectares

These figures may be compared with the total number of title surveys conducted under the Registration of Titles Act which is represented by 101,000 Deed Plans at the end of 1976.
CHAPTER VI
CONCLUSIONS

Cadastral survey is only one part of the concept of security of title to land. It is a fundamental part because if the portion of land itself is not satisfactorily defined the rights and interests appertaining to it cannot be exercised.

If the cadastral definition fails as it failed in the Coast Lands of Kenya, development will be restricted to low cost or short term projects or else be excessively expensive as investors cover themselves against law suits over land rights.

The cadastral system can succeed as has also been demonstrated in Kenya where many thousands of property owners enjoy undisputed security.

The elements of a complete cadastral system are ground definition and sound survey, regardless of the degree of precision specified. Either element can stand alone, but is then like a one-legged man who cannot stand at all if that leg becomes damaged.
The foundations of sound survey are survey control, preferably at national level founded on primary order triangulation, and permanent ground stations. If pressure for quick results and economy lead to poor foundations, problems will inevitably be created in the superstructure for future generations to repair, usually at a higher cost.

The survey requirements are known and are being met. The Survey of Kenya has a large and well equipped photogrammetric section. The control network is being extended and intensified. Modern equipment such as EDM, computers and orthophotography are being employed, frequently operated by graduates from the University of Nairobi, and the figures given in the last chapter should indicate that an enormous number of Kenya people now hold a secure, registered negotiable title to their land who have never before done so.

The problems now are not about survey and initial registration, but about maintaining the registers so that they continue to reflect the position on the ground.
As soon as possible the Preliminary Index Diagrams should be replaced by controlled mapping, whether by orthophotography or conventional photogrammetric maps, so that mutation surveys may be quickly and accurately carried out, the Registrars may have a sound independent source of evidence to support re-determinations of lost or disputed boundaries, and the land owners can be confident that the area shown in the Register is what will actually be found on the ground.

In this way confidence in the Register will not be undermined by the progressive revelation of the distortions and inadequacies of the Preliminary Index Diagrams. At present the errors are found piecemeal as owners wish to subdivide, particularly if a sale is made on the basis of a specified area. It will be unfortunate if all maps were to become distrusted because one kind of map is distorted. To a layman the cautionary note about unrectified air photographs shown on the face of the Preliminary Index Diagram does not mean anything; the diagram is a map as far as he is concerned, and he relies upon it to be right.
At present the survey of mutations is badly in arrears, and lags seriously behind the completed transactions on the ground. This too will distort the reflection of the ground by the Register.

Another particularly difficult problem is for the Assistant Land Registrar of a District to combine his office duties with his very time-consuming field duties under the Registered Land Act. The determination of disputed or uncertain boundaries, the fixing process, and the ordering of maintenance of boundaries, all require his presence on the site, and as persons appearing by the Register to be affected must also be given an opportunity of being heard before the Registrar decides any matter, such tasks can occupy a substantial part of any day. In consequence many of these duties are simply not being carried out. District Surveyors are often making judgements over boundaries that are outside their authority, which is the reverse of the intention of the Act, and such judgements may well be challenged in the Courts.

However, the largest and most intractable problem of all is not a survey one, but the social and economic problem of how to prevent fragmentation occurring all over again. The customary laws of inheritance in most areas require the division of the
of the deceased's land among his heirs. The Land Control Boards sanction such testamentary dispositions even though the resulting plots may be below the minimum area permitted for the District. Similarly many sales of subdivisions below the economic size are sanctioned by the Control Boards for social reasons.

The problems of fragmentation, population growth, and land use, and the solutions being proposed to deal with them, by diversification of the economy and the exploitation of the marginal lands of Kenya, are beyond the scope of this thesis, but inevitably any land development will require surveys and mapping, and probably the cadastral survey of titles.

The means of surveying cadastral titles at whatever precision necessary, by photogrammetry or ground survey, of large ranches or small plots, with physical boundaries or beaconned corners, are all present in Kenya. The one plea of the surveyor is that he be included in the planning at the earliest possible stage, so that he can offer the most suitable survey solution, lay down his control in advance, and provide an economic and efficient service. So often in the past eighty years he has been invited too late with
too few resources to provide the cheapest and quickest results, and then has to suffer the expense and inefficiency of working with these expedients and still fulfil his role in ensuring orderly development and secure ownership of land.
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