200 YEARS
Of
SURVEY
DEPARTMENT
AND
IT'S HERITAGE

By

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PREFACE

The romance of maps and cartography is as old as the story of adventure on the uncharted lands and seas. Maps have so ancient history that it is not possible to ascertain their first beginning. The Egyptians, Greeks, Babylonians and Chinese are said to have produced maps in remote antiquity. The Babylonians contributed a lot to this science. The oldest plan known is a cadastral plan prepared by the Babylonians in 2200 B.C. which is preserved in the Museum of Istanbul. Egypt made the first paper material called the "papyrus" on which maps were made. Ptolemy of Greece acquired great eminence in Astronomy and Geography and for 1400 years, the astronomical theories set forth by him held undisputed away.

The geographers owe great debt to the Muslim Arabs who traveled far and wide from Spain to China in the pursuit of geography. The accounts of the travels of Solaiman, Al Heravy and Ibn-i-Batuta were significant contributions which made the Arabs possess knowledge of a great portion of the globe.

Among the Europeans, the French took a lead by laying down the foundation of mathematical triangulation surveys in 1744. They also made great strides in the science of survey and it was the French cartographer Jean Baptiste Bourguignon d' Anville, who made the first elaborate map of India in 1752.The science made rapid progress in the18th century in Europe. In the sub-continent, howsoever, it took its birth as a matter of necessity, when the East India Company found itself safely entrenched as the future custodians of the sub-continent after the battle of Plassey and Clive appointed Major **James Rennell** as the first Surveyor General of Bengal in 1767, with a view to assess the revenues of their new realm and survey the areas in which the East India Company was interested.

The history of 200 yeas has been briefly narrated in the brochure, bringing out the notable events of those who had made great contributions during the long period. Starting from Lambton who was the pioneer of the Great Trigonometrical Surveys, the laid the foundation of the frame-work on which all the subsequent surveys were based, the narrative mentions in detail the contribution made by Sir George Everest, Major Gen. Sir Andrew Waugh and Gen. J. T. Walker, who covered the entire sub-continent with a series of triangulation from 1802 to 1883. This indeed deserves to be written in golden letters. The spectacular progress of the Topographical Surveys made under General Thuillier has also been brought into focus. The stress and strain through which the department passed during these 200 yeas, I hope, will make an interesting reading.

On Independence in August 1947, the late Frontier Circle took over as the national survey organization in its new role as Survey of Pakistan. Starting from scratch, the Department has been built up to its present shape by the kind assistance of our Government combined with the spirit and selfless work of the officers and staff during these crucial years.

The Department was faced with a formidable job as more than half the area of Pakistan was uncovered by Modern Surveys in 1947 and the maps of the remaining half also needed revision. Besides, the overwhelming demands for surveys and mapping of national development projects were also to be met. In spite of the great handicaps i.e. shortage of instruments, equipment and lack of trained officers and personnel, the Department is proud of its achievements in meeting the needs of maps for the Defense services which were foremost and of other nation building projects.

The science of map making has been revolutionized and the new techniques have replaced the old methods. Modern instruments for use in all branches have been procured, the officers and technicians have been trained abroad and in the country by foreign experts. This has improved the work in quality and quantity.

In the end, I may acknowledge thankfully the valuable assistance given by Mr. Qureshi, Assistant Surveyor General in this undertaking who has compiled the history of Department from 1767 onwards from the old records for which he has taken great pains.

I am also thankful to Mr.S.H. Khan, Officer-in-Charge No.3 Drawing Office, who helped me in completion of the brochure.

Rawalpindi **G.H.KHAN**

15th October 1967

THE 200 YEARS OF
THE SURVEY DEPARTMENT

It is not often that a department celebrates its centenary whereas in the case of the Survey of Pakistan the occasion to commemorate is its bicentenary, which has fallen in 1967 – a rare privilege indeed for those of us who are serving in the department. Two hundred years is a long time as far as departments go and it certainly gives one a sense of pride and purpose in being associated with an organization which has witnessed the political vicissitudes of a vast empire, its creation and its dissolution and the emergence of a new State of Pakistan which has changed the map of the world. It is all the more interesting, as map making is so intimately connected with the growth, development, administration and territorial consolidation of a country. History of this department is, in fact, very closely linked with the history of the sub-continent.

The area of the sub-continent including the new state of ours though existed in the past, had its own geography, but the maps in the form as every student knows them now, did not exist. Those that did exist were at best products of mixture of lively imagination, based on travellers' stories and accounts tinged with an artist's bent of mind.

Early History:-

The first English map of the Mughal Empire in India was published in 1619, by T. Sterne, a globe maker, and many maps were published thereafter by different map makers on the anecdotes of travelers and mariners.

The earliest contribution to the geography of main land of the sub-continent was made by French Jesuit Missionaries. It is from these maps, rough charts of coasts by sailors and travellers' reports that a great geographer Jean Baptiste Bourguignon d' Anville of France completed and printed the first authoritative map of the sub-continent by Western Colonial Powers, Dutch, French and the British, had taken a concrete shape and scope of the activities of the East India Company was spread around Bengal, though there were other settlements also. Surveys of areas in which the Company was interested and in which it anticipated future military operations were carried out surreptitiously and secretly and confined to isolated efforts only.

The victory at Plassey, in 1757, gave the Company new hopes and political ambitions. The resources of newly annexed land had to be tapped to yield profitable return and the boundaries of the new realm charted. To that end on the 1st January, 1767, Clive appointed Major James Rennell, as the first Surveyor General of Bengal comprising areas bulk of which now forms the Eastern Wing of Pakistan. Major James Rennell was a man of outstanding capabilities. He lived from 1742 to 1852. He was the first to map the sub-continent correctly according to that time. His Atlas of Bengal was published in 1773-84. His map of Hindustan also came out in 1783. To him went also the credit of the accurate survey of the River Brahmaputra single-handedly in most arduous conditions.

Incidentally, it may be mentioned that Major Rennell was also one of the sponsors for the establishment of Royal Geographical Society and he received posthumous honour

of a Founder. He has also been given the honour of being termed as the father of geography of the Sub-continent. His appointment as Surveyor General of Bengal was the first step towards the making of the Survey of India.

In the final compilation of the map of the sub-continent, Rennell very ingeniously made use of the survey records passed on to him from the Mughal period in the shape of the distances from Murshidabad to Delhi, from Delhi to Kabul via Lahore to Multan measured in the time of the Mughal Kings, Akbar and Shahjahan.

Rennell's maps were originally military reconnaissances and surveys undertaken by means of ropes and chains, related to astronomically fixed points. They did not claim the accuracy of the modern maps based on the rigid system of triangulation. The foundation of the scientifically controlled surveys was laid later by William Lambton who conceived and started the Great Trigonometrical Surveys.

First Period of Great Trigonometrical Surveys.

At the outset of the 18th century Sir Andrew Wellesley the English Commander in the South, after having consolidated the position of East India Company, embarked on a programme of widespread explorations and collection of accurate topographical information regarding the areas which had then been thrown open to the English.

Major Lambton, having long reflected on the grant advantage to general geography that would be derived with the establishment of a trigonometrical frame-work for basing the future surveys on sound mathematical principles, put forward his proposals and got them approved with the support of Sir Andrew Wellesley.

The trigonometrical survey as envisaged by Lambton comprised the selection and measurement of base lines with high accuracy, the construction of range of triangles,

fixation of permanent control points by angular measurement and computintg the latitudes and longitudes with the help of astronomical observations and a measured side i.e. extention of the base line and lastly to further check the triangles by closing on another base line and astronomical observation. These proposals were very sound, but Lambton had to make strenuous efforts to demonstrate their utility. Even Rennel came forward to maintain that route surveys on an astronomical basis were equally accurate and more economical. But undaunted by such opposition, Lambton went on single-handedly and started his work on 10th April 1802, with the measurement of his base line near Madras.

Second Period of Trigonometrical Surveys.

On the death of Col. Lambton in 1823, his assistant George Everest was appointed to succeed his as Superintendent of Great Trigonometrical Surveys. Thus the last hope of Col. Lambton when he said, "I sincerely hope that after I relinguish the work, somebody will be found possessing zeal, constitution and attainment wherewith to prosecute it and it would indeed be gratifying to me if I could but entertain a distant hope that work which I began should at some future day be extended over British India, "was fulfilled.

Everest proved worthy of the great expectation. His tenure became the most illustrious chapter of Survey in history. He remained the Superintendent of Great Trigonometrical Survey from 1823 to 1830. He completed one of the most stupendous works in the whole history of science. No officer in the Survey department ever had a

grander monument to his memory than the Great Meridional Arc Series completed by his indeflatigable will. Everest was a creative genius. The whole conception of the survey, as it now exists was the creation of his brain. It was he who introduced the Compensation Bars with which every base in the sub-continent was measured upto the beginning of 10th century. He invented the system of observing by heliotrope flashes, the

system of ray tracing and nearly every thing in survey was originated by the great geodesist. Beside the Great Arc, a number of other Series were completed in his time.

It was to commemorate Everest's unique contribution to the Geodesy of sub-continent that his successor, Maj Gen. Waugh named the highest peak of Himalyas as Mount Everst.

This period of George Everest (1823-1843) was considered as the second period of the Trigonometrical Surveys, after Lambton's as First.

It was in 1830 that the posts of Superintendent of Great Trigonometrical Survey and Surveyor General of India were combined when Sir George Everest took over as Surveyor General. It was found convenient in placing the whole department under one head.

The notable feature of this period pertaining to topographical aspect, was the establishment of a separate organization for Revenue Surveys when Major Bedford was appointed as the First Superindent of Revenue Survey. This was done in pursuance of the decision taken at conference of surveyors convened by Lord William Bentinck in 1838. Other important events of the time were the commencement of Revenue surveys of North West Province and the compilation of a map of Sind from the surveys of Alexander Burnes.

Third Period of Great Trigonometrical Surveys.

At the retirement of Sir George Everest in 1843, his able assistant Sir Andrew Waugh took over as Surveyor General and devoted his time to the work left incomplete by his illustrious predecessor. First of all the completed George Everest's project for triangulation of the important regions between the Great Arc Series and N.W.Province and Bengal and a number of meridional and longitudinal series. On the topographical side, most interesting and valuable survey executed in Sir Andrew Waught's tenure

were, undoubtedly, those of Kashmir and the Sind Sagar Doab that fell between the rivers Indus and Jhelum. This region had been the scene of the exploits of Alexander the Great and included the site of Taxila. The survey of this strategic area, which has been invasion route since ages, was considered important. The credit of these surveys, about 10,500 sq. miles, went to Capt. G. Robinson of Bengal Engineers who was the pioneer of the modern method of plane-table surveying, which had its origin in the sub-continent and which produced excellent results in quantity and quality. This was during the illustrious period of Waugh that plane-tabling was accepted as the modern and accurate method for the determination of topo features. A paper on the use of plane-table "Instructions for Topographical Surveying" was also written by Ribinson during Sir Andrew Waugh's time.

The other important work of Waugh's period was North Eastern Himalayan Series which was to connect the northern ends of all meridional series. Markham wrote in his Memoir that the dangers and difficulties in the execution of this series were far greater than those encountered in the majority of the Indian campaigns. He also stated that the life of a surveyor is perilous and sublime as he devotes great talent and ability to scientific work in the midst of as dreadful a circumstance as is met on the field of the battle with little or no prospects of reaping the reward. His labours are of permanent and lasting value but only few know who obtained the valuable results except the gallant surveyor's immediate chief. The North Eastern Himalayan Series of 1690 miles in length

was the most desperate of these grand undertakings and that average slaughter was greater than in many famous battles. In one season alone, 40 men died on account of bad health. Waugh had to join the party himself to carry on operations for fixing the heights of the Himalayan peaks. One of the peaks was found to be 29,002 ft., the highest in the world, and was named by Waugh as Mount Everest after his old Chief.

The third period of the Trigonometrical Surveys (1843-61) was the period of Sir Andrew Waugh whose tenue was another illustrious chapter in the annals of survey. Besides completion of the North Eastern Himalayan Series, the Western Section of Great

Longitudinal Series and number of meridional series including the important Calcutta Series, Karachi Series and Kashmir Series, extensive topographical surveys were carried out in his period. He concentrated more on areas what now form the Western Wing of Pakistan.

Fourth Period of the Trigonometrical Surveys.

Col. Walker, took over as the Superintendent of Great Trigonometrical Survey on 12th March 1861 when Col Thuillier was the Surveyor General. He is the fourth geodesist amongst the great ones, starting from Lambton, Everest, Waugh and then Col. Walker himself. His period from 1861-70 is called the fourth period of the Trigonometrical Surveys. Besides completing a number of triangulation series, mostly in the southern peninsula, the high-lights of his tenure were, the checking up of Lambton's base near Madras which was found to differ with the newly measured one by only ¼-inch, the commencement of leveling operations to fix points with height relative to sea level, a long line of 2250 linear miles of leveling begun in Waugh's time was completed from Karachi to Calcutta. This formed the nucleus for the future network of leveling lines of Primary and Secondary accuracy. Many base lines were also connected by spirit leveling.

The astronomical observations were also started with the help of telegraph line, the determining the difference of longitude, as formerly it was difficult to determine the difference of longitude with the desired accuracy and precision.

In 1871, Col. Walker in London and Major St. John in Tehran, determined telegraphically the longitude of the distance being 3870 miles between the two stations.

Another important scientific aspect of the survey that attracted Col. Walker's attention was the "Deviation of the Plumb Line" from its normal direction in consequence of local irregularities of the Earth's crust. This was a source of error in observation and required careful investigation.

In 1864, Col. Walker applied to Secretary of State for sanction to undertake a series of pendulum experiments for investigation purposes. The sanction was obtained with the active support of the Royal Society who also arranged to sent necessary equipment, an astronomical clock and two invariable pendulums. The work was soon started under Captain Basevi who swung the pendulum at some 10 stations on the Great Indian Arc from Debra Dun to Cape Comorin, two stations each on East and West coasts and also at Minikoy (an Island of the Laccadive group). In 1870, two convertible pendulums were lent to Col. Walker by the Imperial Academy of Science at St. Petersburg, which were used on the Russian Arc. It was hoped that by their means a connection might be established between Russian and Indian Pendulums. Capt. Basevi took these to Tibet and started work at Mian Mir, Leh and Takalung Pass. There he caught severe cold, and one morning when gallantly striving to rise from his bed to commence work, he died. By his death the Survey lost one of its ablest officers.

Besides his field duties, Col. Walker found himself greatly absorbed in the computing office where his personal attention was required. With the printing of observations and data, the reproduction of topographical sheets was also undertaken by

means of Photozincography, introduced by Mr.Hennessey of the computing office for the first time.

Col. Walker also started the verification of standards of length in 1866-67, and was ably assisted by Mr.Hennessey which was the most significant step towards the attainment of accuracy in survey work. In recognition of his services he was promoted Major General.

It was indeed a very noble band; consisting of selfless surveyors who were trained and worked under Lambton, Everest, knowledge of a Cambridge wrangler with every resource and presence of mind of an explorer and the gallantry and devotion which inspire the leader of a forlorn hope.

The story of the Great Trigonometrical Survey forms the broudest pages of the history of this department.

General Sir H>I> Thuillier who succeded Sir Andrew Waugh in 1861 as Surveyor General was Sir Andrew's Deputy Incharge of office since 1847. During these 14-15 years the general usefulness of survey operations had been fully established and their demand had also increased a hundred fold.

Gen. Thuillier's energy and talent resulted in great improvement of the methods of survey in the field and ensured that the results were readily accessible to public. He made the surveys follow in the tract of different triangulation series in order to have the advantage of fixed stations on which to base the detailed surveys.

In his time the Revenue Surveys also received a great fillip which were actively pushed in Oudh, Sind, Assam and Burma.

The topographical survey at the time consisted of 4 parties for Central India, Daccan and North-eastern areas, which increased to 9, out of which 2 being paid for by Mysore State, where these two were employed. During this period widespread and extensive surveys were undertaken in different parts of the sub-continent.

For the efficient handing of these large amount of surveys, a big establishment was required for the reduction, compilation and publication of such a mass of topographical inforation and material. Col. Thuillier showed great talent for such an organization and achieved full success. He created a system by which year by year, he extended the coverage of the survey and made the result of these also rapidly available. As a result of these hectic activities of survey, the need of sppedy publication of the information was never greater. A full fledged publishing branch came into being and the

rise in printing of maps was phenomenal. Starting from a small lithographic press, the branch came to possess 20 presses continually at work besides 3 small ones for publication of the departmental forms.

In addition to map printing, all types of work for various Government Departments were entertained and carried out by the Publication Branch of the Surveyor General's office, in respect of their requirement of diagrams, sketches, illustrations etc.

It is worthy of remark and matter of pride that the first postage stamps for use in the sub-continent were lithographed at the Surveyor General's office.

It will be seen that the story of printing and reproduction of maps and its gradual development in the Survey Department is as fascinating and inspiring as that of the Great Trigonometrical and Topographical Surveys.

Until 1866, all the maps of the survey department with the exception of Atlas sheets were put on the stone by hand drawing on transfer paper, a very laborious process

and liable to eeor. It was found impossible to cope with the publication of the ever increasing number of maps by so slow a process as lithography, and therefore photolithography was introduced, to be followed a few years later of photozincography. The credit of having first introducing the process of photozincography in the sub-continent went to Mr. Hennessy of the Great Trigonometrical Survey.

The process made its mark and outturn steadily increased from 1867 onwards. The advantage of this was the production of the result of the survey within a reasonable time for general use which made it a turning point in the history of map publication. Captain Melville and Liutenant Waterhouse ably superintended this branch of the Department and in the year 1868-69 as many as 44092 copies of maps were printed off

and 97647 sheets were lithographed. The demands both from official and general sources were duly supplied and this branch became not only self-paying but remunerative.

In 1869, the engraving of most of the remaining sheets of Indian Atlas i.e. the ¼-inch scale topographical sheets, planned by aaron Arrowsmith to cover the entire sub-continent in 177 sheets, each measuring about 24" .4 x 38" was transferred from England to Surveyor General's office at Calcutta. Col. Thuillier having engaged a staff of engravers put Mr. Coard as Superintendent of the Reproduction Branch. The first map of the Indian Atlas (No. 125 SE Sylhet) was issued the next year, and as many as 123 maps of the Atlas were engraved. Col. Thuillier also issued a valuable map of India on scale 64 miles to an inch in 1877 and undertook to prepare a general map of India on scale 32" to a mile in six parts which came out in 1881, after his retirement. He became a knight and was promoted to General.

The next step forward was the gradual introduction of lithozincography by which the maps were photographed in complete sheets and were printed directly from the negatives on to zinc without the aid of transfer. Heliozincography gave better results and completely replaced the photozincography after 1907, which was used for engraved maps only.

The extraordinary progress of both topographical surveys and map reproduction helped a great deal towards the completion of knowledge of the physical geography of vast tracts of the sub-continent, the work being chiefly over mountainous and snow-clad regions and deserts. Col. Thuillier truly remarked "For frontier expeditions and wild tracts of areas the departmental methods of surveying by theodolite and planetable based on triangulation cannot be excelled for accuracy, rapidity and cheapness".

This proved a prophetic remark as, later on, we found that working by these methods the Survey Department, in course of time, could raise its head on its great accomplishment, by covering such a great land mass as the major part of the sub-continent with accurate surveys. It will amaze many to know that when compared with great countries, having vast area like the USA, Russia and Canada, even the most modern of them, cannot claim such a well-knit net-work of triangulation and excellent topographic cover.

The progress of Topographical Surveys during General Thuillier's tenure as Surveyor General was:-

Topographical surveys from 1861 onwards	.. 2,91,354 sq. miles.
Revenue surveys (1845-46) during his period as	
Superintendent of Revenue	.. 4,93,293 sq. miles.
Cadastral surveys	.. 12,000 sq. miles.

All these amounted to 8,00,000 sq. miles i.e., more than half of whole area at that time under British suzerainty.

The progress of the topographical surveys continued at amaizing speed, and it was assumed that the work of Survey Department was approaching completion and that the difficulty to be encountered after a few years would not be, to find establishment for the work but to find work for the establishment.

On January 1st 1878, the three branches of the survey Department, the Great Trigonometrical, the Topographical and the Revenue Survey, which were separate Departments were amalgamated. General J.T. Walker, C.B., R.E., F.R.S., succeeded General Sir H.L. Thuillier in 1878.

In 1882, the original programme of the Great Trigonometrical Survey was completed and as topographical work also was regarded as practically finished, in the proper Sub-continent, the Department was then begun to be considered as no more a necessity. A policy was adopted for transferring parties to cadastral work or other paid-for jobs.

The effect of this policy was that the energy of the department was gradually diverted to Forest and Cadastral surveys though the progress of topographical survey continued more or less as before some time.

Gen. J.T. Walker retired in 1884 and was succeeded by Col. G.C. Depree, I.S.C.

In 1886, it was decided to reduce the strength of the Department by one Party every five years till in 1889 the units were reduced to only four in number. During years 1889-1993, the topographical work remained almost at stand-still except in Burma, Baluchistan and Sind.

The period after the retirement of Gen. Walker remained as one of retrenchment and departmental austerity. The Surveyors General Col. Depree, Col. Sir H.R. Thuillier,

Major General C. Strahan and Col. St. G.C. Gore who followed Gen. Walker during the period 1884 to 1994 carried out the normal work with difficulty due to financial stringency and devoted their time and energy to manage the work with the reduced resources.

Indian Survey Committee.

The number of units though increased later, but the Survey department had to call attention to the impossibility of carrying out work that ought to have been done, as bult of

the maps were out of date and needed revision, owing to enforced diminution of its topographical strength.

The Viceroy directed attention to the matter and ordered formation of a committee to take stock of the situation and recommend necessary measures. Consequently, the Indian Survey Committee met in 1994-95. The Committee composed of a representative of the Government of India, the retired Director-General Ordnance Surveys, the then Survey General Col. F.B. Long, C.B., R.E., and a representative of the Army, formally assembled in Calcutta on 15th November 1994, continued its deliberations and examined the methods and working of the Survey of India, with a view to preparing a cycle for preparation, revision and reproduction of the topographical maps after carefully considering the following important points:-

(i) The state of the maps in each Province and the measures required to bring them uptodate.
(ii) Method and expense of survey.
(iii) Method of reproduction.
(iv) Re-organisation of the Department.
(v) Recommendation to be framed with the strictest regard for economy.

The Committee, after careful consideration of the above points and inspection of the various offices of the department and its working made a number of recommendations which were mostly accepted by the Government of India, and these formed the basis of the future work of the Survey Department from 1905 upto the present day, their main recommendations being:-

1. A completely new contoured survey of the sub-continent should be undertaken on a scale of one inch to a mile and completed in 25 years and thereafter revised at a regular interval of 25 years.

2. Revenue & settlement surveys should be left to the control of the Provincial Governments and should be carried out at their own cost.

3. The mapping responsibilities of the Survey Department were clearly specified. The undermentioned maps were made the responsibility of the Survey Department:-

(i)	Standard one inch sheets to Be reduced to half its size ie; 15 min. Latitude by 15 min. Longitude.	…	Scale one inch to a mile
(ii)	The Atlas of India should be Superseded by Degree sheets i.e. 1 degree of Latitude by 1 degree of Longitude.	..	Maps on scale ¼" to a mile "to be compiled from the reductions of one-inch Maps".
(iii)	General Maps of India And Provinces.	…	1/M scale map of India (Engraved) and Provincial Maps on one inch to 32,64,80,96,192 and 256 miles.

4. Maps produced by the Survey Department on the above scales would be published in several colours, thus bringing the country in line with advanced cartographic printing at the time.

5. Hachuring and form-lines in the hills and plain areas to be discarded in favour of contours at regular intervals.

6. For the reproduction of one-inch maps, an improved process of Helio-zincography should be employed as a general rule.

Modern Maps.

The above recommendations mark the watershed for modernity of cartography in this sub-continent. The maps, as a result of these decisions of the Committee, got a new look, appropriate contours at regular vertical intervals, in place of hachures and form-lines, and uniform symbols with detail in different colours to make them more interpretable and legible. In fact, the map making in the sub-continent was completely revolutionized and accordingly post-1905 maps were classified "Modern Maps" later in 1911 Conference for international maps of the World, Greenwich adopted as the prime-meridian, which necessitated a correction of a minutes 27 seconds in the longitudinal lines of all maps produced before.

With the reorganization of the Cartography in 1905, a systematic scheme for mapping of the sub-continent was adopted. Under the scheme, the whole of Southern Asia between meridians 44° and 124° East of Greenwich and parallels 4° and 40° North; was divided into sheets of 4° Latitude x 4° Longitude on 1/1,000,000 (1/Million) scale and each one million sheet was divided into 16 sheets of 1° Latitude x 1° Longitude, known as degree sheet, which in turn was divided into 16 one inch sheets of 15 mins. Latitude x 15 mins. Longitude each and numbered from 1 to 16.

By this time, the Geophysical surveys (Gravity and Magnetic) were also in full swing. These laid the foundation of later surveys and heoped the exploration of mineral resources. The country was also covered by net-work of points of known precise heights, so essential for development.

The proposed changes based on the recommendations of 1905 Committee had hardly been started when World Was 1 broke out. The survey officers were drafted out to take part in operations in the Middle East, Persia and Europe. Before the armistice was signed, 183 officers and men had laid down their lives.

The exploits of the survey parties in Persia, Iraq, Mesopotamia Senai and Palestine during the war were creditable.

Col. Sir S.G/ Burrard, K.C.S.I., R.E., had succeeded Col. Long in 1911.

The war gave way to an uneasy peace soon to be followed by an economic depression. The Department took its mauling. There was considerable retrenchment. Survey efforts were once against diverted to paid-for jobs at the cost of topographical survey programme scheduled in 1995. The 25 years programme for completion of surveys of the sub-continent was thrown over board.

During the post-War period the programme of surveys proceeded at snail's pace and revision of the out-dated maps was also staggered. The only activity of the Department worthy of note was its efforts towards the scientific and geodetic pursuits and explorations with the help of foreign-sponsored expeditions like Sir Auril Stein's Expedition in 1939-31 to Central Asia, P.C. Visser's Himalayan Expedition to Karakoram in 1935 and Eric Shipton's Expedition to Karakoram regions in 1937.

Col. Sir S.G. Burrard was succeeded by:-

(i) Col. C.H.D. Ryder, C.B., C.I.E., D.S.O., R.E., from 1919 to 1924.
(ii) Brig. Sir E.A. Tandy. Kt., R.E., from 1924 to 1928.
(iii) Brig. R.H. Thomas, C.S.I., D.S.O., R.E. FROM 1928 TO 1933.
(iv) Brig. Sir H. Couchman, D.S.O., M.C., from 1933 to 1937.
(v) Brig. Sir C.G. Lewis, O.B.E., R.E., from 1937 to 1941.

The period of the above Surveyors General was mostly devoted to the consolidation of surveys and devising techniques for improvement in efficiency and accuracy both in surveying and cartography.

Events later compulsively drove the world to a Second World War. Brig. C.G. Lewis continued as Surveyor General upto April 1941, but it fell to the lot of Brig. E.O. Wheeler M.C. who succeeded him, to steer the Department during the crucial period of the war years from 1941 to 1946, which were full of turmoil and strain. The Survey Department was once again called upon to meet the growing needs of surveys and maps in the different theatres of war and its mobilized units operated in the Middle East, Ceylon and Burma. The Department expanded and considerable survey resources were placed at the Army's disposal. This time at the end of War there were even more men in uniform, 721 in all. No other civil Department bore such a brunt. The department came out of the vagaries of War with credit and a proud record of meritorious service.

The war over, reconstruction and development work started. There were demands for surveys for many projects. The Department though expanded during the War was still found inadequate to meet the new challenge of the growing demand of development surveys. By 1946, it was clear that the department had to be further expanded to avoid delay in execution of urgent projects. Another expansion scheme was put into operation. In year 1946, Brig. Sir E.O. Wheeler, M.C. after adding another long and illustrious chapter of the Survey achievements was succeeded by Brig. G.F. Heancy C.B.E., F.R.I.C.

In 1946, the Survey Department constituted of the Directorates:-

Headquarters of Surveyor General	… at Delhi.
Eastern Circle	… at Shillong (Assam)
Frontier Circle	… at Murree
Southern Circle	… at Banglore

Geodetic Branch	… at Dehra Dun
Map Publication Offices	… at Calcutta
Mathematical Instrument Office	… at Calcutta

The Frontier Circle, Murree was not only responsible for the topographical surveys of the areas under its jurisdiction, but also for the development of surveys and mapping for the military purposes.

On 14th August 1947, the sub-continent was divided into India and Pakistan giving the Muslims their long cherished home-land. Consequently came the two Survey Departments as successors to the late Survey of India.

The late Frontier Circle with HQs at Murree took over as the national survey organisation in its new role as Survey of Pakistan, the responsibilities and duties in respect of Geodetic Surveys, Topographical Surveys, Project Surveys and Mapping.

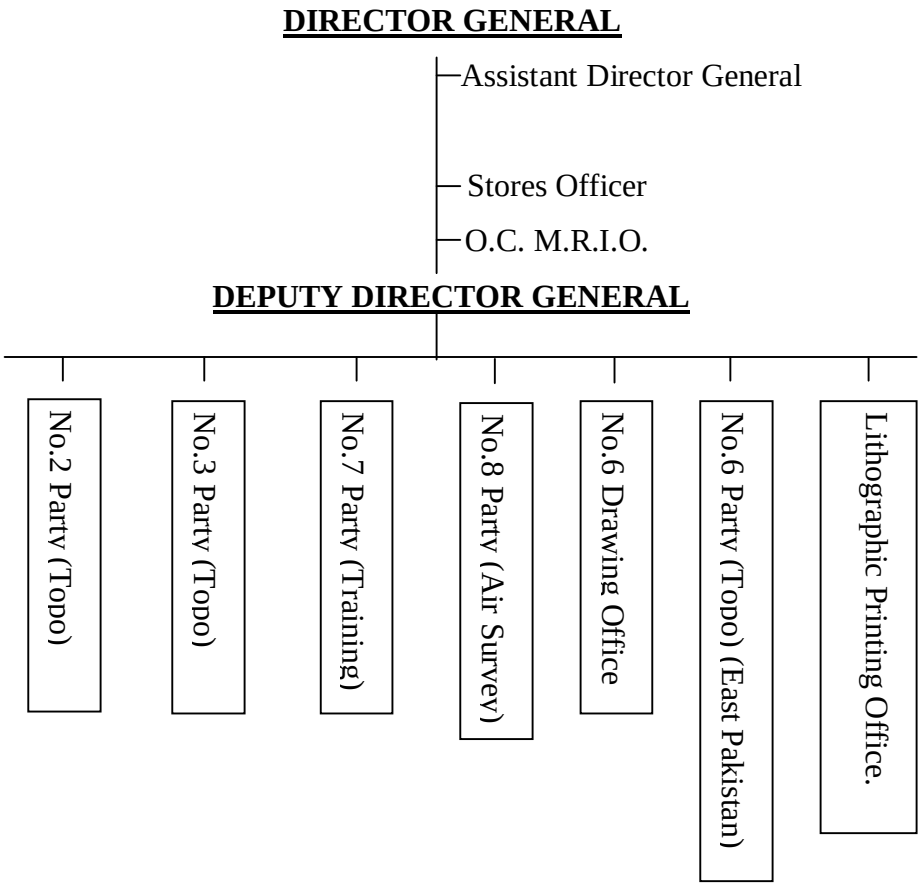
Major R.C.N.Janney R.E. was appointed Director General of Survey of Pakistan.

To start with, the strength of the department which consisted of the opted staff and officers was:-

Class I officers	…	10 including 2 British R.E. officers And one officer on deputation with Provincial Survey Department of East Pakistan.
Class II Officers	…	14 including 3 G.C.S. officers of whom one was a British Officer.
Class III	…	135

Class IV … 1760

The department was organized as under:-



The store, equipment, instruments and furniture of the late Frontier Circle which came to the share of Pakistan were not even sufficient to meet the requirements of the personnel and officers who had opted for Pakistan.

Another great loss to Survey of Pakistan, was the decision of Partition Council, not to divide the assets of the highly scientific and important branches of the Survey of India, the Geodetic Branch, Mathematical Instrument, Office and also the Library by declaring them as 'Unique' and hence indivisible. The effect of this decision and the resultant shortages of the much needed items of stores, instruments and machinery made

the Department struggle against heavy odds during the early years, but it ultimately overcame these by the combined efforts of the staff of the Department and the Ministry of Agriculture. The initiative and energy displayed by Mr.G.H.Khan, the then Survey Transfer Officer in procuring and arranging the movement of Pakistan's share of the assets from India deserves mention.

At the time of independence out of the total area of about 3,65,527 sq, miles of Pakistan (3,10,527 sq. miles of west Pakistan and about 55,000 sq. miles of East Pakistan), about half was uncovered by modern surveys on 1-inch to a mile scale. The maps of the remaining area of Pakistan for which the modern style maps did exist, were outdated and needed revision therefore the available resources were diverted towards the revision of the most outdated maps.

Col. C.A.K. Inncs-Wilson succeded Major R.C.N. Jenney in January 1950. Meanwhile nation building schemes came up and the department had to divert its potential towards the preparation of maps required for the development projects.

The department's meager strength could not cope with the increasing demand of maps for the national development projects and it had to look for assistance from within and outside the country for procuring the latest instruments, equipment and arranging the training of the officers and technicians in the modern methods of surveying and mapping.

From 1952 the department started getting foreign assistance through Colombo Plan and U.N. agencies in the shape of aerial photography of West Pakistan, instruments, experts to impart training and overseas training of officers in photogrammetry, geodesy and Lithographic printing.

During the period of Col. Innes-wilson the Government of Pakistan decided to constitute a National Committee of Geodesy and Geophysics, under the chairmanship of the Surveyor General, with a view to develop these two science in the country on sound lines.

Col. CA.K. Innes Wilson, retired in 1954. He was succeeded by Mr.M.N.A. Hashmie who remained in this office upto 1961. He was the first Pakistani Surveyor General. Most of the expansion took place during his tnure and more Drawing Offices, Photogrammetric Offices and field survey units were established. The construction of new office buildings at Dacca, Quetta and Rawalpindi were also completed during his period. Other features of his tenure were survey and mapping of the nation-building projects, revision of the then existing 1-inch and ¼-inch maps using the Colombo Plan Photography of 1952-54 and then publication on 1/50,000 and 1/250,000 scales respectively. The demarcation of Pak-Iran boundary was also completed during his time. In recognition of his services he was awarded Tamgha-i-Pakistan during his tenure and Sitara-i-Qauaid-i-Azam on his retirement.

On retirement of Mr.Hashmie, Mr.A.R. Qureshi T.Q.A., took over as Surveyor General in 1962. During his short time the notable event was the border agreement between Pakistan and China, and commencement of survey for the demarcation of the common border.

Mr.Quraishi was succeeded by Mr.A. Abad T.Q.A. as Surveyor General in 1963. The demarcation of Pak-China boundary was completed during his time. A new Directorate of Project Mapping was raised in his time to meet the demands of Project Surveys, but it was soon disbanded after a few months. The post of Deputy Director (Geodesy), Quetta along with other unfilled posts were surrendered.

In 1965 the bulk of the strength of the Department remained engaged with the production of maps for the Defense services.

The preparation of Atlas of Pakistan was also undertaken in this period and a National Atlas Board was specially formed for this purpose under the Chairmanship of the Surveyor General of Pakistan.

Mr.Ahad, retired in 1966 and he was succeeded by Mr. Khan, T.Q.A.

In order to meet the increased demands of survey and maps of the Defense services and other Civil departments, Mr.G.H.Khan's efforts, in the beginning, had to be devoted towards revival of the essential posts which were earlier surrendered. The Survey of the remote areas of Baluchistan which had so far been left unsurveyed from the British times has also been taken up by employing the bulk of field strength. This has given a good experience to Surveyors in depiction of intricate hill features.

The programme of aerial photography in the northern region and their mapping by photogrammetric methods is also in hand.

The strength of the department built upto 1967 is:-

Class I officers	…	35
Class II Officers	…	62
Class III Establishment	…	1784
Class IV Servants	…	3,000

The organization of the department, as in 1967, is given in Annex. IV.

The development in the department since the Independence is described in the following paragraphs.

The Development of Survey of Pakistan.

With the limited resources and the handicaps in respect of men and material, as mentioned before, the Department could, with difficulty, cope with the requirements of Development Project Surveys, during the early years, which were too vital to be ignored. The strength of the Department was too meager to devote any appreciable efforts to the topographical surveys which were its primary responsibility. The emphasis on the development needs was a necessity for the new state.

It was however felt that the topographical surveys and the revision, so badly required by the Defence services, would have to be given due importance and priority, as such, the imperative need for expanding the department was upper most in the minds of all concerned. But expansion alone would have been unable to cope with increasing demand of work. The methods of Survey and Cartography required modernization too.

Development in respect of theories, methods of survey and instruments had taken place so rapidly in the science of Geodesy, Cartography and Photogrammetry that it was considered essential to adopt and introduce these new techniques not only to keep pace with the other progressive countries but to be in a position to meet the hundred-fold requirements of maps for development and defence.

A comprehensive scheme for the expansion of Survey of Pakistan was prepared for inclusion in the 1st and 2nd five-year National Plans. The programme included the expansion of existing potential by raising new establishments, introduction of modern techniques and training of our officers and personnel as under:-

(1) Growth of Geodesy and establishment of Directorate of Geodesy.

(2) Setting up of an Air Survey Organisation with a Flight Agency for carrying out aerial photography.

(3) Topographical Survey and raising of more Survey Units and Drawing Offices.

(4) Establishment of a Mathematical Instrument Office.

(5) Construction of office buildings.

The schemes received the Government's approval and Survey of Pakistan made rapid strides towards its own development side by side its enormous contribution in the development of the country, by preparing maps for planning various projects.

But for the timely assistance of the Survey of Pakistan there would have been considerable delay in the implementation of the programme of Power and Irrigation development; and other nation building schemes undertaken since Independence.

Growth of Geodesy in Pakistan

Geodesy is the Science which deals with the investigation of the size and shape of the earth. The precise measurement of long distances on the surface of the earth obtained from the arc of triangulation combined with the astronomical determination of Latitude and Longitude and deviation of the vertical due to the effect of gravity help the Geodesists to reduce the size and shape of the earth which is so essential to astronomers, geographers, geologists and meteorologists.

The other aspect of this science is the provision of geodetic frame work on which survey operations and eventual mapping of a country is based. The geodetic activities of the department consist of:-

(i) Geodetic triangulation of First and Second orders.
(ii) Precise measurement of Base line.
(iii) Determination of latitude, longitude, forces of gravity and terrestrial magnetism.
(iv) Geodetic leveling of High precision.
(v) Tidal forecast.

Although the essential geodetic triangulation frame-work existed but for some areas of the country it was not adequate and it required improvement and extension. It was also necessary to carry on the geodetic work for providing sufficient data in the country in the fields of magnetism, geophysics and astronomy.

A Geodetic Party was raised in 1954. This unit started work with a Wordon Gravimeter and a Base-line measurement equipment. Supply orders for other essential geodetic instruments were placed on foreign firms. All possible steps were taken by this unit to collect the original records and the old departmental publications from different sources for setting up the Geodetic Office. Besides, computers were trained in geodetic

computations and basic training was given to officers of the department posted in this unit. From 1954 to 1956 the unit remained mostly employed on training in gravity and magnetic observations.

In July 1956, a United Nations Expert, Dr.Ik Asplund, from Sweden was attached as a Geodetic Adviser with this department. But due to shortage officers, he was able to impart training to a few only. In his first stay for the period from May 1956 to July 1957, he drew up plans for the establishment of a Geodetic Institute. Dr.Asplund left for Sweden in July 1957 and Mr. L.Patterson, United Nations expert replaced him. Mr.Patterson followed up the project till the return of Dr.Asplund. One officer was trained in Geodesy in U.K. in 1953 and more were sent abroad for training. A number of geodetic instruments and considerable equipment were procured through departmental resources and a few instruments obtained through the assistance of the United Nations Technical Assistance Programme.

In September 1957, the Deputy Directorate of Geodesy was raised with its headquarters at Karachi which was later on shifted to Quetta. The work during season 1957-58-59 was confined to survey operations relating to the demarcation of international boundaries along Indo-Pak and Pak-Iran borders and Precise leveling from Quetta to Mirjawa (near Pak-Iran border).

A Tellurometer for precise linear distance measurements was received through UNTAA in 1957. Officers were trained in the use of this instrument and it was put in operation in 1958. With the completion of training of officers in various branches of geodesy and receipt of the instrument etc. progress has been made in the fields of magnetic and gravity observations and in Geodetic Triangulation in some areas as described in the following paragraphs.

The present Deputy Directorate of Geodesy has one field Party for geodetic work and one Field Party for Topo work under its control.

Geodetic Triangulation.

Pakistan has a fairly good cover of geodetic triangulation but it requires further extension at some places. In 1955, a programme of network of geodetic control at ten miles apart in the country was presented to the Government. But due to shortage of funds the work has not been taken up so far.

Geodetic triangulation was started in Makran area from the existing Kalat Longitudinal Series. This triangulation provided connection with the southern end of Pak-Iran boundary triangulation executed for providing control and fixing co-ordinates of the boundary pillars erected along Pak-Iran boundary in the years 1957-59.

More geodetic triangulation series will be taken up to provide geodetic frame-work in the areas where such control is scanty or it required for the revision of weak series e.g., "East Calcutta Longitudinal Series" A preliminary programme for a number of years has been drawn up.

Geodetic Leveling.

The Geodetic leveling is an operation to determine number of vertical control points which form the basis for determination of heights of other points. These heights are in relation to the fixed datum of Mean Sea Level, which have been established through series of tidal observations spread over years. By this process, Primary bench marks are established all over the country, which in addition to their utilization for study of Earth's movements for geodetic investigations also serve as highly reliable points of reference for heights for engineering projects.

Leveling has been divided in Pakistan into three general categories, viz:

(i) Primary leveling (High Precision).
(ii) Secondary Levelling (Precision).

(iii) Tertiary Levelling.

Of the above, the first two categories are carried out by the Geodetic Party. In Pakistan a small but well adjusted, 'Geodetic Levelling' net-work exists but it requires checking as many years have passed. In addition further extensions are necessary in the developing areas.

Two links of Primary leveling, one with Iran and the other with Burma, have been made in 1955 to 1959 and 1959-60 respectively as under:-

Quetta-Mirjava Levelling.

A primary level line (approx. 400 linear miles) was run during 1957-58 between Quetta-Mirjawa to provide a datum Bench Mark for the Government of Iran.

Chittagong-Akyab Leveling.

Another project of International importance for affecting a junction of the leveling of high precision between Pakistan and Burma covering a length of approximately 220 miles has been completed.

Magnetic Surveys.

The plan to establish Magnetic Observatory in Pakistan and conduct magnetic surveys was first mooted at a meeting between the Surveyor General and the Director Meteorological Serives during 1950. UNESCO was sought and they deputed Dr. K.A. Wienert of Germany as a Geomagnetic Expert with their Geophysical Mission which arrived in Pakistan in 1951. The UNESCO also undertook to provide several sets of Variometers and field instruments. The Variometers have been installed at the Geophysical Observatory at Quetta, maintained by the Pakistan Meteorological Department. This Observatory is designed to form the basis for the magnetic survey.

The field observations are carried out by Survey of Pakistan. A few officers have been trained in magnetic observations. The magnetic survey in both East and West Pakistan has been completed in 1960 and the repeat observations have also been done in 1965.

It is planned to provide a dense net work of magnetic stations all over Pakistan to help isolated areas of economic interest as far as particable.

Gravity.

Gravity observations are ost useful for the determination of figure and shape of the earth, to prospect for oil and minerals and lot the study of deep seated geological structures below the alluvium. The intensity of gravity had been observed during the pre-independence period at 564 pendulum stations, eventually distributed over the whole of Pakistan, India and Burma. Of these Pakistan has 100 gravity stations about 100 to 220 miles apart. This control is inadequate for the geological and scientific studies. In 1952 a Wordon Gravimeter (No.102) was made available to the department through UNESCO. Dr.Norgard, Leader of the UNESCO Mission in Pakistan, initiated the training of officers in field observation, and considerable work has since been done.

A programme for gravity observations for providing stations at about every 10 miles is also in hand.

Astronomical Observations.

Astronomical Observations of Azimuth and Laplace stations are necessary to keep the triangulation net-work in correct orientation with respect to the true North. For this purpose Astronomical Latitude and Longitude positions are compared with their geodetic positions to determine the size and figure of the earth after taking into account the error due to the deviation of the vertical on account of gravity etc.

Wild Theodolite T-4 meant for the astro observations has been procured by the department. Training in its use was imparted to the officers of the department by Messrs Patterson and L. Asplund.

A Plan for covering the country with Latitude, Longitude and Azimuth stations and setting up of an observatory has been drawn up. We however still need the assistance of geodetic experts and efforts are affot to procure the services of some renowned geodesist in the near future.

A decision was taken in 1966 in the annual meeting of N.C.G.G. that the Astronomical Observatory will be set up in the Salt Range area near Buchal Kalan, about 70 miles S.W. of Rawalpindi.

Devices for Precise Measurement of Distance.

The development of electronics during the last decade has helped the surveyor greatly. One of his problem for many years in the past, has been to evolve a method with which the measurement of distances could be precisely made which should avoid the labours of actual measurements on the ground. An important invention in this field is the introduction of an electronic instrument called "Tellurometer" based on the principle of measurement of travel time of micro waves. Similar electronic instrument based on the principle of travel time of light waves, such as Geodimeter has also come in the field. In the Survey of Pakistan as mentioned earlier, Tellurometers have been obtained and measurements with this device are being carried out. It is planned to procure more instruments of this type to cope with out requirements.

A few Geodimeters have been recently obtained by E.P. WAPDA for work in East Pakistan.

AIR SURVEY ORGANIZATION

Photogrammetry.

Photogrammetry means the measurement on photographs from the Greed word 'Grammo' meaning measurement. This term as applicable to survey signifies preparation of maps from the aerial photographs. The science started in the First World War when by installing cameras in the aeroplanes the French Army took the photographs of German concentrations behind the front.

The photographs began to be used for topographical purposes soon after World War 1. But the methods of air survey were mostly graphical, and remained dormant for a long time.

Later on a major break-through was achieved with the introduction of stereoplotting instruments, which completely revolutionized the technique and made the air survey quick, accurate and economical.

During the early years after Independence the topographical survey programme was getting into arrears on account of heavy demands of survey for nation building projects, it was therefore decided to modernize the techniques by introducing new photogrammetric methods and the sophisticated instruments. A comprehensive plan was prepared by the Surveyor General according to which a number of officers were sent abroad for learning the new techniques. Instruments were obtained from the departmental resources and the foreign aid with the help of which some officers and technicians were trained in the country by the foreign experts. A laboratory for processing the aerial films and printing of photographs was established in 1955 after the Canadian left on completion of the Colombo Plan Photography of West Pakistan.

A Deputy Directorate of Photogrammetry was established in 1958 and, for the first time, maps were produced by using the new methods. It is gratifying to note that starting training in photogrammetry as late as 1954, the department has now reached world standards and has revised all the existing maps on 1-inch scale for publication on

1/50,000 scale which was adopted in 1958. The intention is to embark on a programme of mapping by more sophisticated instruments and Electronic Computers in future.

Flight Agency.

The department has its own Flight Agency for carrying out aerial photography. The Deputy Directorate of Photogrammetry is working as a full-fledged organization and it will be raised to a full Directorate in due course.

CARTOGRAPHY

From time immemorial, the fair drawing for the preparation of map original for reproduction has been done by fine pointed nibs requiring skilled work by experienced draftsmen. This trade has been modernized and new technique of scribing on plastic sheets has been introduced. In the same way, the names used to be hand typed on the original in the past, which was also a slow and time consuming process and needed modernization. Names are now composed in the letter press and printed on transparent

material for being pasted on the original. These new methods have considerabley improved the pace of map drawing.

The Lithographic Printing Office has been modernized with the installation of new automatic printing machines which are much faster. The adoption of separate colour originals has considerably eliminated the slow colour separation method. The science of colour reproduction is developing fast and the new possibility of a break-through by means of filters and use of various colour sensitive films, now under experiment, is not far remote. This will necessitate further modernization and renovation of our existing Lithographic presses.

In order to cope with the increasing demand of maps, the drawing and printing offices have been expanded. The printing offices need further expansion.

Topographical Surveys.

As narrated earlier owing to the two World Wars and retrenchment in Survey of India in 1931, the programme of survey and revision had fallen in arrears over the whole sub-continent. On Independence, out of 3,65,527 sq. miles about half the area was uncovered by the modern one inch or 1/2 –inch scale topographical survey and over half of it already needed revision. The photogrammetric methods combined with improvements in the methods of drawing and reproduction greatly accelerated the progress of our topographical survey. The department has by now completed topographical surveys of more than 2,81,340 sq. miles on 1/50,000 scale and we expect to complete it by 1972 if every thing goes according to schedule and the programme is not interrupted.

The scales of Topographical maps were changed in 1957 from 1-inch = 1 mile to 1/50,000 and 1-inch = 4 miles to 1/250,000.

In addition to the above, the department carried out surveys and mapping for more than hundred nation building projects vide Annexure I, which involved considerable efforts on the part of all concerned.

In order to carry out the above surveys a number of Field Units were raised.

Mathematical Instruments.

It will not be out of place here to mention that since the very outset, difficulties were felt with regard to procurement of surveying instruments. Col. Lambton was in constant trouble with his instruments and he had no means of repair. Incidentally, while in field carrying out triangulation, Lambton's Theodolite was violently carried away by a Khalasi and bumped against a tower and got damaged. Lambton had to shut himself in a tent alone for weeks and repair the damage with his own hands. In the evening of his days, difficulties also arose in respect of the measuring chains. He also felt the want of supply of proper instruments and necessary testing. It will be interesting to know that the first bases were measured with wooden rods, glass tubes, to be followed by 100 ft. steel chains and finally be the compensation bars.

Sir George Everest foresaw these evils and personally superintended every detail in the construction of his instruments in England. While returning to India he brought Mr.Barrow, an accomplished instrument maker and established a small Mathematical Instrument Office.

Syed Mohsin's laudable services when he helped Sir George Everest in rectifying the defects in the top heavy astronomical circle are worth mentioning. When Mr.Barrow retired, he was succeeded by Mr.Syed Mohsin, possessed of great mechanical talen. Sir George Everest like most men of genius had a sort of intuitive perceptiveness in selecting the right man, and at once singled out Mohsin as an outstanding technician. According to Markham this able man, though he could not read English, would have taken a leading place even among European instrument makers.

The Survey of Pakistan unfortunately could not get its share of the assets of the Mathematical Instrument Office, God, a nucleus of Mathematical Instrument Office has been established which is in the process of development.

BUILDINGS.

At the time of Independence, there was only one Directorate (Frontier Circle) at Murree in West Pakistan. There were no office buildings except at Murree and Risalpur. For the expanding Department, these buildings were far from being adequate and as such the necessity was badly felt for the construction of office buildings required in both East and West Pakistan. A plan for the construction of buildings for the expanding

department, keeping in view the future requirements was prepared and got approved by the Government for Dacca, Quetta and Rawalpindi. The main buildings at the three places were completed by end of 1962 and another block has been added in Rawalpindi offices in 1965-66. Construction of ancillary buildings in Map Publication Offices, Rawalpindi is pending on account of financial stringency. A plot of 21 acres of land has been acquired in Islamabad to meet further requirements. There is a great need for establishing residential colony for the Survey of Pakistan employees at Rawalpindi because they are not, at present, provided any residential accommodation by the Estate Office, Rawalpindi.

A building for the Astronomical Observatory has to be constructed in the Salt Range area near Buchal Kalan about 70 miles S.W. of Rawalpindi. The scheme has yet to be submitted to the Government.

A building for the Mathematical Instrument Office (M.I.O) also is to be constructed at Karachi for which land has already been allotted by K.D.A.

Buildings to accommodate two E.P. WAPDA Field Parties are to be constructed in the second Capital at Dacca in accordance with the U.N. Special Fund Scheme.

The Department has to complete the following jobs.

Geodetic activities:-

(i) Geodetic triangulation in Baluchistan in the areas which require extension and also revision of weak series like “Calcutta East Longitudinal Series” in East Pak.

(ii) Establishment of new pendulum stations for absolute values of gravity and their consequent effect on the existing net-work.

(iii) Compilation of Trig & Levelling pamphlets.

(iv) Publication of Magnetic and Gravity data.

(v) Establishment of astronomical observatory.

(vi) Setting up of laboratory for standardization of lengths.

(vii) Establishments of net-work of Geodetic Marks at ten miles apart in both the wings of Pakistan.

(viii) Revision of old Prevision leveling lines and provision of more lines in deficient areas.

(ix) Convertion of existing mathematical tables, Levelling and Grid data into meteric system.

Topographical Survey.

(i) Survey and mapping of the unsurveyed area on 1/50,000 scale of the remaining 25% area of West Pakistan.

(ii) Compilation and publication of 1/250,000 scale maps, based on the latest 1/50,000 scale maps.

(iii) Convertion of existing maps in meteric system.

(iv) Revision of the outdated maps of fast developing strategic areas.

(iv) The demarcation survey of the Rann of Kutch boundary according to the award by the Tribunal and the survey of new areas under the award if any.

Administrative.

(i) Construction of ancillary buildings as included in the original plans of Map Publication Offices at Rawalpindi.

(ii) Construction of building for the units of East Pakistan WAPDA in the second Capital area at Dacca in accordance with the U.N. special Fund Scheme.

(iii) Construction of Residential Colony for Survey of Pakistan employees stationed at Rawalpindi, Murree and Dacca. It will be proposed to the Government for sanctioning necessary funds for raising a colony on the 21-acre plot of land in Islamabad, belonging to Survey of Pakistan and for necessary arrangements at other places.

A brief history of the expeditions and of the boundary demarcation is appended as Annexures II and III respectively.

ANNEXURE-I

LIST OF PROJECT SURVEYS IN WEST PAKISTAN

1. Mianwali Hydel & Pumping Project Survey.
2. Warsak Reservoir.
3. Anambar Project.
4. Balkassar Map.
5. Bolan Reservior.
6. Jhelum Bridge.
7. Nari-Cut Area Survey.
8. Lower Sind Project Survey.
9. Warsak High Level Canal.
10. Kurram Garhi Irrigation Project.
11. Makarwal Coal Mines.
12. Hyderabad Regional Survey.
13. Warsak Dam site Area ‘C’.
14. Samli Sanatorium.
15. Havelian Large Scale Survey.
16. Makhi Dhand Reclamation, Contour Charts.
17. Warsak Dam Site Area ‘D’.
18. Karachi University Site Survey.
19. Kalabagh Dam Site.
20. Warsak Dam Site Area ‘A’.
21. Kalabagh Dam Site job No.3..
22. Indus Canal Survey.
23. Murree By-Pass Road Survey.
24. Mangla & Rohtas Reservoir Area.
25. Rohtas Dam Site.
26. Lohar Gali Reservoir.
27. Survey of Korangi Area Karachi.

28. Tarbela Reservoir.
29. Gudu Barrage Project.
30. Beef Farm Site Karachi.
31. Federal Capital Site Gadap.
32. Rajdhani Dam Site Area ‘D’.
33. Lohar Gali Dam Site.
34. Taunsa Barrage Project.
35. Sui Gas Survey.
36. Kalabagh Right Bank Canal Project.
37. Sind University Site.
38. Survey of North of Malir, Karachi.
39. Nari Bolan Project Survey.
40. Gul Kach Reservoir.
41. Darband Kanshi Link Area.
42. Gul Kach Dam Site.
43. Karachi City Map.
44. Mangla Dam Site Extension Area.
45. Jari Dam Area ‘B’.
46. Jari Dam Area ‘C’.
47. Chichawatni Plantation.
48. Federal Area (Islamabad).
49. Kalam Dam Site Survey.
50. Murtaza Wei Project Survey.
51. Islamabad Survey.
52. Khad Dam Area.
53. Pashthana Reservoir.
54. Lower Mula (Naulung) Reservoir.
55. Tali Tangi Reservoir.
56. Railo Reservoir.
57. Tanda Banda Project.
58. Kachhi Plain Project.

59. Mangi Reservoir.
60. Babar Kachh Reservoir.
61. Anambar Reservoir.
62. Kalam Reservoir.
63. Flood Control Area D.I, Khan.
64. Sutlej Bridge Survey.
65. Lyallpur Town Area Survey.
66. Peshawar Special Area.
67. Master Plan For Peshawar.
68. Chatti Bridge Dam Site.
69. Anambar Dam Site.
70. Ghatti Bridge Reservoir.
71. Babar Kachh Dam Site No.1.
72. Babar Kachh Dam Site No.2.
73. Bara River Canal.
74. Lahore Town Area Survey.
75. Sialkot Flood Control Survey.
76. High Power Transmitting Station.
77. Radio Pakistan, Lahore.
78. Alipur Transmitting Station.
79. Bunha River Survey.
80. Capital Survey (Islamabad).
81. Jalipur Irrigation Scheme Survey.
82. Kalabagh Dam Site Job No.2.
83. Kahan River Survey.
84. Liaquat Bagh Survey.
85. New Township North of Karachi.
86. Parliament House Ghizri Area, Karachi.
87. Ravi Bridge Survey.
88. Riwat Transmitting Station.

ANNEXURE-I

1. Karnaphuli Reservoir.
2. Karnaphuli Reservoir Extension.
3. Halda Irrigation Survey.
4. Dakatia Basin Irrigation Survey.
5. Gumti Spill area.
6. Narayanganj Town & Surrounding area.
7. Chandpur Port area.
8. Chittagong Town & Surrounding area.
9. Karnaphuli Hydro Electric Project.
10. Dacca Town & Surrounding area.
11. Ganges Kobadak Project.
12. Dinajpur Pilot Tube Well Scheme.
13. Cox's Bazar.
14. North Patenga.
15. Tista Project.

ANNEXURE-II

EXPEDITIONS

The explorations beyond the northern frontier of the sub-continent started in Maj. Gen. Waugh's time and were carried out in Col. Thuillier's time as Surveyor General under Col. Montgomery. The account of the Surveyors who traversed length and breadth of the country in different terrain embracing treacherous marshes, impenetrable jungles, inhospitable deserts and challenging Himalayas are stores of rare courage and adventure.

While travelers like Forsyth Hayward and Trolliers explored the routes to Chines Turkistan, scientific surveyors like Johson, Godwin Austin conducted detailed scientific surveys in the desolate northern areas. The famous peak K_2, the second highest in the world, falls in the same region and is often called Mount Godwin Austin after the illustrious surveyor.

The early Jesuit Missionaries of the 17^{th} century like Azeredo John de Olivera, Cacella, John Catral, John Guber, Albert Dorvile, though during their proselytizing mission into Tibet had done much pioneering work by recording the hair raising accounts of the travels, but it is from the native explorers like Abdul Subhan, Mirza, the Mullah Muhammadi Hamid and Nan Singh, trained by the Great Trigonometrical Survey, that, the world first obtained the knowledge of the Rooof of the World, the Hindu Kush, the Karakoram etc. While Subhan explored the course of the River Oxus and traversed hundreds of miles in East Turkistan, Nan Sin explored vast territories in Tibet and Muhammad Hamid fixed the position of Yarkan and explored vast areas which now form the northern limits of West Pakistan.

The scientific and geodetic pursuits and explorations continued with the help of foreign sponsored expeditions like Sir Auril Stein's in 1930-31 to Central Asia, P.C. Visser's expedition to Karakoram and Shakogow regions in 1937. The adventurous work, in these expeditions, of surveyors Khan Sahib Afraz Gul with Sir Auril Stein,

Asghar Ali who accompanied Col. Schomberg to explore areas to the East and North East of Leh, and Muhammad Ayub Khan, is the finest example of courage and fortitude and will be source of inspiration to the surveyors of this Department for generations.

Suffering great privations and hardships, these explorers traveled across inhospitable regions and translated the information, which they gathered, into maps and thus laid the foundation of the geography of the northern frontier of the sub-continent.

These predecessors of ours have woven the fabric of topography of the sub-continent literally with their blood and sweat.

In the recent years also more expeditions were led by the foreigners who were accompanied by the surveyors of Survey of Pakistan, as given below:-

(1) Italian Karakoram Expedition 1953-54 was led by Professors Daised to conquer K_2 (28250 ft.) the second highest peak in the world. Mr.Badshah Jan S.A. Supdt. Of this department accompanied this expedition.

(2) German Himalayan Expedition, 1954-55 was led by Wolsgang Pillewizer, Mr.Sahib Shah, Surveyor, went with this expedition.

(3) In 1957-58 Mr. I.A. Quraishi, Surveyor, was deputed to accompany Imperial College of Science and Technology Expedition to Karakoram Range. This expedition was led by Eric Shipton the well-known geographer and mountaineer.

(4) During 1957-58 Mr.Badshah Jan again accompanied another expedition led by H.R.A. Streacher of Exford University Mountaineering Club.

(5) During 1957-58 German Scientific Expedition led by Dr. Hens J. Schneider went to Karakoram Range. Mr.Sahib Shah, Surveyor, accompanied this expedition.

(6) Mr.Sahib Shah, Surveyor, during the same year again went with the British-Pakistan Forces Himalayan Expedition led by Flight Lt. J. R. Sims.

(7) During 1959-60 Mr.Sahib Shah accompanied the Anglo-American Karakoram Expedition led by Mr.Wilsrid Nayce.

(8) Group Captain A.J.M. Smith led Royal Air Forece Karakoram Expedition in 1960-61. Mr.Sahib Shah, S.A. Supdt. Also accompanied this expedition.

ANNEXURE-III

BOUNDARY DEMARCATION

In the later part of the 19th and the early twentieth century, the British Government in India, in its role as mediator was called upon to settle the boundaries between Russia and Afghanistan, Afghanistan and Iran, Iran and Turkey, Iraq and Turkey and India's own boundary with Afghanistan. The Survey Department was made responsible for these grand undertakings where it rendered yeoman's service in the matter of border settlement between our neighbours and came out successful despite many knotty problems encountered during the proceedings.

At the outbreak of War in 1914, the Survey of India had a detachment under Lt. Col. C.H.D. Ryder, D.D.O.R.E., working with Turko-Persian Boundary Commission. The frontier from Muhammarah to Urumieh had been demarcated, under the instructions of Government of India. During the way, the Survey Department rendered great assistance to the Russians in these areas.

The Survey of India's help was also sought by the Sino-Burmese Boundary Commission, where a party under Captain Angwin spent two field seasons and completed the boundary demarcation between China and Burma in years 1936-37-1938.

On these occasions, large survey parties fully equipped to deal with various problems involved in travels in inaccessible mountains or semi desert areas were employed to collect material and prepare numerous large scale maps and sketches. These maps and reports constitute a mine of information.

Pakistan has common border with India, Iran, Afghanisatan, Burma and People's Republic of China. On Independence none of the boundaries except

with Afghanistan (Durand & Me. Mohan Lines) and a small portion with Iran was demarcated. The question of the demarcation of boundary with India though of more urgent nature, was soon to be followed by border demarcation with Iran and China. Thus the Survey of Pakistan was called upon in its erstwhile role for the demarcation of the border with our neighbours.

Pakistan-India Border.

Demarcation of common border with India was not a smooth affair, and a number of disputes arose with regard to the interpretation of Redcliff Award both in West and East Pakistan. In East Pakistan however the interpretation regarding certain portions of Redcliff Award had to be again referred to Bagge Tribunal who gave an award which was binding for both India and Pakistan. The disputes I and Ii (Murshadabad and Rajshahi) were accordingly settled which were jointly demarcated in 1951 by the Survey Departments of the two countries. The disputes II and IV (Patharia Hill Forest) were also settled in 1959 after a Ministerial level conference and the borders were demarcated jointly by the Director Land Records & Surveys of East Pakistan and Assam (India). The other disputes in case of East Pakistan were settled under Noon-Hehru Agreement, but the implementation is still held up.

The border demarcation of West Pakistan with India was jointly carried by the Survey Departments of the two countries. Most of the boundary has been demarcated except the portion running through the Rann of Kutch, which is under adjudication of an International Tribunal; this boundary will be demarcated jointly by the Survey departments of the two countries according to the award of the Tribunal.

Border with Iran.

The demarcation of the boundary between West Pakistan and Iran had been completed by Survey Departments of both the countries in 1957-58. This sector-a stretch of 590 miles from Koh-i-Malik Siah to Gwatar Bay-was complted in record time of 9 months. This had been comparatively a smooth affair on brotherly basis between two neighbourly countries.

West Pakistan-China Border.

The successful demarcation of common border with People's Republic of China, in areas falling in the snow clad high mountains of Karakoram range, is a miraculous achievement of both Governments as well the Survey Departments of the two countries.

The border agreement was signed by the two Governments in March 1963 along with the agreed procedure to be adopted for the demarcation.

The project was hazardous as the area comprised very high snow clad mountain tracts ranging from 16,000 to 28,000 ft. above mean sea level. Elaborate preparations had to be made for the survey teams for working at such high altitude which required special equipment.

The demarcation was done on the ground with the erection of 'Special Boundary Markers' in the most cordial atmosphere by the survey teams of both the countries. It took two years for completion. The area was air photographed, followed by fixation of astronomical control and points by triangulation, and finally the mapping by Photogrammetric methods and acceptance of the alignment. This will go down in History as a proud achievement of the Survey of Pakistan.