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THE WITWATERSRAND

A Study in Metropolitan Research and Analysis undertaken for Metrocom to assist the Central Guideplan Committees for the East and West Rand 1972-73

SECOND REPORT

PART ONE

THE ECONOMY

URBAN AND REGIONAL RESEARCH UNIT
UNIVERSITY OF THE WITWATERSRAND
JOHANNESBURG

June 1973

SUMMARY

CONCLUSIONS AND POSSIBLE PLANNING STRATEGIES REPORT ON THE SOUTHERN TRANSVAAL

CONCLUSIONS

1. Intra and inter-metropolitan problems to physical planning arise from the topography of the region, the presence of dolomite and the existing mixed land use pattern on the East Rand.
2. Probable problems will arise from the ribbon-like industrial and residential thrusts along the main highways and railway lines giving rise to urban sprawl.
3. Questions arise whether (i) this apparent sprawl is inevitable and (ii) if inevitable can it be moulded into a planned concept and (iii) whether it should be contained and satellite areas developed.
4. The following are the implications for a regional development policy:
 - (i) Short-term policy should be based on the existing structure, but there is a need (a) to control the sprawl along the region's N-S axis by moulding into corridors of new towns and (b) to analyse and improve the E-W axis particularly on the E. Rand.
 - (ii) Longer term strategy should be the expansion of peripheral towns.
 - (iii) Both the short and long-term strategies should be related to national goals.
5. In the Southern Transvaal and the Witwatersrand, secondary and tertiary activities are expanding at about 3,5% per annum and these activities together with housing needs and the inter movements make demands for the provision of land and planning considerations should concentrate on these.
6. In terms of numbers, housing and related movements the Bantu population provides the greatest planning problem of the next two decades.

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7. It is unlikely that in a multi-centred system, the necessary mobility can be provided in any other way than by automobile expressway. Integration of national, regional and local highway networks are essential and all of these must be integrated with land use present and future.
8. The need to provide the infrastructure for the region is continuing to grow at a rate outstripping that of population and economic growth.
9. Regional development planning is essential.
10. There is a need to obtain origin and destination data to assess movements both on highways and railways on a regional basis.
11. Essential to initiate metropolitan and sub-metropolitan planning and for the assembly of data required for it.
12. The metropolitan plan should ensure the reservation of land for the infrastructure of highways, railway lines, power lines, sewage disposal works, trunk mains, reservoirs etc.
13. It is most important that a strategy plan be prepared for the S. Tvl and its major metropolitan complexes in order that the disposition and character of broad future land uses may be determined.
14. The two-way relationship obtaining between land use and communications namely, land use requires highways to serve it and new highways in turn generate extensions to land use needs and these must be carefully assessed in the strategy planning.

Planning Strategies

15. Final strategies can be formulated only when the subsequent reports of this study have been prepared. Possible interim short-term strategies follow.
16. In the short term (say for the next 20 years)
 - (a) base the strategy on the existing structure of the three metropolitan regions.
 - (b) control inter-metropolitan sprawl along the region's north-south transportation axis.

- (c) analyse spatially and improve appropriately the urban organization of the region's east west axis (especially the East Rand.

If this approach were to be adopted, alternative urban forms for the containment of present inter-metropolitan sprawl would be profitably examined on a "development axis approach" with centres built up along transportation axes between metropolitan cities and without sacrificing access to the open countryside. One possible strategy would be to encourage this form of development on the N-S axis (See 122 b P. 102), and an alternative for the E-W axis from Nigel and Heidelberg to Westonaria and Carletonville. (See 122 c page 103) which has certain "green belt" advantages.

A third strategy would be a fusion of the above two which would retain much of the present trends. (122 d, page 104).

A fourth strategy could well be the megalopolitan or regional city approach (122 e, pages 104 & 105).

Development elsewhere in the country has slowed down the proportionate growth of the S. Tvl and has relieved some of the pressures. (123 P. 106).

The region's population may be forecast to grow from 3,8 million in 1970 to between 6,8 and 7,5 million in 1990. Nevertheless, this amounts to a doubling of population in 20 years with all the attendant problems of providing the infrastructure of services and facilities.

Southern Transvaal's own regional communications network should be designed and constructed in accordance with the chosen strategy of urbanization and not otherwise. (P. 108). There should be a full coordination of the national regional and urban networks.

17. Long Term Strategy. (P. 109 Para 125)

If the short-term strategy should be oriented towards the regional

/ (city).....

city concept, then the long-term strategy could give consideration to the possible expansion of the towns which are peripheral to the S. Tvl. (See also Chapter 1, P. 32 ii, P. 21). Any such long-term planning strategy would need to be formulated with an eye to the effective functioning of the nation's urban and regional hierarchy as a whole.

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PREFACE

This first part of the Second Report in the study of the goals and problems of metropolitan development on the Witwatersrand is concerned with an analysis of growth and change in the economy over the last two decades, on a metropolitan and sub-regional basis. Together with a subsequent second part covering growth and change in population, land uses and the communications network over the same period and on the same basis, it forms the foundations for a third, concluding part of the Report which will incorporate broad projections of future development in these categories for the region as a whole and its major subsidiary zones, and will formulate possible metropolitan and sub-regional planning strategies.

This part of the Report has been prepared by Dr L.P. Green, with the assistance of Professor T.J.D. Fair and Mr B.G. Boaden of the Unit's staff. The maps and diagrams have been drawn by Mrs H.D. Marais of the Cartographic Unit of the Department of Geography and Environmental Studies, and the report has been typed by Mrs J. Stone and Mrs B.E. Green.

Grateful acknowledgement for most helpful discussions and the provision of valuable information is very gladly made to the Department of Planning and the Environment, the Department of Statistics, the Department of Roads of the Transvaal Provincial Administration, the Electricity Supply Commission, the Rand Water Board, the Forward Planning Branch of the City Engineer's Department of the Johannesburg City Council, and to the City Engineer's Departments and Bantu Affairs Departments of all local authorities on the Witwatersrand, including especially members of Metrocom.

GENERAL PREFACE

(appearing in the *First Report, The Southern Transvaal*)

At a meeting of the Johannesburg City Council on May 30, 1972 (Minutes p.1932), the Management Committee reported that "The Forward Planning Branch of the City Engineer's Department, which has been called upon to play a leading part in the activities of both Metrocom and the Central Guide Plan Committees* established by the State, has found it virtually impossible to make any progress in executing the studies and work that are necessary. A number of important studies are in hand and it is also necessary to update past studies, but this Branch cannot cope satisfactorily with these and cannot take on further work.

The Council is well aware of the need for regional and metropolitan planning and for the integration of its planning with these.

The Urban and Regional Research Unit of the University of the Witwatersrand is prepared to carry out research work into the physical, social and economic characteristics of the Witwatersrand. This research is necessary to enable Johannesburg and other Metrocom local authorities to assist the Guide Plan Committees...

The matter has been discussed by the Advisory Sub-Committee of Metrocom, and it was unanimously agreed to recommend to Metrocom that its constituent local authorities should participate and contribute to the

*Members of Metrocom are the City Councils of Johannesburg and Germiston; the Town Councils of Alberton, Edenvale, Kempton Park, Krugersdorp, Randburg, Roodepoort and Sandton; the Village Council of Bedfordview, and the Modderfontein Health Committee. Members of the East Rand and the West Rand Central Guide Plan Committees include members of Metrocom together with the Town Councils of Benoni, Boksburg, Brakpan, Elsburg, Nigel, Randfontein and Springs.

cost of R22 000 involved. It will be on a pro rata basis as was established in connection with research undertaken by the Randse Afrikaanse Universiteit for Metrocom. Johannesburg's contribution will be about R13 000. This recommendation will be considered by the main body of Metrocom in due course... It is proposed, therefore, that the Council should agree to underwrite the costs involved". The proposal was agreed to by the Johannesburg City Council.

In turn, the University, through the Board of Control of the Urban and Regional Research Unit, agreed to undertake the research, which is to be completed by the end of 1973.

In order to meet the specific requirements of Metrocom and the Central Guide Plan Committees for the East and the West Witwatersrand, the study comprises a broad overview of the region, a more detailed analysis area by area within the Witwatersrand and the formulation of proposals for the strategic planning of the region. Emphasis is placed particularly upon problems of employment, population, land use and transportation.

Acceptance by the Unit of the proposal to undertake the study has been made possible by obtaining the services of Dr L.P. Green, who was Research Officer to the Johannesburg City Council in the 1950s. Dr Green then joined the Institute of Public Administration, New York, and subsequently the Ford Foundation, as a project specialist. He was engaged in urban and regional research for the Calcutta Metropolitan Planning Organization from 1960 to 1965, and for the development plans of the Federal and State Governments of Nigeria from 1966 to 1971. In the course of the latter assignment he was attached to the Nigerian Institute of Social and Economic Research at the University of Ibadan.

The present study, as indicated more fully in the

introduction to the First Report, will comprise four parts - the Southern Transvaal, in order to provide the regional setting; the Witwatersrand, an overview; more detailed analyses of sub-regions of the Witwatersrand; and an assessment of the present organization and procedures of government applying to metropolitan regions in general and to the Witwatersrand in particular.

Until completion of the whole study, the four reports should be regarded as interim only, and subject to amendment in the light of later information and analysis, and comment from members of Metrocom and the Central Guide Plan Committees.

The First Report which is now presented is mainly the work of Dr L.P. Green with assistance from the Unit's staff - Professor T.J.D. Fair, Mr B.G. Boaden, Miss P.M.R. Morris, Mr T. Hart, Mrs N.C. Berman and Miss H. Zwanziger, who is seconded to the Unit by the Forward Planning Branch of the Johannesburg City Engineer's Department. The maps have been prepared by Mrs H.D. Marais of the Cartographic Unit of the Department of Geography and Environmental Studies and the report has been typed by Mrs J. Stone.

Grateful acknowledgement for assistance in the preparation of the First Report is made to the Department of Planning and the Environment, the Department of Statistics, the Departments of Local Government and of Roads of the Transvaal Provincial Administration, the Electricity Supply Commission, the Rand Water Board and to Local Authorities in the Southern Transvaal, including especially members of Metrocom and the Central Guide Plan Committees.

Discussions on specific aspects of the work were held

with Mr H.M. Marsh, Chairman of the Central Guide Plan Working Committees for the Witwatersrand, and members of the Forward Planning Branch of the Johannesburg City Engineer's Department, of which Mr Marsh is Executive Director; and with Professor D.C. Midgley of the Department of Civil Engineering, Dr N. Patricios, Mr J.P. Lea and Miss J. Verster of the Department of Town and Regional Planning, and Mr K.S.O. Beavon of the Department of Geography and Environmental Studies, all of the University of the Witwatersrand.

Mr J.D. Roberts,
Chairman : Board of Control
Urban and Regional Research Unit.

Professor T.J.D. Fair,
Director :
Urban and Regional Research Unit.

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CHAPTER 1.

THE METROPOLITAN CONCEPT

Introduction

1. As indicated in the general introduction to this Study, which appeared in the First Report,¹ the object of the present report is to attempt for the Witwatersrand an essentially similar analysis to that undertaken for the Southern Transvaal, in relation to the region's people, the work they do, the land uses they create, and the movement of men and commodities that takes place within its borders. But the grain of analysis will be finer, the zonal sub-structure of the Witwatersrand will be delineated, more detailed attention will be paid to trends in demographic, economic and spatial aspects of the system's development, goals of regional rather than national policy will be considered, and the planning problems and possible strategies of development will be defined more sharply in terms of their nature, incidence and location.

Metropolitan Regions

2. The report approaches this task by means of the concept of a metropolitan region. This concept, which is used both to determine the actual field of enquiry and to provide an appropriate method of analysis, may

¹*First Report: The Southern Transvaal*, Urban and Regional Research Unit, University of the Witwatersrand, Feb., 1973; pp.1-4.

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be defined in the following terms.² "A metropolitan region... is primarily a region of intense movement of people, goods and services between residential areas and industrial and commercial centres, whose existence and structure are largely functions of communications and whose boundaries are determined by degrees of human contact. (Such a region) comprises a complex social and economic organization made necessary by industry and commerce, and made possible by commerce and technological invention... Its essential purpose is to serve the needs of industry and commerce (but it is not) merely an economic concept... It is a dynamic, complex society of people who have cultural as well as economic needs, who constantly reorganize and adapt their society to its changing environment, and who thus develop resilient regional characteristics."

3. "Nor does a metropolitan region lack form or shape. Because of its underlying economic function, and the available technical means of serving that function, it is a nodal region with a characteristic physical framework that is easily recognized... (This) framework consists, firstly, of a dominant metropolitan hub comprising the central business district and industrial core. This hub may contain more than one distinct centre, but the region always remains basically nodal. Secondly, described about the metropolitan hub and extending for some 10 to 15 miles in all directions, there is an inner metropolitan zone of close and intimate daily contact with it. This close contact is overwhelmingly for purposes of work and marketing in the hub, or for servicing the inner metropolitan zone, and can be measured in terms of the

²L.P. Green, *Provincial Metropolis*, Allen and Unwin, London, 1959; pp.27-30.

circulation of people, goods and services. It is naturally a zone of extremely high population densities, and is almost wholly built-up into a closely-packed mass of houses, factories, office blocks, shops and other premises. Thirdly, beyond the boundary of this zone lies an outer metropolitan zone of less intimate contact in which local populations are still affected by the journey to work in the main regional centre, and are certainly dependent on the hub for many specialized functions and services. But the zone's average density of population tends to fall rapidly in proportion to distance from the regional hub and the web of local communities is far less closely knit, although large towns and even cities may be situated within it. The outer boundary of this zone, and therefore the boundary of the entire region, is a broad transitional area which, even if hardly precise, can readily be recognized as a commuting, marketing and service watershed."

4. "As a metropolitan region becomes more populous, the daily movement of residents to its hub from the inner metropolitan zone tends to increase less than proportionately, largely because of a growing economic decentralization. Conversely, the movement of residents from the outer metropolitan zone to the hub, and to subsidiary centres within the inner zone, tends to increase. In particular, a remarkable growth of suburban shopping areas is encouraged by central traffic congestion, parking difficulties and soaring land values, by rising costs of travel and by an expanding local market potential. A substantial suburbanization of industry is also stimulated by the need for more factory space, easier and cheaper transport facilities and lower costs of land and labour, and more congenial home conditions for staff, particularly for top executives. Thus, within the broad primary framework of the metropolitan region may be discovered many social

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and economic sub-centres, particularly within the inner metropolitan zone, which tend to expand faster than the region itself as it grows larger and older, and which exert a growing secondary influence on its patterns of communications, commerce and industry."

The Witwatersrand Metropolitan Region

5. As this concept is one of hierarchical systems of movement between work areas and residential areas, it permits the spatial analysis of urban complexes in economic, social and physical terms within the parameters of traffic flows between origins and destinations. It is thus possible, within a metropolitan framework of systems of movement, to undertake the present enquiry in three parts, the first of which deals with the development of spatial as well as sectoral aspects of the metropolitan economy, the second with the Witwatersrand's demographic and physical development, and the third with possible future planning strategies. Furthermore, use of the concept permits direct comparisons to be made with the results of research undertaken in the 1950s, when it was employed to analyse the social and economic structure of the emergent Witwatersrand metropolitan region,³ to determine some of the major spatial planning problems of this region⁴ and to suggest ways

³L.P. Green, *The Future Development of Johannesburg. First Interim Report: The Social Structure of the Witwatersrand Metropolitan Region. Second Interim Report: The Economic Structure of the Witwatersrand Metropolitan Region.* Johannesburg City Council, 1957 (unpublished).

⁴*Report of the Witwatersrand Interim Planning Committee*, Natural Resources Development Council, Pretoria, 1960 (unpublished); T.J.D. Fair *et al*, *A Planning Survey of the Southern Transvaal*, Natural Resources Development Council, Government Printer, Pretoria, 1957/8.

and means of meeting those problems. Such a direct comparison is illustrated by Figures 1 and 2, which summarize the broad functional structure of the Witwatersrand in 1955 and 1973, according to major areas of work and residence. The physical growth implicit in these figures is a direct consequence of an economic development, the dimensions of which fall to be analysed in this first part of the present report, by zone as well as by sector. The figures thus serve as an essential background to such economic analysis, relating the latter to its physical counterpart, which is to be undertaken in greater detail in Part Two.

6. For example, the two figures portray the expanding physical mosaic of the Witwatersrand, formed by the outspreading and newly-arising residential areas needed to accommodate the various ethnic groups comprising the region's growing population, and by the proliferating industrial, commercial and service areas in which this growing population earns its living. They reveal the rapid evolution of a central built-up core radiating in all directions from the central business district of Johannesburg, and especially towards Randburg and Sandton to the north, towards Roodepoort and Krugersdorp to the west, and towards Edenvale and Kempton Park to the north-east of that district. They indicate a substantial intensification of land uses in and around Germiston, Alberton, Boksburg and Benoni eastwards of the central core. They illustrate a progressive consolidation of non-White residential areas throughout the region, and, in particular, the massive growth of Soweto to the south-west of Johannesburg. They in fact highlight most of the principal changes that have taken place in the physical structure of the Witwatersrand during the last two decades from Randfontein in the west to Springs and Nigel in the east, and from Halfway House in the north to the

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townships of Lenasia and Grasmere spreading southwards of the proclaimed gold-mining areas towards the Klip River, Ennerdale and beyond.

7. What the figures do not reflect, however, are the multiplying links which have increasingly bound together these major functional land uses into a coalescent metropolitan region. They do not reflect the manifold economic relationships being forged between these uses by the cumulative needs of industry, commerce and services of all kinds, for rising inputs of labour, finance and materials, and for growing outlets for the commodities and services produced. They do not reflect the resulting vast and intricate flows of passenger and freight traffic by road, rail and air which have been expanding in volume and complexity at ever faster rates. Nor do they reflect the consolidating urban hierarchy of the Witwatersrand, and the progressive ranking of its urban centres within this hierarchy in terms of dominance and sub-dominance, which have been so much a function of these links, relationships and flows. It is these dynamic elements of growth and change in the Witwatersrand region which form the subject matter of the following chapters.

WITWATERSRAND: FUNCTIONAL ZONES 1955

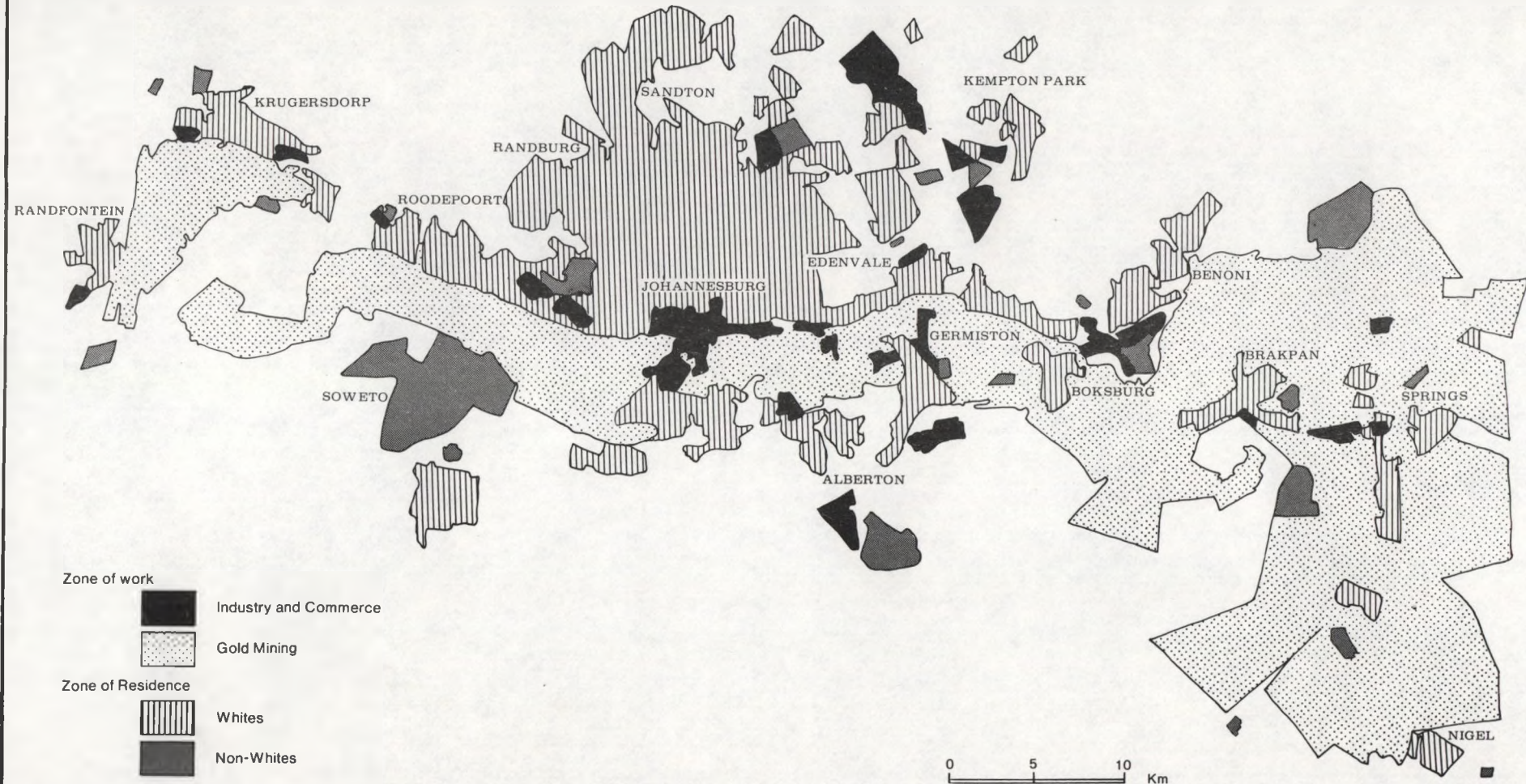


Figure 1.

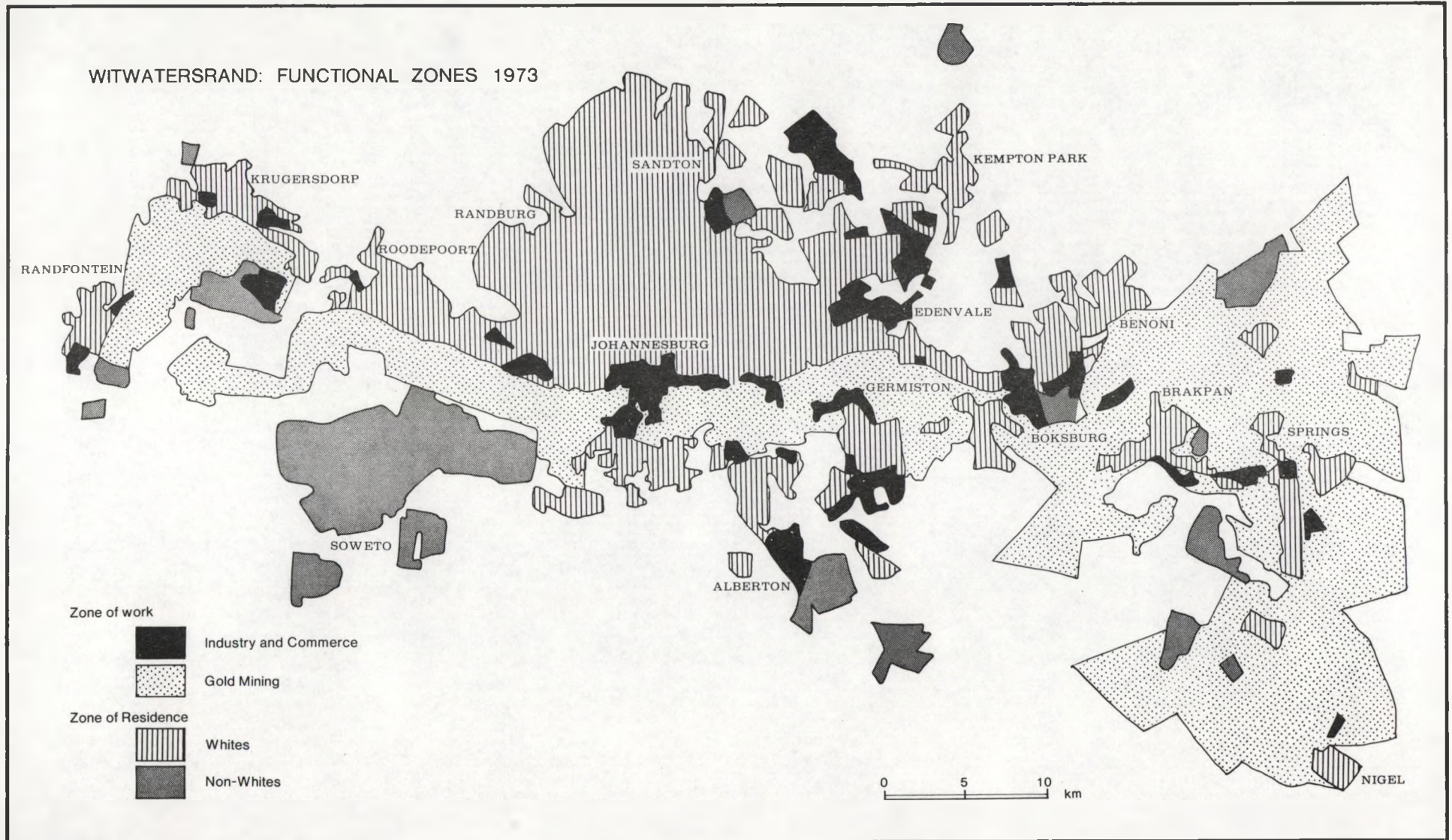


Figure 2.

CHAPTER 2.THE METROPOLITAN FRAMEWORKIntroduction

8. The present megalopolitan region of the Southern Transvaal is clearly divisible into three dynamic and interwoven systems of movement of people, goods and services, centred respectively on Pretoria, Johannesburg and the Vaal Triangle. These systems, which are well illustrated by the pattern and volume of traffic flows in Figure 14 of the First Report,¹ there confirm the validity of recognizing the Southern Transvaal as comprising three growing metropolitan regions, which are being progressively joined together by axial corridors of movement and physical development. In turn, this three-fold division forms the foundation for the analysis of the Southern Transvaal's settlement patterns, demographic structure and economic organization, and their growth-trends. It also forms a basic element in the formulation of alternative planning strategies for the future development of the region as a whole.

9. Similarly, in this Second Report, analysis of the metropolitan development of the Witwatersrand as a growing economic agglomeration, concentration of population and mosaic of industrial, commercial, residential, administrative, recreational and transportation land uses, is based on the fact that this

¹*First Report: The Southern Transvaal*, op.cit.

8.

development is woven together and partly determined by an intricate system of movement of people, goods and services. This dynamic system, which, at the present stage in the development of the Witwatersrand, is divisible into a hierarchy of sub-systems delimited below, indelibly impresses its form and structure on the region's urbanization. The report thus begins with an examination of the system's essential features, in order to establish the existing metropolitan framework of the Witwatersrand, as a foundation for its further regional analysis and for the ultimate formulation of regional planning strategies.

First-Order System of Movement: The Metropolitan Region

10. The growth and present physical extent of the Witwatersrand metropolitan region have been illustrated in Figures 1 and 2 above. The contours of its contemporary first-order system of movement are illustrated in Figures 3 and 4, and the articulation of that system is analysed in Table 1. Overwhelmingly, Johannesburg is the dominant node around which the entire metropolitan network pivots, and to and from which people, goods and services move from and to all parts of the region. Figure 3 and Table 1 well illustrate this dominance, and the interconnections between Johannesburg and all other towns from Randfontein to Nigel throughout the region's length, either directly, or indirectly *via* a hierarchy of subsidiary centres of movement. In 1961 (the latest year for which data are available), out of a daily metropolitan total of 44 770 direct inter-town movements of vehicles, Johannesburg was the origin or destination of 23 310 or 52%. This traffic was generated by direct connections with Germiston

(9 500 vehicles), Roodepoort (6 300), Alberton (2 700), Kempton Park (2 180), Edenvale (1 870) and what is now Soweto (760 and not an independent town). Germiston, ranked second in the hierarchy, was the origin or destination of 16 280 direct inter-town vehicle movements, and the volume of traffic generated between it and Johannesburg alone was greater than the *total* traffic attributed in Table 1 to any other town. For example, Roodepoort, the next, third-ranking town, was the origin or destination of no more than 8 500 direct inter-town vehicle movements.

11. If Johannesburg and Germiston are taken together in Table 1, these first and second-ranking traffic nodes, which are so strongly inter-connected, account for 67% of the total direct inter-town vehicle movements occurring throughout the Witwatersrand in 1961. If they are so combined, the field of direct contact with these two nodes extends eastwards to include Boksburg (7 960 vehicles and ranked equal third with Roodepoort), and the traffic involved rises to 30 090 vehicle movements. Eastwards again, this field is strongly connected by Boksburg and Kempton Park to Benoni (5 390 vehicles and ranked equal fourth with Kempton Park), and thence to Brakpan (4 580 vehicles and ranked equal fifth with Alberton), Springs (2 950 vehicles and ranked equal sixth with Edenvale), and Nigel (1 290 vehicles and ranked seventh). Westwards, the field is strongly connected by Roodepoort to Krugersdorp (3 260 vehicles and ranked equal sixth with Springs and Edenvale), and thence to Randfontein (1 660 vehicles and ranked equal seventh with Nigel). To both the east and west, traffic volumes and town rankings thus fall progressively with distance from Johannesburg, the dominant metropolitan node. Its dominance in rail traffic is even greater: 80% of all monthly totals of weekly and season railway tickets sold to White passengers throughout the Witwatersrand during

10.

August 1966, were accounted for by journeys undertaken between Reef stations and Johannesburg in both directions. Journeys between Reef stations and Germiston, again the second ranking node, accounted for no more than 8,8% of the tickets sold.

12. Whereas Johannesburg is thus the pivot of the metropolitan system of movement as a whole, it is clear from the above analysis and Table 1 that it has very much stronger connections with some parts of the system than with other parts. Indeed, of all Witwatersrand cars registered outside Johannesburg and the new towns of Randburg and Sandton contiguous to its northern boundary, which in 1971 daily entered this combined area and whose occupants worked there, 70% originated from Roodepoort, Edenvale, Kempton Park, Germiston and Alberton.² It is also clear from Table 1 that Germiston, and each lower-ranking traffic node in the metropolitan hierarchy, itself acts as the pivot of a more local system of movement, although some of these systems are relatively very weak. It is thus necessary to pursue the analysis beyond the first-order system of movement comprising the metropolitan region as a whole, in an attempt to uncover the more significant second-order systems which constitute the next essential elements in its framework.

Second-Order Systems of Movement: Inner and Outer Metropolitan Zones

13. In 1956/57, an examination³ of traffic survey

²External Cordon Survey, City Engineer's Department, Johannesburg City Council, 1971.

³L.P. Green, *The Future Development of Johannesburg. First Interim Report*, op.cit.

data of 1954 covering the origins and destinations of the daily movement of vehicles between the central business district of Johannesburg and the rest of the Witwatersrand, then revealed two major subsidiary systems of movement. One was an inner metropolitan zone having a high degree of daily contact with that centre; another was an outer metropolitan zone having a considerably weaker contact. The delimitation of the two zones was based principally on these data, but also on available railway passenger statistics, on the origins and destinations of road traffic generated by the Johannesburg produce market, on the interdependence between Germiston - as an important and closely-associated subordinate node - and certain "ring" towns (as illustrated in Table 1), and on areas of recognizably high population density located around the region's major work centres.

14. In the result, as reflected in Figure 1, the inner metropolitan zone was defined as stretching from the western boundary of Roodepoort eastwards through Johannesburg and Germiston to, most probably, Benoni. It thus included, besides these urban areas, Boksburg, Elsburg, Kempton Park, Edenvale, Bedfordview and Alexandra township. In the north, the zone's boundary was demarcated by Ferndale, Bryanston and Sandhurst, which now form part of the new municipalities of Randburg and Sandton. In the south, the boundary included Alberton and what is now Soweto. The outer metropolitan zone was defined as extending in all directions beyond this boundary, to include Randfontein and Krugersdorp in the west, Brakpan and Springs in the east (and possibly Benoni, but not Nigel), areas northwards to Halfway House (and thus including Rivonia and Jan Smuts airport), and areas southwards to at least the Klip river and Palmietfontein, and possibly even beyond these limits towards Ennerdale in the south-west.

12.

15. Of the 58 065 vehicles counted in the traffic survey and having final destinations in the Johannesburg C.B.D., 91,5% came from the inner metropolitan zone so defined (including Benoni), and 5,5% came from the outer metropolitan zone. Of the 235 000 persons estimated as travelling daily to final destinations in the Johannesburg central business district by bus, tram, train, car and lorry, over 90% also came from the inner zone.

16. A survey undertaken in 1965,⁴ and subsequent research for local development plans, have revealed significant shifts in the location and compass of these two zones in the last fifteen years, as a result of fundamental industrial and commercial developments and their impact on the distribution and movements of the region's continually growing population. Defined in terms of daily work trips made by car, train and bus to the Johannesburg municipal area, and the percentage of the White working population resident in other towns who daily travelled to work in that area, the zones as delimited in 1965 appear in Table 2. Of the 37 640 work trips made to the Johannesburg municipal area from the rest of the Witwatersrand (excluding Nigel), 69% now originated from an inner metropolitan zone comprising Roodepoort, Germiston, Edenvale, Alberton, Bedfordview and the new municipalities of Randburg and Sandton, and in each case accounted for at least 29% of their resident White workers. Kempton Park, Boksburg and Benoni no longer appeared to belong to this zone, as in no case did the proportion of their resident

⁴*Metropolitan Johannesburg*, Forward Planning Branch, City Engineer's Department, Johannesburg City Council, November 1966.

White workers commuting to Johannesburg exceed 20%. They thus appeared to fall into the outer metropolitan zone, together with Randfontein, Krugersdorp, Brakpan and Springs, from which originated 31% of the daily work trips to Johannesburg from the rest of the metropolitan region.

17. Subsequent data from local development plans incorporated in Table 2, indicate that Krugersdorp should now be regarded as beginning to fall into the inner zone, as the proportion of its resident White workers commuting to Johannesburg rises from 17% to 27% in only five years. Most certainly, the western boundary of this zone now encompasses its newer north-eastern residential suburbs. Moreover, the table confirms that neither Edenvale nor Bedfordview may still be regarded as "ring" towns to Germiston. Indeed, they are both clearly dormitory to Johannesburg, and the latter city's outward growth has engulfed them within its immediate sphere of influence. By contrast, the subsequent data in Table 2 tend to confirm the location of Kempton Park in the outer metropolitan zone, as the proportion of its resident White workers commuting to Johannesburg falls from 19% to 13% by 1970. Furthermore, by 1968 it was attracting 48% of its White labour force from neighbouring municipalities to its industrial areas of Isando and Spartan, to Jan Smuts airport and to the Atlas Aircraft factory.⁵ Boksburg and Benoni have also become major work centres in their own right.

18. Thus, the inner metropolitan zone has tended to

⁵Charl Viljoen and Partners, *Kempton Park Development Plan*, 1970; p.16.

shift westwards during the last fifteen years. As illustrated in Figure 2, White residential development connected with growing work opportunities in Johannesburg has spread rapidly to the western areas of the Witwatersrand beyond Roodepoort into north-eastern Krugersdorp, assisted by the availability of rail transport and the construction of Ontdekkers Road. To the east of Johannesburg, the boundary of the inner zone has contracted with the rise of Kempton Park as a major industrial centre, but the White population resident within that boundary has grown apace and become increasingly dormitory to the metropolitan hub. The outer metropolitan zone has contracted on the western Witwatersrand, but has expanded on the east, and become more closely knit around the expanding work areas of its major urban nuclei, which account for an increasing proportion of the daily commuting of the zone's resident White workers. In the result, the inner and outer metropolitan zones now occupy the areas and embrace the traffic nodes shown in Figure 4. In the result, too, the intensity of movement in the inner zone has increased by four-and-one-half times during the last two decades: in 1954, 78 000 vehicles entered and left the Johannesburg municipal area daily; in 1972, 345 000 vehicles did so,⁶ and by far the greater part of this traffic was undoubtedly generated within the inner metropolitan zone. Of this latter total, 50% was accounted for by the region's northern and western quadrants where, because of their rapid growth, Roodepoort, Randburg and Sandton now house a total of 160 000 White residents, most of whom work in Johannesburg. Of the remaining traffic, 33% was accounted for by the mixed passenger and industrial

⁶Information supplied by the City Engineer's Department, Johannesburg City Council.

movements of the eastern quadrant, and 17% by the southern quadrant. In all, the road traffic converging upon or originating in Johannesburg has grown at rates of between 9% and 11% per annum in the past ten years.

19. This very rapid increase in road traffic has in part reflected improvements in communications between Johannesburg's C.B.D. and the rest of the inner metropolitan zone; but these improvements are now being very significantly augmented by the construction of a freeway network. An extremely important consequence of these freeways - the full ramifications of which have yet to be determined - will be their impact not only on the major zonal structure of the Witwatersrand in particular, but on the megalopolitan development of the Southern Transvaal in general. Attention was drawn in Chapter 4 of the First Report⁷ of this Study to the fact that transportation systems are powerful and creative engines of development. On the one hand, the completion of the presently-planned freeway network will undoubtedly have far-reaching megalopolitan consequences. The greater ease and speed of movement between the Witwatersrand and the two other metropolitan regions of the Southern Transvaal, may well extend the perimeters of their outer metropolitan zones into each other's daily commuting range. They will certainly intensify existing pressure to expand and deepen inter-metropolitan urban sprawl along the Southern Transvaal's north-south axis, and they may in fact play a determining rôle in the choice ultimately made between the alternative planning strategies for that region's future form and organization set out in Chapter 5 of the First Report.⁸ On the other hand,

⁷*First Report: The Southern Transvaal*, op.cit., p.78.

⁸*Ibid.*, pp.98-110.

16.

as far as the Witwatersrand's own *internal* metropolitan framework is concerned, the expressways may so increase longer-distance traffic as to bring Benoni and Boksburg into the inner zone again, together with Brakpan in the east and possibly Randfontein in the west; thus, for instance, greatly augmenting the existing very high volumes of commuting traffic moving daily between Johannesburg and the rest of the inner zone.

20. In the regrettable absence of potential impact studies in connection with the planned freeway network, and of up-to-date origin and destination traffic surveys, reliable projections of the megalopolitan and metropolitan consequences of these fundamental changes in the regional transportation system cannot be made. Before suggesting possible alternative planning strategies for the Witwatersrand, Part Three of this report will thus attempt to rectify the more serious omissions in so far as the major intra-metropolitan systems of movement are concerned, because the repercussions on these systems will undoubtedly be wide-ranging. It may be that new patterns of movement, and therefore land uses, which are as yet unappreciated, will be found to be either already emerging or potentially emergent in the near future.

21. The freeway network now under construction will, however, be unlikely to exert a major influence on the commuting of Bantu, Asian and Coloured workers. Their movement is much less flexible and intricate than that of White workers, and in the case of Bantu workers (who constitute 94% of the Witwatersrand's non-White labour force of 859 000 persons) it is rigidly controlled and directed by Government policy and regulation. As reflected in Figures 2 and 6, each municipality on the Witwatersrand now has its own Bantu residential area located regionally by the Mentz Committee in the 1950s,

from which the bulk of its Bantu workers is drawn; 77% or 566 000 of these workers live in such areas within the inner metropolitan zone, in which the great majority of them are employed; and their movement between their residential and work areas takes place by public transport along short-distance rail and road routes directly linking these areas (and often specially constructed for this purpose). Here, then, is another system of movement within the Witwatersrand which is associated with those of the inner and outer metropolitan zones. But it is largely independent of the latter; it comprises a simple series of distinct, short-distance journeys instead of a complex system of multi-directional movements; and it is determined by Government policy in respect of separate residential areas for different ethnic groups, influx control and industrial decentralization. *Whereas the regional systems of movement of White workers have evolved as largely autonomous consequences of the overall configuration of land uses and the articulation of the transportation network, the regional movement of the non-White workers is largely a controlled consequence of a distribution of residential areas planned in relation to work areas, and of a complementary, planned, transportation network directly linking these land uses to each other.*

22. It is not anticipated that this largely independent series of movements of Bantu workers, which is related to that of White workers through shared work areas, will be significantly modified in the immediate future by the establishment of two Bantu Affairs Administration Boards for the Witwatersrand. One of these Boards will have jurisdiction over the western areas from Randfontein to the eastern boundary of Johannesburg (thus also including Krugersdorp, Roodepoort, Randburg, Sandton, Soweto and Alexandra Township), and the other will have jurisdiction over the

18.

eastern areas (from Germiston through Alberton, Edenvale, Bedfordview, Elsburg, Boksburg, Kempton Park, Benoni and Brakpan to Springs and Nigel). Nevertheless, since this administrative reorganization will permit Bantu workers resident within the area of a Board to seek employment anywhere within its boundaries, and since motor car ownership amongst the Bantu population of the Witwatersrand is rapidly growing, the next decade may well witness considerable changes in the existing series of movements, in spite of the prevalence of contract labour. These potential changes must also be taken into account when possible alternative planning strategies for the Witwatersrand are being formulated in this report.

23. For the present, however, the second-order systems of movement, differentiating the inner and outer metropolitan zones, are undoubtedly located and delimited as illustrated in Figure 4. The largely independent series of movements of Bantu workers is accommodated within this overall pattern, as shown in Figure 6, with only a marginal disagreement in the vicinities of Germiston, Alberton and Edenvale, which mark the eastern perimeter of the inner zone. There is no doubt, therefore, that for *present* purposes these two major zones of movement are to be regarded as basic elements of the metropolitan framework, as principal tools for the spatial analysis of the Witwatersrand's economy, population and land uses, and as major foundations for the construction of future development strategies. Whatever changes may possibly be introduced by the completion of the freeway system and the setting up of the new Bantu Affairs Administration Boards, in the short run they will, in any case, be but modifications of these fundamental, second-order systems of movement.

24. Nevertheless, as Figure 3 and Table 1 clearly indicate, there are other systems of movement within the metropolitan region, which are associated with traffic nodes subsidiary to Johannesburg and which are undoubtedly of substantial significance for urban and regional planning. It is necessary to uncover these further, third-order traffic patterns in order to complete the essential metropolitan framework of the Witwatersrand.

Third-Order Systems of Movement: Subsidiary
Metropolitan Zones

25. Although, beneath the overlay of inner and outer metropolitan zones of movement, there certainly lie further subsidiary zones associated with the smaller urban nodes and work centres of the Witwatersrand, very little information about them is available, particularly because of the absence of recent origin and destination studies outside Johannesburg itself. For the present report, therefore, a preliminary study⁹ of the degree of connectivity between places of work and places of residence has been made, involving the White population only (as the existing connectivity involving the working Bantu population is already known). The results appear in Table 3 and Figure 5. By identifying and counting car registration numbers, the residential origins of White workers employed in the majority of the main industrial areas of the Witwatersrand have been determined. The values in Table 3, which are given as percentages, indicate for the industrial areas concerned the proportions of White workers employed in each area or

⁹Survey carried out by Mr B.G. Boaden, Urban and Regional Research Unit, University of the Witwatersrand, 1972.

group of areas according to their municipal origins. Thus, in the case of Aureus industrial area, 81% of its White workers are drawn from Randfontein municipality, 13% from Krugersdorp municipality, 4% from Roodepoort municipality, and smaller, insignificant percentages from other Witwatersrand municipalities. In the case of Johannesburg, only four representative and well-spaced industrial areas were surveyed, mainly in order to show the linkages with adjacent municipalities.

26. The salient features of the resulting pattern of movement appearing in Figure 5 are as follows:

- (i) Each industrial area draws the greatest single proportion of its White workers from its parent municipality, and the next highest proportion from an adjacent municipality. Clearly, *distance to work* thus appears to be the most important consideration governing the locational or spatial relations between places of residence and places of work, as far as the majority of the Witwatersrand's White industrial workers are concerned.
- (ii) Very few White industrial workers move between the eastern and western areas of the Witwatersrand. Johannesburg acts as a barrier to such movement, and is in fact the terminal point for most industrial workers coming to it from either the West or the East Rand.¹⁰ At the same time, while it absorbs a high proportion of White industrial workers from surrounding municipalities, Johannesburg is also the origin of a high proportion of workers found in the industrial areas of adjacent municipalities.

¹⁰ Compare, for instance, Figure 3.

From Johannesburg originate 16% of Krugersdorp's White industrial workers, 13% of Roodepoort's, 16% of Kempton Park's, 23% of Germiston's and 33% of Alberton's. These findings not only confirm the validity of an inner metropolitan zone of movement centred upon Johannesburg, but indicate that the latter is itself the chief generator of such traffic and the principal subsidiary zone.

- (iii) Those industrial areas which are situated at the extremities of the region, namely, Aureus (Randfontein), New Era and Nuffield (Springs) and Vorsterkroon and Pretoriusstad (Nigel), draw the overwhelming proportion of their White workers from their parent municipalities, viz. 81%, 77% and 78%, respectively.
- (iv) The West Rand, employing in all 5% of the Witwatersrand's White industrial workers, shows some degree of interdependence as a system of movement between Randfontein, Krugersdorp and Roodepoort. But this comparatively weak zone is overshadowed by the more dominant and higher-ranking Johannesburg core (Table 1).
- (v) There are very substantial cross-currents of White workers moving between the municipalities of Germiston, Alberton, Kempton Park, Boksburg and Benoni - in which they live - and the various industrial areas of all of these towns - in which they work. The five municipalities together employ 37% of the Witwatersrand's White industrial workers, and because of the complex relationships obtaining between the latter's numerous places of

residence and places of work, they may be viewed as forming a distinctive system of movement of industrial workers and industrial traffic in general. The rapid growth of this traffic, including that generated by Jan Smuts international airport and the Rand commercial airport, has resulted in four-and fivefold increases since 1954 in the volumes of vehicles per day using roads leading into Kempton Park, and even a ten-fold increase (to 30 000) in the neighbourhood of Jan Smuts airport.

- (vi) Between this system and the Far East Rand, Brakpan municipality acts as primarily a dormitory town. Although its own industrial area draws the main proportion of its White workers from Brakpan itself (67%), no less than 68% of the town's White workers (in all categories) is employed beyond its boundaries - mainly in Benoni, Springs, Johannesburg, Boksburg and Germiston.¹¹ In this sense, Brakpan belongs both to the system of movement just described and encompassing the towns to its west, and to the system of movement centred on Springs to its east.
- (vii) Springs municipality forms an important, peripheral node in its own right, not only drawing 77% of its White industrial workers from its own residential areas, but attracting substantial numbers from neighbouring Brakpan and Nigel as well. Traffic volumes per day fall off rapidly east of Benoni from a maximum of 15 000 vehicles, but rise again to between 5 000 and 10 000 at the approaches to Springs.

¹¹ Charl Viljoen and Partners, *Brakpan Development Plan*, 1972; p.36.

27. Using Table 3 and Figure 5, therefore, it is possible to discern a hierarchy of at least four distinctive subsidiary metropolitan zones of movement. As illustrated in Figure 6, these four zones comprise, first, a very strong and dominant system of movement focusing on *Johannesburg*, the first-ranking traffic node in Table 1, and encompassing Randburg, Sandton, Soweto, Edenvale and Bedfordview, which are all very intimately linked to the city's C.B.D. by high volumes of daily commuting traffic. Secondly, they include a relatively weak, sub-dominant system of movement on the *West Rand* circulating between Roodepoort (a third-ranking traffic node in Table 1), Krugersdorp (a sixth-ranking node) and Randfontein (ranked seventh). Thirdly, they comprise a relatively strong, multi-centred and closely-knit system of movement, which involves the *East Rand* municipalities of Germiston (ranked second in Table 1), Boksburg (ranked third), Kempton Park (ranked fourth), Benoni (also ranked fourth) and Alberton (ranked fifth), but which is, nevertheless, subordinate to that of Johannesburg. Fourthly, they comprise a peripheral and weaker, yet integrated and semi-independent system of movement centring on the *Far East Rand* municipality of Springs (ranked sixth in Table 1), and involving Nigel (ranked seventh) and Brakpan (ranked fifth). The latter, however, also belongs to the East Rand system, and thus links together these two subsidiary metropolitan zones.

28. Although, except in the case of Johannesburg, the four subsidiary zones of movement are delineated on the basis of the movements of White industrial workers only, Figure 6 shows that the movements of Bantu industrial workers are very closely integrated into these zones, because the latter workers not only share the same industrial areas but are confined to short-distance travel between their residential and work areas.

Conclusions

29. In the light of the analysis of the circulation of people, goods and services made thus far, in the First Report in connection with the Southern Transvaal in general and in this Second Report in connection with the Witwatersrand in particular, a number of systems of movement can at present be delimited which together form the essential metropolitan framework of the latter region as it exists today. These systems, which provide the foundation for the analysis to be made in both this part and Part Two of the present report, and which constitute a regional hierarchy, are reflected in Figures 4 and 6. They are as follows:

- (i) Within the present Southern Transvaal megalopolitan system, which also encompasses Metropolitan Pretoria and the Vaal Triangle, a first-order system of movement may be identified which defines the limits of the Witwatersrand metropolitan region, stretching from Randfontein in the west to Nigel in the east and centred upon Johannesburg, its commercial, industrial and service hub.
- (ii) Subsidiary to this first-order metropolitan system, two second-order systems of movement may be delimited. These comprise (a) a strongly-knit inner metropolitan zone focused also on Johannesburg and stretching from Krugersdorp in the west to Germiston in the east; and (b) a more loosely-knit outer metropolitan zone covering the remainder of the metropolitan region, which, nevertheless, is still focused on the region's principal city.
- (iii) Beneath the overlay of second-order metropolitan systems lies a hierarchy of four third-order

systems of movement. This subordinate hierarchy comprises (a) a central Johannesburg zone, immediately surrounding the first-ranking traffic node and its C.B.D; (b) the West Rand, a peripheral, lower-ranking and comparatively weak system which yet possesses a local interconnectivity that can only increase as work opportunities grow in this area; (c) the East Rand, a relatively strong, multi-nodal and complex system of movement which ranks higher than the West Rand but, nevertheless, is sub-dominant to Johannesburg, with which it is closely connected; and (d) the Far East Rand, a peripheral and more simple, lower-ranking system which, even so, appears to have a greater degree of nodality and independence from the metropolitan hub than does the higher-ranking East Rand.

30. Although the completion of the freeway network now under construction, and the reorganization of the administration of Bantu affairs on the Witwatersrand, will both have an impact on these systems of movement which has yet to be determined, they are most unlikely to invalidate the latter's hierarchical tendencies.¹² They are more

¹²cf. A.Z. Guttenberg, 'Urban Structure and Urban Growth', *Journal of the American Institute of Planners*, vol. XXVI(2), May, 1960; p.106: "Limits to both concentration and dispersion are set by immobile persons and by facilities which cannot be distributed. But not all persons are equally immobile, and not all facilities are fixed or concentrated in the same degree. Mobility differs according to age, sex, and income, whereas distribution is a matter of economic plant size or of the spatial scatter of natural resources. These facts explain the hierarchical tendency of urban structure: people must travel different distances to facilities and the facilities themselves have different service radii. Also, they account in part for the existence of central places of several sizes and the corresponding differentiation of the highways which serve them into major and minor arterials and local streets."

likely merely to modify the spatial extents and volumes of traffic characterizing these systems. During the current industrial phase of urbanization, the metropolitan framework will undoubtedly remain that of a first-order, region-wide system of movement, which embraces a second-order system of inner and outer metropolitan zones, and an underlying third-order system of subsidiary zones which is itself hierarchical in character and centres on the metropolitan core.

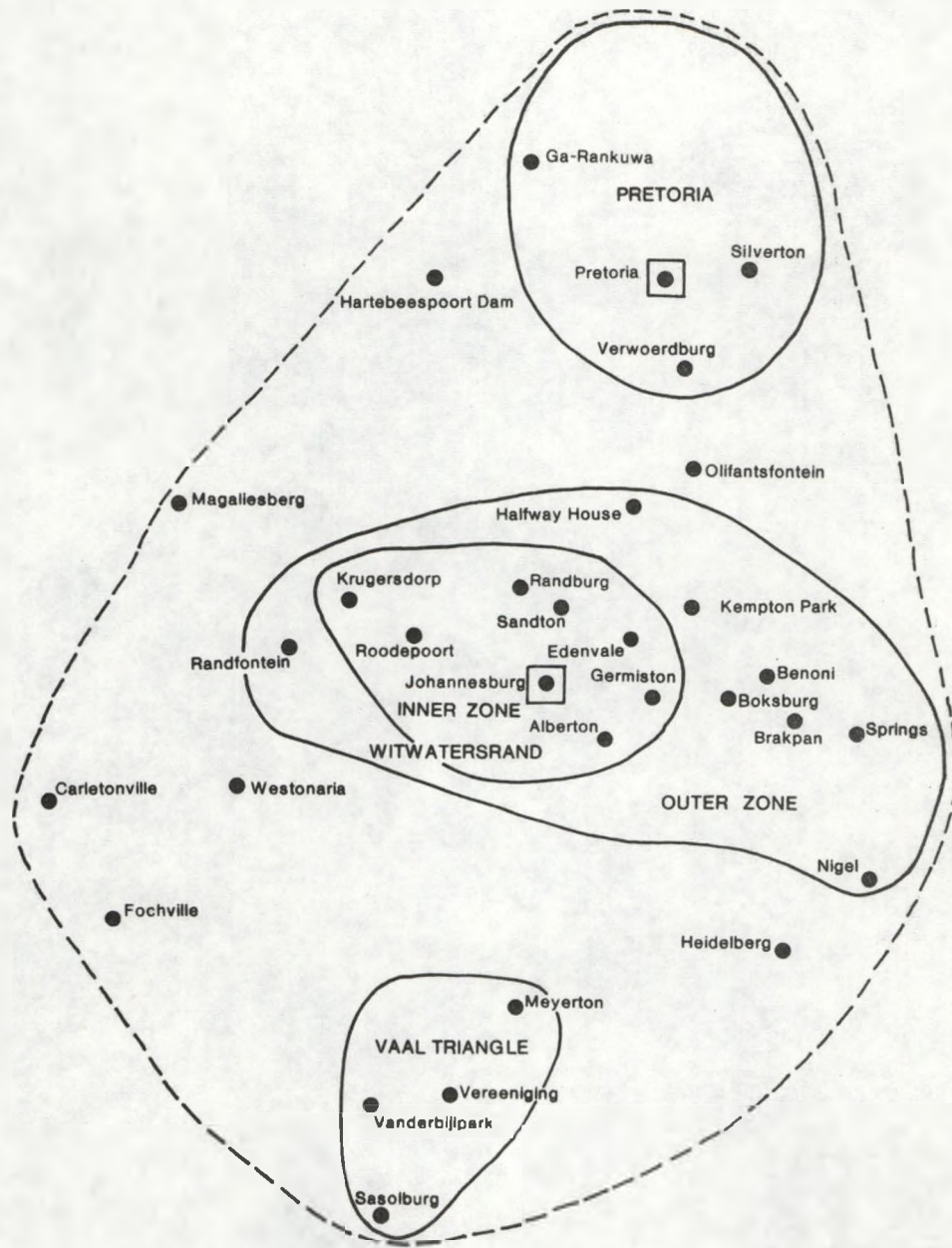


Figure 4.

The Southern Transvaal: Major Systems of Movement, 1972

TABLE 1.

DAILY DIRECT INTER-TOWN ROAD TRAFFIC, 1961

Place of Origin/Destination	Number of Vehicles	Place of Destination/Origin	Cumulative number of Vehicles	Index of Volume (JBG=100)	Rank Order of Town
Johannesburg	9 500 6 300 2 700 2 180 1 870 760 <u>23 310*</u>	Germiston Roodepoort Alberton Kempton Park Edenvale Soweto**	9 500 6 300 2 700 2 180 1 870 760 <u>23 310</u>	100	1
Germiston	9 500 3 200 1 780 1 260 540 <u>16 280</u>	Johannesburg Boksburg Alberton Kempton Park Edenvale	- 3 200 1 780 1 260 540 <u>30 090</u>	70	2
Roodepoort	6 300 1 900 300 <u>8 500</u>	Johannesburg Krugersdorp Randfontein	- 1 900 300 <u>32 290</u>	36	equal 3
Boksburg	3 260 3 200 750 ^e 750 ^e <u>7 960</u>	Benoni Germiston Kempton Park Brakpan	3 260 - 750 750 <u>37 050</u>	34	equal 3
Kempton Park	2 180 1 260 750 ^e 700 540 ^e <u>5 430</u>	Johannesburg Germiston Boksburg Benoni Edenvale	- - - 700 540 <u>38 290</u>	23	equal 4
Benoni	3 260 1 430 700 <u>5 390</u>	Boksburg Brakpan Kempton Park	- 1 430 - <u>39 720</u>	23	equal 4
Brakpan	2 400 1 430 750 ^e <u>4 580</u>	Springs Benoni Boksburg	2 400 - - <u>42 120</u>	20	equal 5
Alberton	2 700 1 780 <u>4 480</u>	Johannesburg Germiston	- - <u>42 120</u>	19	equal 5
Krugersdorp	1 900 1 360 <u>3 260</u>	Roodepoort Randfontein	- 1 360 <u>43 480</u>	14	equal 6
Springs	2 400 550 <u>2 950</u>	Brakpan Nigel	- 550 <u>44 030</u>	13	equal 6
Edenvale	1 870 540 540 ^e <u>2 950</u>	Johannesburg Germiston Kempton Park	- - - <u>44 030</u>	13	equal 6
Randfontein	1 360 300 <u>1 660*</u>	Krugersdorp Roodepoort	- - <u>44 030</u>	7	equal 7
Nigel	740 550 <u>1 290</u>	Dunnottar** Springs	740 - <u>44 770</u>	6	equal 7

* estimated.

* excluding direct traffic to and from Carletonville and Westonaria.

** not a traffic node.

Source: Figure 3.

TABLE 2.

WORK TRIPS TO JOHANNESBURG BY ZONES, WHITES ONLY, 1965

Place of Origin	Total Work Trips to Johannesburg by car, bus and train (Whites)		% of the working population working in Johannesburg (Whites)	
	1965		1965	1970
<u>Inner Zone</u>				
Rodepoort	11 190		56	n/a
Randburg	n/a		75?	75?
Sandton	n/a		75?	75?
Edenvale	2 250		33	51
Bedfordview	1 060		59	n/a
Germiston	9 450		29	n/a
Alberton	2 090		31	n/a
T o t a l	26 040	69%	-	-
<u>Outer Zone</u>				
Randfontein	940		16	n/a
Krugersdorp	2 260		17	27*
Kempton Park	1 600		19	13
Boksburg	2 510		20	n/a
Benoni	2 080		11	n/a
Brakpan	1 210		9	13
Springs	1 000		5	n/a
Nigel	n/a		n/a	n/a
T o t a l	11 600	31%	-	-
Grand Total	37 640	100%	-	-

* Krugersdorp located in the inner zone by 1970.

n/a not available.

Sources: 1965: *Metropolitan Johannesburg*, op.cit., Table 4.12

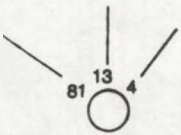
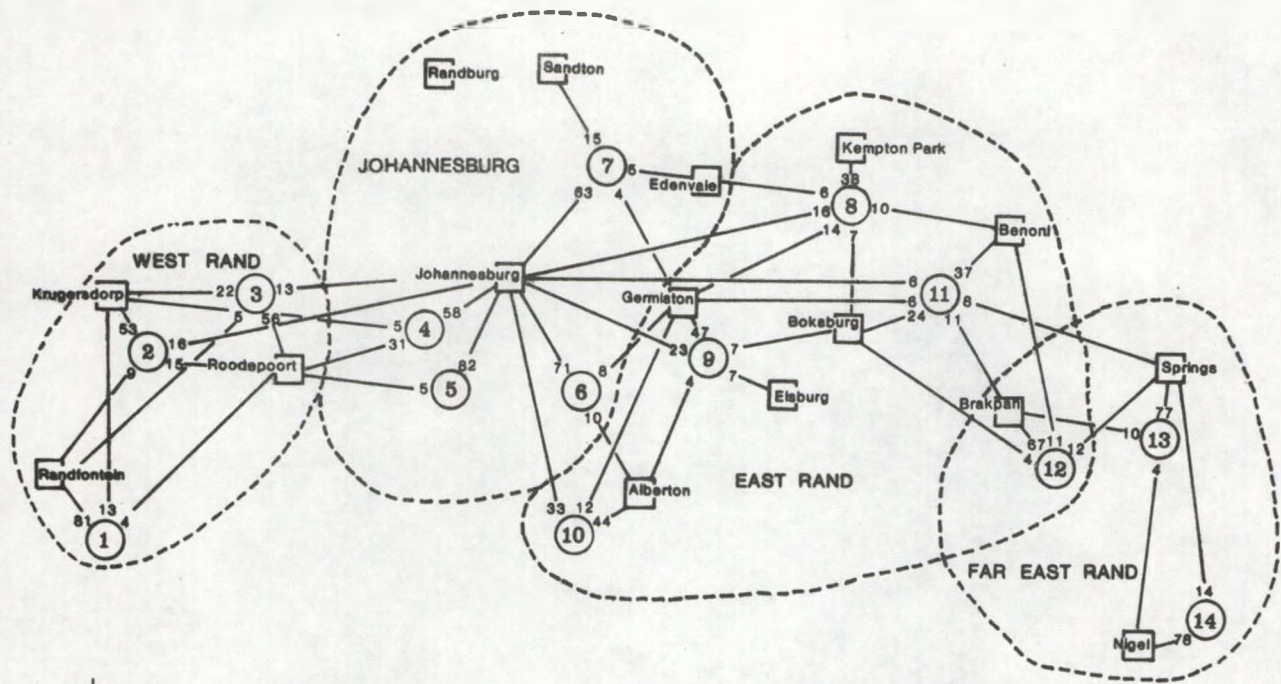
1970: *Development Plan Reports: Kempton Park, Edenvale and Brakpan* (Charl Viljoen and Partners); *Krugersdorp* (Plan Associates).

TABLE 3.

ORIGIN OF WORK TRIPS TO WITWATERSRAND INDUSTRIAL AREAS : WHITES ONLY, 1972

(To nearest %)

Work trips from Municipality	Randfontein	Krugersdorp	Roodapoort	Johannesburg	Randburg	Sandton	Edenvale	Kempton Park	Germiston	Elsburg	Alberton	Boksburg	Benoni	Brakpan	Springs	Nigel	Total
Work trips to Industrial Areas																	
1. Aureus	81	13	4	2	-	-	-	-	-	-	-	-	-	-	-	-	100
2. Factoria and Chamdor	9	53	15	16	1	1	1	1	1	-	1	-	-	-	-	-	100
3. Technikon and Manufacta	5	22	56	13	-	-	-	-	-	-	-	-	-	-	-	-	100
4. Johannesburg - Langdale	1	5	31	58	2	1	-	-	1	-	1	-	-	-	-	-	100
5. Aaroton	-	-	5	82	2	-	-	2	2	-	2	1	-	-	-	-	100
6. Electron	-	-	3	71	1	1	-	1	8	-	10	2	1	-	-	-	100
7. Kew, Wynberg	-	-	2	63	3	15	5	3	4	-	1	1	2	-	1	-	100
8. Isando, Spartan, Airport (tech)	-	-	1	16	1	1	6	38	14	-	1	7	10	2	1	-	100
9. Wadeville and Germiston West	-	-	-	23	-	-	2	3	47	7	4	7	3	1	1	-	100
10. New Rudruth and Alrods	1	-	1	33	2	-	-	1	12	-	44	1	1	1	1	-	100
11. Boksburg East, Benoni Ind. and Apex	-	-	-	6	1	-	-	3	6	-	1	24	37	11	8	1	100
12. Vulcania	-	-	-	2	-	-	-	-	1	-	-	4	11	67	12	-	100
13. New Era and Huffield	-	-	-	2	-	-	-	-	1	-	-	1	3	10	77	4	100
14. Vosterkroon and Pretoriusstad	-	-	-	3	-	-	-	-	1	-	-	-	1	2	14	78	100



Industrial Area(s)

e.g., 81% of workers employed at Aureus come from Randfontein, 13% from Krugersdorp, 4% from Roodepoort.

Less than 4% not indicated, e.g. Randburg.

Trips given as a percentage of total.

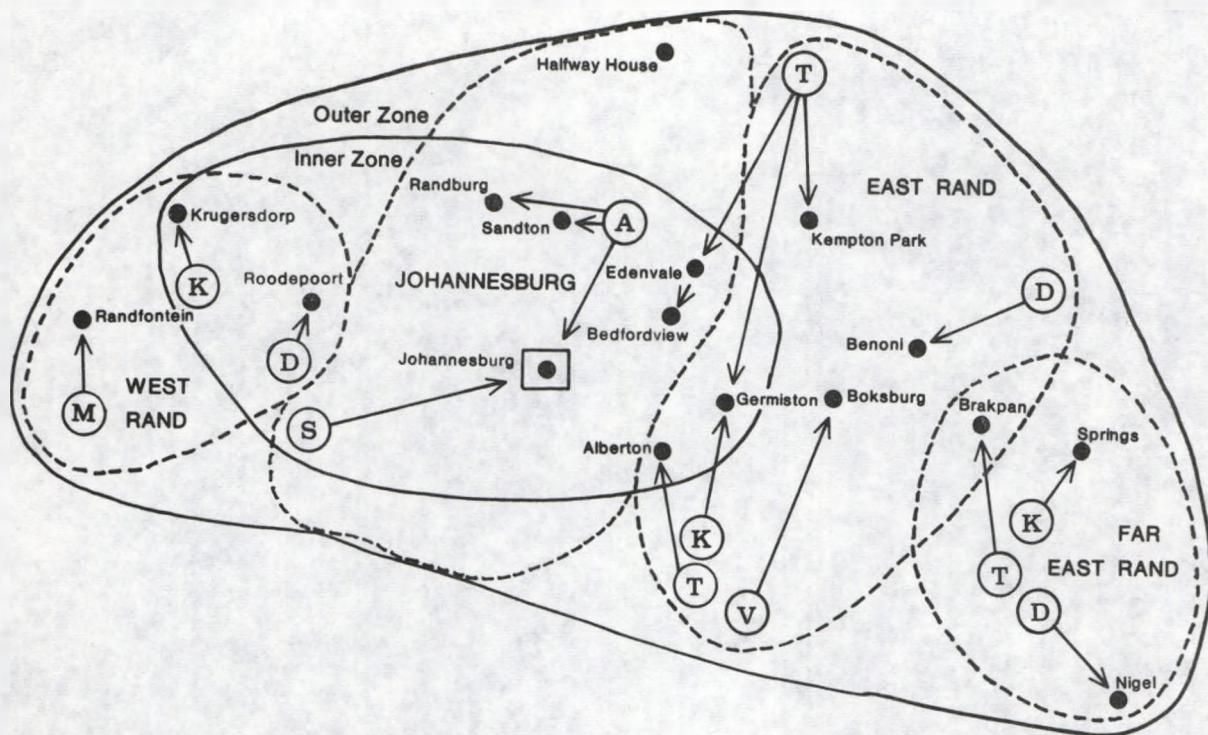
INDUSTRIAL AREAS

1. Aureus
2. Factoria & Chamdor
3. Technikon & Manufacta
4. Langdale
5. Aeroton
6. Electron, Tulisa Park, Steeledale
7. Kew, Wynberg
8. Isando, Spartan, Airport Technical
9. Wadeville & Germiston West
10. New Redruth & Alrode
11. Boksburg East, Benoni & Apex
12. Vulcania
13. New Era & Nuffield
14. Vorsterkroon & Pretoriusstad

Figure 5.

Origins of Work Trips to the Witwatersrand Industrial Areas, 1972; Whites Only

(Source: Table 3)



BANTU TOWNSHIPS

Johannesburg

- S Soweto
- A Alexandra

West Rand

- M Mohlakeng
- K Kagiso
- D Dobsonville

East Rand

- T Tembisa
- D Daveyton
- V Vosloorus
- T Tokoza
- K Katlehong

Far East Rand

- K Kwa Thema
- T Tsakane
- D Dudusa

Figure 6.

The Witwatersrand: Systems of Movement, 1972

CHAPTER 3.THE ECONOMIC BASERegional Trends, 1951 - 1970

31. In 1951, the economic capacity of the Witwatersrand metropolitan region¹ to earn imports from beyond its borders depended on the "basic" export activities of mining, secondary industry and commerce in that order.² As shown in Table 4, mining was well over twice as basic to the regional economy as secondary industry, and over eleven times as basic as commerce (including financial and transport services). Whereas mining employed only 31% of the total number of persons gainfully employed within the region, its export potential was so high that it accounted for nearly 63% of the net regional earning capacity in terms of net "surplus" workers. Secondary

¹As defined in Chapter 2 and existing in 1970, thus differing from the delineation made for c.1951 in L.P. Green, *The Social Structure of the Witwatersrand Metropolitan Region*, op.cit., p.10. Hence, Tables 4, 6 and 8 below are not to be compared with Tables I, III and V of L.P. Green, *The Economic Structure of the Witwatersrand Metropolitan Region*, op.cit., pp.10, 13 and 17, which relate to different areas because of changes in the metropolitan and zonal boundaries since 1951 (when Nigel was excluded from the Witwatersrand and no census data on employment in commerce, transport and services were available).

²For an explanation of the basic/non-basic concept and its relevance for the analysis of a metropolitan economy, see the *First Report: The Southern Transvaal*, op.cit., pp.43-45. See also N.N. Patricios, *The Nature of Metropolitan Areas*, Metropolitan Planning Information Paper No. 1, Department of Town and Regional Planning, Witwatersrand University, 1973; p.4.

industry and commerce combined to employ 42% of the total gainfully employed, but accounted for only 31% of the region's net external earning capacity. Nevertheless, the latter groups were significant factors in the regional economy, and without their net "surplus" the proportionately large net import of essential foodstuffs could not have been maintained.³

32. Today, in striking contrast, the Witwatersrand's economic base in terms of net "surplus" workers is as reflected in Table 5. Mining, which now accounts for only 8% of the region's employment, is no longer basic to its economy. Secondary industry, which employs 37% of the work force, is alone responsible for 54% of the region's net external earning capacity. Commerce (including financial and transport services), which accounts for 27% of the work force, is responsible for another 32% of net external earning capacity. Other public and private services, which in 1951 were most probably not basic to the region's economy, now account for 26% of the work force and for 14% of net external earning capacity, and must unquestionably be viewed as basic activities (except in respect of domestic servants).

33. In the short space of only twenty years, therefore, the Witwatersrand has been transformed from what was still primarily a mining area into what is now

³It is true that services also appear to be net earners of imports in Table 4, but the "basicness" of this sector must be seriously questioned, as the overwhelming majority of its workers were domestic servants. Disproportionately high numbers of these servants were employed in Johannesburg and particularly distort the economic structure of the inner metropolitan zone in Table 6.

a maturing metropolitan region,⁴ increasingly dependent for its prosperity and continued development on basic, export growth in its manufacturing industries, commercial activities (including finance and transport) and public and private services, in that order. The work force has grown from 972 000 to 1 211 000 persons, or by 25%, in spite of a steep fall in mining employment from 300 000 to no more than 94 000 workers. Net external earning capacity in terms of net "surplus" workers has risen by 20%, although mining is almost wholly export-oriented; and there appears to be no significant, internal *economic* obstacle to the region's future progress through its present, secondary industrial phase of urbanization,⁵ now that the major structural transformation in its economic base has been successfully accomplished. It is a principal task of metropolitan planning to help to ensure that *other* obstacles⁶ to the Witwatersrand's further development as an integrated economic complex do not seriously impede its onward advance during this present phase in its evolution, in which manufacturing has so clearly emerged as the leading export component of its economic base.

The Inner and Outer Metropolitan Zones, 1951-1970

34. As partly reflected in Figures 1 and 2, this

⁴For a résumé of economic functions characterizing the metropolitan phase of urbanization, see N.N. Patricios, *ibid.*, pp.17 and 18.

⁵See *First Report: The Southern Transvaal*, *op.cit.*, pp.20, 98-102, and 105.

⁶i.e. non-economic obstacles, such as physical congestion, traffic saturation, environmental deterioration, housing deficiencies, lack of capacity in power and water supplies, social conflicts and defective governmental policies, powers, procedures and organization.

remarkable transformation in the region's economic base has been associated with fundamental internal changes in both the spatial and functional organization of its economy. The closing down of most of the older gold mines on the Central and the East Rand has been accompanied by a westward shifting of the inner metropolitan zone focused upon Johannesburg's central business district. The fast-growing industrial areas of Kempton Park, Boksburg and Benoni no longer fall mainly within the latter's immediate sphere of influence as in 1951. Nevertheless, so strong has been industrial development in Johannesburg, Germiston, Alberton and Edenvale, within what is today the inner metropolitan zone of the Witwatersrand, that the economy of this zone has experienced no significant set-back during the last twenty years. Indeed, as its commercial and service sectors⁷ have also grown rapidly, it has been able to withstand the loss of its formerly important mining capacity without adverse effects on its external earning power, which has continued to rise.

35. The results of these significant changes in the functions and structure of the present inner metropolitan zone's economy are reflected quantitatively in Tables 6 and 7. Between 1951 and 1970, total employment rises by 35%, and total basic employment by as much as 45%, during a difficult transitional period. In 1951, disregarding services for reasons already stated, secondary industry and commerce (including finance and transport) account for 51% of the inner zone's employment and for 59% of its net external

⁷Discounting domestic servants, who now form a much smaller proportion of the workers in this sector.

earning power, while mining still accounts for 18% of employment and 21% of net external earning power. By 1970, however, mining is no longer a basic activity and gives employment to only 5% of the zone's workers. Secondary industry and commerce now employ 67% of all workers and account for no less than 83% of net external earning capacity.⁸ Services, which may now undoubtedly be included in the economic base, provide employment for a further 28% of the labour force and account for the remaining 17% of net external earning capacity.

36. Primarily because of rapid industrial development in Kempton Park, Boksburg and Benoni since 1951, the outer zone as delineated today has experienced even greater contrasting changes in the structure of its economic base during these years, especially in the eastern areas. So far, however, its economy has been much less resilient. As reflected in Tables 8 and 9, from being dependent on mining for 57% of employment and 100% of net external earning power in 1951, by 1970 this zone is dependent on secondary industry and commerce (including finance and transport) for 58% of employment and 78% of net external earning power. Mining now accounts for only 15% of employment and 22% of net external earning power, and is rapidly relinquishing its rôle as a basic economic activity. In the result, total employment increases by less than 6% and "basic" employment falls substantially, suggesting a serious overall loss of external earning capacity, particularly

⁸Even so, Table 7 understates the "basicness" of commerce to the economy of the inner metropolitan zone, in so far as it makes no allowance for the commuting of employees in this sector who are resident in the outer zone but work in the inner zone. See paragraph 38 *et seq.* below.

in relation to the inner metropolitan zone, where the economy has been so buoyant.

37. As shown in Figures 1 and 2, however, the outer metropolitan zone has always tended to be differentiated into at least two sectors lying to the west and east of the metropolitan core. Between them, Johannesburg has represented so strong a communications barrier that it has for long been more realistic to analyse the outer zone in terms of at least the West and East Rand. For 1951, therefore, the Second Interim Report on the future development of Johannesburg⁹ distinguished between the economic structure and potential of the eastern and western portions of the outer zone, although insufficient data were then available for detailed examination.¹⁰ It also pointed out that the picture was not so simple as is apparently implied by Table 8, and needed careful analysis. Since 1951, development in the eastern portion of the outer metropolitan zone has been fundamentally affected by, firstly, the shifting of its outer limits eastwards to include Nigel, and, secondly, the shifting of its inner limits westwards to include Benoni, Boksburg and Kempton Park. It is thus more necessary now than in the 1950s to extend analysis of the metropolitan economic base to subsidiary, intra-zonal growth and change on the West Rand, the East Rand and the Far East

⁹L.P. Green, *The Economic Structure of the Witwatersrand Metropolitan Region*, op.cit., pp.35, 48 and 49.

¹⁰The results of the 1951 Census of Employment did not become available until 1960.

Rand, as delimited in Chapter 2.

38. This analysis is undertaken below, and begins with an examination of the fourth and most mature subsidiary zone comprising the metropolitan core of Johannesburg (including Soweto), Randburg, Edenvale and Bedfordview municipalities, lying between the West and East Rand. Moreover, it necessarily makes some allowance for the increasingly significant movement of White workers employed in the Johannesburg zone but living in the three other zones, as the census data on employment by type of economic activity refer to the *places of residence* of employees and not to their *places of work*. Because of this anomaly, the subsidiary breakdowns of the economic bases of the inner and outer metropolitan zones for both 1951 and 1970 give somewhat different aggregate pictures from those of Tables 6 to 9 above, in respect of commerce (including finance and transport) and, to a lesser degree, private and public services. But direct comparison is not in fact possible, as the subsidiary zones of the West and East Rand both include portions of the inner as well as the outer metropolitan zones, and Brakpan is included in the Far East Rand as well as the East Rand.

The Subsidiary Zones, 1951-1970

39. Johannesburg. The changing economic base of the metropolitan core, as delimited today, is reflected in Tables 10 and 11 for 1951 and 1970 respectively. Although information on the journey to work is available only in the form of road traffic studies made by the Johannesburg City Council in 1954, 1965 and 1972, of incomplete statistics of public transport passenger volumes by rail and road compiled by the City Council in 1954 and 1965, and of data more recently assembled during the

preparation of town plans in certain other municipalities, an attempt has been made to incorporate such information into the two tables, as described in the footnotes to them (and to Tables 12, 13, 14, 15 and 17). The estimated numbers of White commuters travelling daily to Johannesburg from the rest of the Witwatersrand so incorporated amount to 12 200 in 1951 and 48 400 in 1970 (excluding workers in agriculture, mining and manufacturing). Their sectoral distribution has been estimated on the basis of the employment censuses of 1951 and 1970; and, until full journey-to-work statistics are made available by the national census, a greater degree of precision will be difficult to obtain, although analysis of the economies of each zone must continue to be seriously impeded without these fundamental data.

40. Given an unmeasurable degree of error remaining because of lack of data, Tables 10 and 11 nevertheless record an impressive increase of employment in the Johannesburg subsidiary zone of nearly 43% between 1951 and 1970, i.e. from 493 000 to 703 000 workers. They record an even more impressive increase of nearly 61% in net external earning capacity. This very substantial progress, especially in zonal exports, is achieved in spite of a steep decline in gold mining (from 52 000 to 20 000 workers), and it is almost wholly the result of major advances in commerce (including finance and transport) and secondary industry, which together account for an increase of 200 000 jobs. Moreover, whereas in 1951 secondary industry accounts for 28% of zonal employment and for 37% of net external earning capacity - followed in order of basic importance by commerce (26% of employment and 32% of earning capacity) and services (34% of employment but only 31% of earning capacity) - by 1970, commerce (including finance and transport) has overtaken secondary industry in both

total and basic employment. It now accounts for 34% of the zone's work opportunities, and for 45% of its net external earning capacity. Secondary industry accounts for as much as 33% of employment, but for only 34% of earning capacity, while the position of the services section has weakened relatively, to 29% of employment and 21% of earning capacity.

41. This swift emergence of commerce (including finance and transport) as the dominant sector of Johannesburg's economic base both reflects and symbolizes the final stages of the Witwatersrand's transition from a mining area to a metropolitan region.¹¹ This structural change in the metropolitan economy as a whole - which will be analysed in Chapter 4 below - has been initiated in, and led by, its innovating core. The core has not only become increasingly differentiated as a commercial, financial and transport hub servicing a growing manufacturing region external to itself; it has become increasingly differentiated as the region's major generator of secondary and tertiary employment, being responsible for over 58% of its total work opportunities in 1970 as against under 51% in 1951.

42. The very significant metropolitan consequences of this transformation in the economic base and structure of the Witwatersrand - as regards the growth and spatial distribution of population, the growth and spatial distribution of economic activities, the proliferation and changing patterns of land uses, the acceleration and orientation of passenger and goods traffic by road and

¹¹Commerce (as defined) is the most typical economic characteristic of metropolitan regions: *see* N.N. Patricios, *op.cit.*, pp.17 and 18.

rail, and the rising demands made upon physical infrastructure of all kinds - will be spelled out in the chapters of this report specifically dealing with them. Nevertheless, it may be noted here that, between 1964/65 and 1970/71, the value of non-residential building plans passed in the Johannesburg zone *rose* from 62% to 64% of the total for the Witwatersrand as a whole, whereas the value of residential building plans passed *fell* from 57% to 45%. Evidently, therefore, while work opportunities have been tending to concentrate increasingly within the metropolitan core, residential development has been tending to take place increasingly outside its boundaries. From this widening divorce between place of work and place of residence flow rising *metropolitan* problems of transportation, of the provision of physical infrastructure and of the complementary growth and control of land uses which are *inter-zonal* in origin and nature, and thus face government with mounting *inter-zonal* problems of planning and administration.

43. The West Rand. In contrast to Johannesburg, employment in the West Rand subsidiary zone is shown in Tables 12 and 13 to remain well-nigh static in aggregate between 1951 and 1970, rising only from 119 780 to 121 790 workers in the course of twenty years. Furthermore, net external earning capacity falls by nearly 61% in terms of net "surplus" workers during the same period. The immediate cause of this relative stagnation is a severe decline in mining (from 75 980 to 27 890 workers) which, in 1951, is the only basic sector of the West Rand's economy, and in 1970 continues to account for 67% of net external earning capacity (although mining now employs only 23% of the work force as against 63% at the beginning of the period). Commerce (including finance and transport) is at no time

a basic activity, although employment in this sector rises from 8% to 17% of the zonal total and, by 1970, it seems to be adequately catering to intra-zonal needs. Services, which form the second largest employing sector in 1951 although being non-basic at that time, now provide most work opportunities, account for 25% of all employment and appear to be responsible for 15% of net external earning capacity. Employment in secondary industry, which is also a non-basic activity in 1951, rises from 11% to 25% of the zonal aggregate by 1970, when this sector accounts for 18% of external earning capacity and is clearly the potential substitute for mining as the key element in the West Rand's export base.

44. By no means, however, has secondary industry been able to off-set the decline of mining as a basic activity. The transformation in the economic base of the Witwatersrand as a whole has necessarily resulted in a differential development from zone to zone, which is decreasingly dependent on the locational immobilities of geology and primary industry, and increasingly dependent on the spatial distribution and growth of relatively "foot-loose" secondary (and tertiary) activities. During the present, metropolitan phase in the evolution of urbanization on the Witwatersrand, a tendency towards a net concentration of relatively mobile secondary activities in or close to the metropolitan core is only to be expected, because, as observed in the First Report,¹² urbanization is a process of agglomeration. A tendency towards a net deconcentration of secondary activities from the metropolitan core to the peripheral

¹²*First Report: The Southern Transvaal,*
op.cit., p.36.

suburbs may be expected to emerge during a later phase of urbanization than has so far been reached on the Witwatersrand; that is, when the metropolitan phase has begun to merge into the megalopolitan phase. This later tendency is normally preceded by a tendency towards a progressive, net deconcentration of population - at first in relative terms but ultimately in absolute terms.¹³ Such a tendency began to be manifested on the Witwatersrand in the 1950s¹⁴ and will be analysed in Part Two of this report. It has especially affected the West Rand, where an increasing proportion of the population has thus become dependent for a livelihood on the economy of the Johannesburg zone in which it works, instead of the zone in which it lives.

45. From this standpoint, the inability of export growth in secondary industry to off-set the decline in mining on the West Rand does not raise so serious an economic problem as in an area which is not an integral part of a metropolitan region, and must thus pull itself up by its own boot-straps. But it certainly raises planning, administrative and financial problems of transport, traffic, building, sewerage and drainage in both of the subsidiary zones concerned, for which, because of their sub-metropolitan character, *inter-zonal* rather than *intra-zonal* solutions must undoubtedly be sought.

¹³ See P. Hall, 'Spatial Structure of Metropolitan England and Wales', *Spatial Policy Problems of the British Economy*, M. Chisholm and G. Manners, eds., 1971; R. Schiller, 'Recent City Growth in the U.S.A.', *Town and Country Planning*, vol. 40, no. 2, December 1972.

¹⁴ L.P. Green, *The Social Structure of the Witwatersrand Metropolitan Region*, op.cit.

46. The East Rand. In contrast to the peripheral West Rand, Tables 14 and 15 show the more centrally located East Rand subsidiary zone to off-set a major decline in mining employment by an even larger increase in employment in secondary industry between 1951 and 1970. During this period, therefore, it experiences no more than a marginal fall in net external earning capacity (as measured in terms of net "surplus" workers). More precisely, in 1951, mining employs 39% of the zone's work force of nearly 249 000 persons, and accounts for 72% of its net external earning capacity; secondary industry employs 27% of the work force and accounts for the remaining 28% of external earning capacity. Services, commerce (including finance and transport) and agriculture are all non-basic activities, and commerce appears to be particularly weak, presumably because of the proximity and dominance of Johannesburg in this sector. By 1970, mining employs only 9% of a total work force of nearly 303 000 persons, and is no longer basic to the zonal economy. Commerce (including finance and transport) has increased its contribution from 11% to 17% of zonal employment, but it is still not a basic activity; and the services sector likewise remains non-basic, although employing 20% of the work force, as in 1951. Thus, secondary industry, which accounts for 52% of employment in 1970, is now the sole exporting sector of the East Rand's economic base, which in consequence appears to be considerably less self-sufficient than that of the West Rand, because it is considerably more specialized.

47. As indicated in the First Report,¹⁵ this

¹⁵*First Report: The Southern Transvaal*, op.cit., p.11.

restructuring of the zone's economic base, which has been achieved by an increase of 134% in employment in secondary industry, has undoubtedly been influenced by the availability of land close to Johannesburg with a low degree of slope, lack of physical encumbrances and ease of communications north and south of the mining areas. The railway network centring on Germiston (now complemented by the new freeway network directly connecting most of the zone's towns to the metropolitan core), the construction of Jan Smuts airport and the development of locally-accessible Bantu residential areas, have also stimulated industrial expansion. Moreover, there is little doubt that some of the firms now situated on the East Rand were originally located in Johannesburg, and have moved there for reasons of space, and labour supplies.

48. Nevertheless, in spite of the speed and volume of industrialization in this zone, the relevant tables show Johannesburg to have increased its secondary employment between 1951 and 1970 by 95 000 workers as against the East Rand's increase of 90 000 workers, so that it is questionable if the metropolitan core has in fact commenced a relative net deconcentration of manufacturing to even this most favourably placed of the other subsidiary zones. Furthermore, the sectoral narrowness of the East Rand's economic base in 1970, indicates that, if not in transport, at least in commerce, finance, and public and private services, it remains dominated by the metropolitan core. In contrast to the specialization in secondary industry, these sectors are relatively under-developed, to a degree which emphasizes the interdependency of the economies of the two zones concerned, and clearly reveals the economic causes of the metropolitan problems arising from increasing zonal specialization.

Because of the differential basic development, there is a daily export of vast numbers of people from the East Rand to Johannesburg for tertiary employment which is not locally available, and a reverse daily import of thousands of commercial and service vehicles from Johannesburg to the East Rand. This traffic, which has been quantified in Chapter 2 as far as available data permit, is further inflated by rising daily flows of industrial traffic between two zones both of which now have strong, secondary export sectors.

49. The Far East Rand. Tables 16 and 17 reveal a basic development on the peripheral Far East Rand between 1951 and 1970 which is very similar to that experienced on the West Rand. At the beginning of the period, the economic base is wholly composed of mining, which accounts for 67% of total employment. All other sectors are non-basic, and commerce (including finance and transport) appears to be especially weak, employing only 6% of the work force, as against 12% by secondary industry and 14% by services. In 1970, mining continues to be the major exporting sector, accounting for 60% of net external earning capacity as against 40% by secondary industry. The commercial sector is also now becoming basic to the zonal economy, and the services sector is not greatly deficient. But total employment experiences a severe decrease from 167 000 to 110 000 workers, or by 34%, because of a major decline in mining, which now accounts for only 26% of the work force. Secondary industry employs 32% and commerce (including finance and transport) 18%; but, although their combined labour forces grow by 80% in two decades, this expansion cannot off-set the loss of net external earning capacity incurred by the closing-down of the mines. In terms of net "surplus" workers, the zone's export potential falls by no less than 66%.

50. Table 17 suggests somewhat stronger basic industrial and commercial sectors on the Far East than on the West Rand by 1970, and that by the latter year the Far East Rand is beginning to act as the commercial nucleus of a wider area (as suggested in Chapter 2 above). Even so, the table also appears to indicate that, because of its peripheral location in the metropolitan region which has by now replaced the former mining area, as in the case of the West Rand and for the same fundamental reasons the transformation in the Far East Rand's economic base has necessarily subordinated its development to that of the Johannesburg zone. As Cockhead¹⁶ has clearly demonstrated, however, the resulting relative weakness in its base is likewise of less consequence than if the Far East Rand did not form an integral part of a maturing metropolitan economy, the growth and prosperity of which must to a very high degree be dependent on the functioning of its economic core. By the same token, it is in the immediate interest of such a peripheral zone that the proper functioning of the core should not be impeded, and it is clearly the principal task of metropolitan planning to help to promote that fundamental end.

¹⁶P.J. Cockhead, 'Structural Economic Adaptation in the East Rand', *South African Geographical Journal*, vol. 52, December 1970; pp.112-113. "The industrial core of the Witwatersrand (has) spread out to encompass the (Far) East Rand towns and to take over their non-basic sectors... Only through the (Far) East Rand's proximity to, and integration into, the (Southern Transvaal's) industrial core have locational forces attracted industry into (the former). It was this integration into the industrial core..., not the local gold mining activities, that ensured the survival of the local economy".

Conclusions

51. Analysis of trends in the economic base of the Witwatersrand between 1951 and 1970, which are summarized by the profiles appearing in Figure 7, reveals that the transition from a long-established mining area to a rapidly maturing metropolitan region has been associated with fundamental structural changes in its base which have been both sectoral and spatial in character. Sectorally, whereas at the beginning of this period 63% of the Witwatersrand's net external earning capacity depends on mining, 25% on secondary industry and 6% on commerce (including finance and transport), by the end of the period mining has ceased to be basic to the economy, 54% of the region's net external earning capacity is now accounted for by secondary industry, 32% by commerce (including finance and transport), and 14% by public and private services. In the result, the Witwatersrand's economy increases its net external earning capacity by 20%, in spite of a serious decline in the export-oriented mining sector. Spatially, whereas at the beginning of the period 66% of the Witwatersrand's net external earning capacity is generated in its inner metropolitan zone comprising the magisterial districts of Johannesburg, Germiston (including Alberton) and Roodepoort, by the end of the period no less than 81% is now being generated in this zone. The latter *increases* its net external earning capacity by 45% between 1951 and 1970; the outer metropolitan zone *decreases* its net external earning capacity by 68%.

52. *The principal result of this fundamental structural transformation in the base of the Witwatersrand's space economy is a shift in the prime responsibility for its continued growth from a single*

sector - mining - which is ubiquitous throughout the region in 1951, to a number of sectors - both secondary and tertiary - which are overwhelmingly concentrated in its inner metropolitan zone by 1970. An increased sectoral reliance on the export potential of manufacturing and commerce (including finance and transport), and a spatial concentration of these sectors in and around the regional core, are typical of metropolitan regions and only to be expected on the Witwatersrand; but these tendencies result in a heightened degree of interdependence between its several parts in social and physical as well as economic terms, which inevitably raises complex problems of metropolitan planning and administration to which there can be no single solution.

53. Analysis of trends in the economic base of the subsidiary metropolitan zones of Johannesburg, the West Rand, the East Rand and the Far East Rand between 1951 and 1970 - which are also summarized in Figure 7 - not only confirms these general conclusions but reveals essential reasons for the growing interdependence. In 1951, Johannesburg's net external earning capacity depends on secondary industry (37%), commerce (32%) and services (31%); by 1970, that capacity has come to depend on commerce (45%), secondary industry (34%) and services (21%), and it has increased in magnitude by nearly 61% since the beginning of the period. By contrast, the net external earning capacities of the peripheral West and Far East Rand zones, which are both solely dependent on mining in 1951, continue to depend for the most part on this sector in 1970, to the extent of 67% and 60% of total capacity respectively. On the West Rand, secondary industry (18%) and services (15%) now account for the remaining export potential, and, on the Far East Rand, secondary industry (40%) and

commerce (but not, as yet, to a significant degree). The development of these alternative export sectors, however, has failed to off-set the losses experienced in the mining sectors, so that overall net external earning capacity has fallen by 61% on the West Rand and by 66% on the Far East Rand.

54. Unlike these two peripheral zones, the more centrally located East Rand virtually maintains its net external earning capacity between 1951 and 1970, in spite of the fact that mining, which accounts for as much as 72% of such capacity at the beginning of the period, is no longer basic to its economy twenty years later. As reflected in Figure 7, secondary industry, which is responsible for the remaining 28% of net external earning capacity in 1951, is now the sole basic activity, and neither commerce nor services has developed a net export capacity, presumably because of close proximity to the metropolitan hub of Johannesburg.

55. On the one hand, the losses of external earning capacity by the West and Far East Rand, and the failure so far of the East Rand to develop export capacity in its commercial and service sectors, do not raise such serious basic problems for these subsidiary zones as if they were independent, self-contained economies having to pull themselves up by their own boot-straps. In so far as their economies have been integrated into that of the metropolitan region, their prosperity now depends less on their own, local basic development than on the development of the region's economic base as a whole. On the other hand, it is now more vital to their own, local interests that the metropolitan economy in general should continue to progress; and such progress has come to depend increasingly on the external earning capacity of the Johannesburg zone,

which is the metropolitan core. A prime task of metropolitan planning must thus be to help to promote the interests of this core zone which, besides providing commercial, financial and transport services throughout the Witwatersrand, has during the last two decades experienced a larger absolute increase in secondary employment than any other subsidiary metropolitan zone.

56. Because of the differential zonal development of exporting sectors and capacities, however, the problems facing such planning are becoming increasingly complex. As illustrated in Chapter 2, the West Rand, with relatively little to offer to Johannesburg other than labour in exchange for the daily imports of goods and services received from it, exports to the latter every day vast numbers of workers in secondary and tertiary occupations. To a lesser extent because of a greater development of secondary industry, the Far East Rand also takes part in this daily exchange, which may well increase considerably when its road communications with Johannesburg are improved in the near future by the building of a southern freeway. The East Rand, apart from exporting every day an even greater number of workers to the metropolitan core, and receiving from the latter even heavier commercial and service traffic, vies with Johannesburg in generating a rising industrial traffic which is by no means confined to exchanges between the two main exporting zones.¹⁷

¹⁷ Because of the importance to metropolitan development, both sectorally and spatially, of inter-industry transactions, and the lack of information about them, the Urban and Regional Research Unit has initiated a special study of these transactions in selected areas of the West and the East Rand. P.J. Cockhead, *ibid.*, covers the Far East Rand's industrial connections with the rest of the Witwatersrand.

It is from this growing economic specialization and sectoral interdependence that the mounting problems of metropolitan planning are largely originating; and it is because of the spatial and inter-zonal nature of this growth that these problems are assuming a typical metropolitan form.

TABLE 4.

ECONOMIC BASE OF THE METROPOLITAN ECONOMY, 1951
(including Nigel municipal area)

Sector	Employment		Absolute Number of Net "Surplus" Workers	Total Employment Index of Net "Surplus" Workers	
	Number	%	Number	Number	%
Mining	300 210	30,90	192 030	19,77	62,88
Secondary Industry	235 620	24,25	76 370	7,86	25,01
Services	248 910	25,62	20 140	2,07	6,59
Commerce (including Transport)	172 260	17,73	16 870	1,74	5,52
Total	957 000	98,50	305 410	31,44	100,00
Agriculture	14 580	1,50	-305 410	-31,44	-100,00
Grand Total	971 580	100,00	-	-	-

Note. For an explanation of the total employment index of net "surplus" workers, see First Report: *The Southern Transvaal*, ch. 3.

Sources: Natural Resources Development Council, *Industrial Development in the Southern Transvaal*, Pretoria, May, 1954. 1951 Census of Employment (unpublished).

TABLE 5.

ECONOMIC BASE OF THE METROPOLITAN ECONOMY, 1970
(including Nigel municipal area)

Sector	Employment		Absolute Number of Net "Surplus" Workers	Total Employment Index of Net "Surplus" Workers	
	Number	%	Number	Number	%
Secondary Industry	452 890	37,39	199 110	16,44	54,33
Commerce (including Transport)	323 410	26,70	115 550	9,54	31,53
Services	314 660	25,98	51 830	4,28	14,14
Total	1 090 960	90,07	366 490	30,26	100,00
Agriculture	26 640	2,20	-347 270	-28,67	-94,76
Mining	93 690	7,73	- 19 220	- 1,59	- 5,24
Total	120 330	9,93	-366 490	-30,26	-100,00
Grand Total	1 211 290	100,00	-	-	-

Note. As this table includes Nigel municipal area, excludes Oberholzer magisterial district, and uses the 1967/68 Census of Manufacturing Industries to make a more direct comparison with the 1951 Table, which also uses data from the industrial census, it differs from Table 18 of the First Report (*The Southern Transvaal*). The major difference lies in mining employment, as Table 18 includes the West Rand gold mines. In addition, Asian employment in Randfontein, Krugersdorp, Roodepoort, Germiston and Kempton Park districts has been estimated on the basis of the 1960 Census (Population and Employment) and 1970 Census (Population).

Sources: *First Report: The Southern Transvaal*, Table 21, plus Nigel municipal area and less Oberholzer magisterial district employment estimated on the basis of the 1960 and 1970 Censuses of Population and Employment, the 1967/68 Industrial Census, and Chamber of Mines statistics, 1970.

TABLE 6.

ECONOMIC BASE OF THE INNER METROPOLITAN ZONE, 1951

Sector	Employment		Absolute Number of Net "Surplus" Workers	Total Employment Index of Net "Surplus" Workers	
	Number	%	Number	Number	%
Secondary Industry	185 400	28,87	80 150	12,48	39,28
Mining	113 900	17,74	42 410	6,61	20,78
Services	192 540	29,99	41 350	6,44	20,27
Commerce (including Transport)	142 820	22,24	40 130	6,25	19,67
Total	634 660	98,84	204 040	31,78	100,00
Agriculture	7 430	1,16	-204 040	-31,78	-100,00
Grand Total	642 090	100,00	-	-	-

Source: see Table 4.

TABLE 7.

ECONOMIC BASE OF THE INNER METROPOLITAN ZONE, 1970

Sector	Employment		Absolute Number of Net "Surplus" Workers	Total Employment Index of Net "Surplus" Workers	
	Number	%	Number	Number	%
Secondary Industry	315 840	36,57	134 890	15,62	45,47
Commerce (including Transport)	258 870	29,97	110 660	12,81	37,31
Services	238 470	27,61	51 070	5,91	17,22
Total	813 180	94,15	296 620	34,34	100,00
Agriculture	8 370	0,97	-258 240	-29,90	- 87,06
Mining	42 120	4,88	- 38 380	- 4,44	- 12,94
Total	50 490	5,85	-296 620	-34,34	-100,00
Grand Total	863 670	100,00	-	-	-

Sources: see Table 5.

TABLE 8.

ECONOMIC BASE OF THE OUTER METROPOLITAN ZONE, 1951
(including Nigel)

Sector	Employment		Absolute Number of Net "Surplus" Workers	Total Employment Index of Net "Surplus" Workers	
	Number	%	Number	Number	%
Mining	186 310	56,55	149 630	45,41	100,00
Secondary Industry	50 220	15,24	-3 790	-1,15	-2,53
Services	56 370	17,11	-21 210	-6,44	-14,17
Commerce (including Transport)	29 440	8,93	-23 260	-7,06	-15,55
Agriculture	7 150	2,17	-101 370	-30,76	-67,75
Total	143 180	43,45	-149 630	-45,41	-100,00
Grand Total	329 490	100,00	-	-	-

Source: see Table 4.

TABLE 9.

ECONOMIC BASE OF THE OUTER METROPOLITAN ZONE, 1970
(including Nigel municipal area)

Sector	Employment		Absolute Number of Net "Surplus" Workers	Total Employment Index of Net "Surplus" Workers	
	Number	%	Number	Number	%
Secondary Industry	137 050	39,42	64 220	18,47	72,13
Mining	51 570	14,84	19 170	5,51	21,53
Commerce (including Transport)	64 540	18,57	4 890	1,41	5,49
Services	76 190	21,92	760	0,22	0,85
Total	329 350	94,75	89 040	25,61	100,00
Agriculture	18 270	5,25	-89 040	-25,61	-100,00
Grand Total	347 620	100,00	-	-	-

Sources: see Table 5.

TABLE 10.

ECONOMIC BASE OF JOHANNESBURG,* 1951

*comprising the municipality of Johannesburg (including what is now Soweto)

Sector	Employment**		Absolute Number of Net "Surplus" Workers	Total Employment Index of Net "Surplus" Workers	
	Number	%	Number	Number	%
Secondary Industry	140 160	28,45	59 390	12,05	36,95
Commerce (including Transport)	129 800	26,34	50 990	10,35	31,73
Services	166 360	33,76	50 330	10,22	31,32
Total	436 320	88,55	160 710	32,62	100,00
Mining	52 400	10,63	- 2 460	- 0,50	- 1,53
Agriculture	4 030	0,82	-158 250	-32,12	- 98,47
Total	56 430	11,45	-160 710	-32,62	-100,00
Grand Total	492 750	100,00	-	-	-

** Adjusted on the basis of (a) 50% and (b) 45% of the White workers in commerce, transport and services resident in the municipal areas of (a) Roodepoort, and (b) Germiston, Benoni, Boksburg and Brakpan, being employed in Johannesburg.

Sources: see Tables 4, 12 and 14.

TABLE 11.

ECONOMIC BASE OF JOHANNESBURG,* 1970

*comprising the municipalities of Johannesburg (including Soweto), Randburg, Sandton, Edenvale and Bedfordview

Sector	Employment**		Absolute Number of Net "Surplus" Workers	Total Employment Index of Net "Surplus" Workers	
	Number	%	Number	Number	%
Commerce (including Transport)	237 330	33,75	116 650	16,61	45,17
Secondary Industry	235 130	33,43	87 780	12,48	33,99
Services	206 400	29,35	53 800	7,64	20,84
Total	678 860	96,53	258 230	36,73	100,00
Mining	19 780	2,81	- 45 770	- 6,51	- 17,72
Agriculture	4 640	0,66	-212 460	-30,22	- 82,28
Total	24 420	3,47	-258 230	-36,73	-100,00
Grand Total	703 280	100,00	-	-	-

** Adjusted on the basis of 42%, 20% and 5% of the White workers resident on the West Rand, East Rand and Far East Rand (Springs) respectively being employed in Johannesburg, excluding the sectors of agriculture, mining and manufacturing. Employment statistics for the latter sector used in this table are those of the 1967/68 Industrial Census, and thus reflect the numbers of persons employed in factories located in Johannesburg itself.

Sources: see Tables 5.

TABLE 12.

ECONOMIC BASE OF THE WEST RAND,* 1951

*comprising the municipal areas of Krugersdorp, Randfontein and Roodepoort

Sector	Employment**		Absolute Number of Net "Surplus" Workers	Total Employment Index of Net "Surplus" Workers	
	Number	%	Number	Number	%
Mining	75 980	63,43	62 640	52,30	100,00
Secondary Industry	13 540	11,30	-6 090	-5,09	-9,72
Services	19 220	16,05	-8 980	-7,50	-14,34
Commerce (including Transport)	9 450	7,89	-9 710	-8,10	-15,50
Agriculture	1 590	1,33	-37 860	-31,61	-60,44
Total	43 800	36,57	-62 640	-52,30	-100,00
Grand Total	119 780	100,00	-	-	-

**Adjusted on the basis of 50% of the White workers in commerce, transport and services resident in Roodepoort municipal area being employed in Johannesburg. The sectors of agriculture, mining and manufacturing are excluded from such commuting (the employment statistics for the latter sector used in this table being those of the 1949/50 Industrial Census, and thus reflecting the numbers of persons employed in factories located on the West Rand itself). According to 1954 traffic volumes, this is a conservative adjustment as it involves only 2 800 commuters, as against an estimated total of 8 000 persons travelling daily to work in Johannesburg from the West Rand in that year.

Sources: see Table 4.

L.P. Green, *The Social Structure of the Witwatersrand Metropolitan Region*, op.cit., pp.7-9 (for traffic statistics, 1954).

TABLE 13.

ECONOMIC BASE OF THE WEST RAND,* 1970

*comprising the magisterial districts of Krugersdorp, Randfontein and Roodepoort

Sector	Employment**		Absolute Number of Net "Surplus" Workers	Total Employment Index of Net "Surplus" Workers	
	Number	%	Number	Number	%
Mining	27 890	22,90	16 540	13,58	66,91
Secondary Industry	29 920	24,57	4 400	3,61	17,80
Services	30 210	24,80	3 780	3,11	15,29
Total	88 020	72,27	24 720	20,30	100,00
Commerce (including Transport)	20 860	17,13	- 40	- 0,03	- 0,16
Agriculture	12 910	10,60	-24 680	-20,27	- 99,84
Total	33 770	27,73	-24 720	-20,30	-100,00
Grand Total	121 790	100,00	-	-	-

**Adjusted on the basis of 42% of the White workers resident on the West Rand being employed in Johannesburg, excluding the sectors of agriculture, mining and manufacturing. Employment statistics for the latter sector used in this table are those of the 1967/68 Census of Industries, and thus reflect the numbers of persons employed in factories located on the West Rand itself.

Sources: see Table 5.

TABLE 14.

ECONOMIC BASE OF THE EAST RAND,* 1951

*comprising the municipal areas of Germiston, Benoni, Boksburg and Brakpan

Sector	Employment**		Absolute Number of Net "Surplus" Workers	Total Employment Index of Net "Surplus" Workers	
	Number	%	Number	Number	%
Mining	97 860	39,35	70 170	28,22	72,40
Secondary Industry	67 510	27,15	26 750	10,76	27,60
Total	165 370	66,50	96 920	38,98	100,00
Services	49 010	19,71	-9 540	-3,84	-9,84
Commerce (including Transport)	26 680	10,73	-13 090	-5,27	-13,51
Agriculture	7 610	3,06	-74 290	-29,87	-76,65
Total	83 300	33,50	-96 920	-38,98	-100,00
Grand Total	248 670	100,00	-	-	-

** Adjusted on the basis of 45% of the White workers in commerce, transport and services resident in the municipal areas of Germiston, Benoni, Boksburg and Brakpan being employed in Johannesburg. The sectors of agriculture, mining and manufacturing are excluded from such commuting (the employment statistics for the latter sector used in this table being those of the 1949/50 Census of Industries, and thus reflecting the numbers of persons employed in factories located on the East Rand itself). According to 1954 traffic volumes, this is a conservative adjustment as it involves only 9 400 commuters, as against an estimated total of 26 000 persons travelling daily to work in Johannesburg from the East and Far East Rand in that year.

Sources: see Table 4.

TABLE 15.

ECONOMIC BASE OF THE EAST RAND,* 1970

*comprising the magisterial districts of Alberton, Benoni, Boksburg, Brakpan, Germiston and Kempton Park (excluding the municipalities of Edenvale and Bedfordview)

Sector	Employment**		Absolute Number of Net "Surplus" Workers	Total Employment Index of Net "Surplus" Workers	
	Number	%	Number	Number	%
Secondary Industry	157 990	52,21	94 600	31,27	100,00
Mining	27 350	9,04	- 860	- 0,28	- 0,91
Commerce (including Transport)	50 530	16,70	- 1 390	- 0,42	- 1,47
Services	59 750	19,75	- 5 910	- 2,01	- 6,25
Agriculture	6 960	2,30	-86 440	-28,56	- 91,37
Total	144 590	47,84	-94 600	-31,27	-100,00
Grand Total	302 580	100,00	-	-	-

**Adjusted on the basis of 20% of the White workers resident on the East Rand being employed in Johannesburg, excluding the sectors of agriculture, mining and manufacturing. Employment statistics for the latter sector used in this table are those of the 1967/68 Census of Industries, and thus reflect the numbers of persons employed in factories located on the East Rand itself.

Sources: see Table 5.

TABLE 16.

ECONOMIC BASE OF THE FAR EAST RAND,* 1951

*comprising the municipalities of Brakpan, Springs and Nigel

Sector	Employment		Absolute Number of Net "Surplus" Workers	Total Employment Index of Net "Surplus" Workers	
	Number	%	Number	Number	%
Mining	111 570	66,91	93 010	55,78	100,00
Secondary Industry	19 610	11,76	-7 720	-4,63	-8,30
Commerce (including Transport)	10 680	6,40	-15 990	-9,59	-17,19
Services	22 670	13,60	-16 590	-9,95	-17,84
Agriculture	2 210	1,33	-52 710	-31,61	-56,67
Total	55 170	33,09	-93 010	-55,78	-100,00
Grand Total	166 740	100,00	-	-	-

Sources: see Table 4.

TABLE 17.

ECONOMIC BASE OF THE FAR EAST RAND,* 1970

*comprising the magisterial districts of Brakpan and Springs, and the municipality of Nigel

Sector	Employment**		Absolute Number of Net "Surplus" Workers	Total Employment Index of Net "Surplus" Workers	
	Number	%	Number	Number	%
Mining	28 980	26,40	18 750	17,08	59,70
Secondary Industry	35 650	32,48	12 650	11,52	40,27
Commerce (including Transport)	18 850	17,17	10	0,00	0,03
Total	83 480	76,05	31 410	28,60	100,00
Services	22 300	20,31	- 1 520	- 1,38	- 4,84
Agriculture	4 000	3,64	-29 890	-27,22	- 95,16
Total	26 300	23,95	-31 410	-28,60	-100,00
Grand Total	109 780	100,00	-	-	-

**Adjusted on the basis of 13% and 5% of the White workers resident in Brakpan and Springs respectively being employed in Johannesburg, excluding the sectors of agriculture, mining and manufacturing. Employment statistics for the latter sector used in this table are those of the 1967/68 Census of Industries, and thus reflect the numbers of persons employed in factories located on the Far East Rand itself.

Sources: see Table 5.

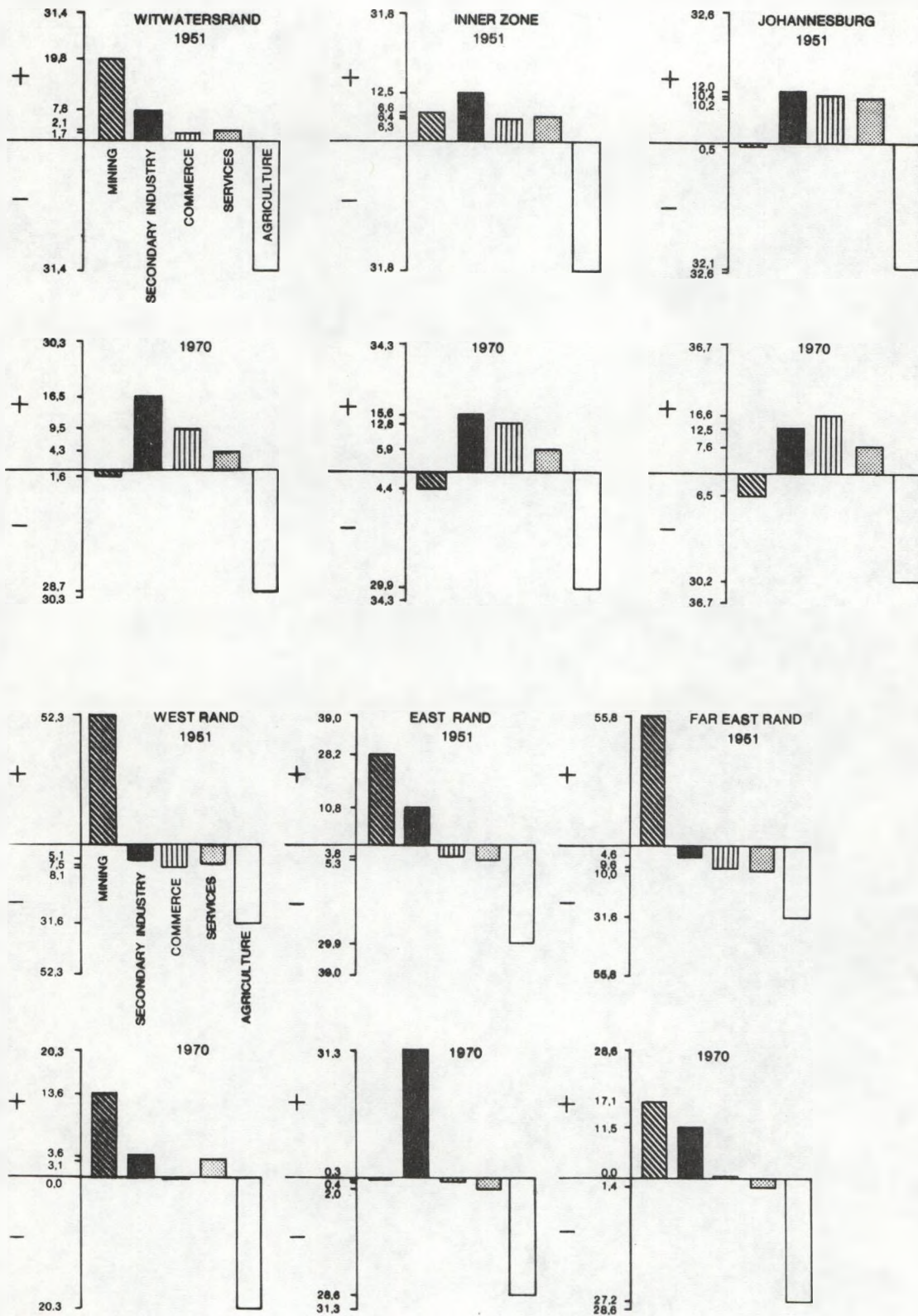


Figure 7.

Economic Base Profiles, 1951 and 1970: Total Employment Indices of Net "Surplus" Workers

(Sources: Tables 4 - 17)

CHAPTER 4.ECONOMIC DEVELOPMENTIntroduction

57. A city's economic development is a function of its earning power, which in turn is dependent on "its ability (a) to export goods and services to beyond its borders, and (b) to specialize in those exports in which it has a comparative advantage. These 'basic' export activities (however) need to be supported by non-export or 'non-basic' activities which may, in the long run, come to determine the competitiveness of the city's export trade and its total earning capacity".¹

Moreover, both kinds of activities generate wealth; in aggregate, non-basic activities contribute more than basic to a city's gross geographic product; and by and through the changing sectoral and spatial make-up of their joint contributions, both kinds of activities act together as prime movers in a city's historical evolution, from the pre-industrial phase of urbanization, through the primary industrial to the secondary industrial or metropolitan phase and, eventually, to the post-industrial or megalopolitan.² While, therefore, it is vitally necessary for planning purposes to understand

¹*First Report: The Southern Transvaal*, op.cit., p.44.

²See, for instance, J. Friedmann, *Regional Development Policy: A Case Study of Venezuela*, M.I.T. Press, Cambridge, 1966.

the changing nature of the Witwatersrand's economic base, both sectorally and spatially, it is no less necessary to analyse the changing metropolitan economy erected on that base, and to ascertain the changing contributions made through time to its overall development, sector by sector and zone by zone. Neither physical nor social planning can afford to ignore growth and change in the productive capacities of different activities and areas within a metropolitan region; indeed, the interests of these differing capacities must play a major rôle in any decisions to be taken about the future form and orientation of urban development on the Witwatersrand.

58. To undertake this analysis, tables of gross geographic product have been constructed for the years 1954/55, 1963/64 and 1970/71, covering, sectorally, ten major divisions of the metropolitan economy, and, spatially, the Witwatersrand, its inner and outer zones, and its four subsidiary zones, as defined in Chapter 2. The tables for the years 1954/55 and 1963/64 are based on data prepared for the Prime Minister's Economic Advisory Council, on tabulations made by Kleu³ and van der Merwe,⁴ and on reports of the Transvaal and Orange Free State Chamber of Mines. For 1970/71 they are based on Chamber of Mines data, the Department of Statistics revised estimates of gross national product (September 1972), the 1970 Censuses of Population and Employment, the 1967/68 Census of Industries, and information on the

³S.J. Kleu, "Industrial Development in the Johannesburg-Witwatersrand Complex", *Proceedings of Symposium on Johannesburg Today and Tomorrow*, February, 1963.

⁴E.J. van der Merwe, *Die Goudmynbedryf in die Pretoria-Witwatersrand-Vereenigingstreek*, Department of Planning, Pretoria, 1970.

journey to work in Johannesburg contained in Chapter 2 above. Differences between these tables and Tables 15, 16 and 33 of the First Report are explained in the footnotes to each table, and arise mainly from the different areas covered and different data included in the mining sector (which here relates to the production of gold and uranium).

59. The estimates for 1970/71 are thus not strictly comparable with those for 1954/55 and 1963/64, which in aggregate and by major sector conform to van der Merwe (although the mining data differ); but the margin of error is very small in the primary sector (since the mining data are strictly comparable), it cannot be significant in the secondary sector (since the manufacturing data for 1970/71 are those of the industrial census, which is based on place of work and not place of residence), and the tertiary sector (which breaks down national sectoral estimates on the basis of employment, and of population in the case of property) takes into account available information on the journey to work in Johannesburg from the rest of the Witwatersrand. Nevertheless, the complete lack of census and other economic data on a metropolitan and sub-metropolitan basis, and the inability of the censuses to provide any information whatsoever on the journey to work in metropolitan regions, have rendered this exercise extremely difficult, and the 1970/71 estimates must be regarded as provisional only.

The Economy in 1954/55

60. As reflected in Table 18, in 1954/55 the Witwatersrand's annual gross geographic product (G.G.P.) amounted to R10 361 million at ruling prices, or about

R560 per head. Nearly 20% of this wealth was generated by the primary sector, 29% by the secondary sector and 51% by the tertiary sector. Manufacturing was the largest single contributing activity, accounting for 23% of G.G.P., followed by mining (19%), commerce (19%) and services (16%); but, as an identifiable group of closely related activities, commerce, finance and transport combined contributed as much as 31% of the region's wealth.

61. The economy of the inner metropolitan zone, which generated a G.G.P. of R732 million at ruling prices (or about R580 per head), accounted for nearly 71% of the Witwatersrand's wealth and had a substantially different structure. Nearly 60% of its G.G.P. was drawn from the tertiary sector, as against 32% from the secondary sector and only 8% from the primary sector, which consisted almost wholly of mining. Manufacturing and commerce were by far the largest single contributing activities, the former accounting for nearly 26% of the overall total, and the latter for 23%; and commerce, finance and transport combined contributed over 38%. By contrast, in the outer metropolitan zone, nearly half of the G.G.P. was accounted for by the primary sector, with mining alone contributing 46% of the overall total; both the tertiary and secondary sectors were relatively little developed, contributing no more than 30% and 22% respectively to the total product; and G.G.P. per head amounted to only R520 at ruling prices.

62. Thus, although mining was still of ubiquitous importance on the Witwatersrand in 1954/55, and although its contribution to the overall G.G.P. was so significant as to suggest that the region as a whole was yet standing at the threshold of the secondary industrial phase in its urban evolution, all parts of the region

were by no means at the same stage of development. As concluded in the Second Interim Report on the future development of Johannesburg,⁵ the economic foundations of urbanization in the inner zone had already assumed a metropolitan character by that year, with 92% of the wealth produced being generated by the secondary and tertiary sectors, and with manufacturing and commerce being firmly established as the leading activities. In the outer zone, however, economic development still remained in mainly its primary phase, and urbanization was by no means metropolitan in character.

63. Further analysis of the metropolitan economy according to subsidiary zones, now made possible by the greater availability of data, more clearly illustrates the different stages of urbanization reached from area to area on the Witwatersrand at this time. As shown in Table 19, in the Johannesburg zone, a G.G.P. of nearly R592 million was generated during 1954/55, of which 65% was contributed by the tertiary sector, 31% by the secondary sector, and only 4% by the primary sector. Since commerce accounted for 26% of the total product, and manufacturing for 24%, these two activities were alone responsible for half the wealth being progressively created in this zone. Johannesburg is thus revealed as not only the expanding commercial and manufacturing hub of the Witwatersrand, but as having already left the primary industrial phase of its urbanization well behind. The East Rand zone, which had a much smaller G.G.P. of R233 million, still depended for 22% of that

⁵L.P. Green, *The Economic Structure of the Witwatersrand Metropolitan Region*, op.cit.

total on the primary sector, and only a further 39% was generated by the tertiary sector; but the East Rand does appear to have begun to pass beyond the threshold of the secondary industrial phase in its urbanization, in that 31% of its wealth was already being accounted for by manufacturing alone. The West and the Far East Rand had yet to enter that phase, however, as 56% and 65% respectively of their wealth was still being produced by the primary sector, manufacturing accounted for not more than 11% of G.G.P., and commerce for not more than 8%.

64. Apart from the very evident time-lag in urban development between the Johannesburg core of the Witwatersrand and the West and the Far East Rand peripheral areas, Table 19 also suggests a substantial complementarity between Johannesburg and the East Rand. Together, these two zones cover most of the area delineated in 1957 as the inner metropolitan zone, excluding only Roodepoort from that zone and adding only Brakpan. It is not surprising therefore that, taken together in Table 19, less than 10% of their aggregate G.G.P. of R825 million was derived from the primary sector in 1954/55, as against 33% from the secondary sector and 57% from the tertiary sector; nor that their leading single activity was manufacturing (which accounted for 26% of G.G.P.), closely followed by commerce (22%). These statistics strongly suggest that the East Rand was in fact so greatly dependent on Johannesburg for tertiary services at that time as hardly to be distinguished as a separate zone. The spatial structure of the Witwatersrand's economy was undoubtedly less differentiated than now, after a further two decades of urbanization; and, although the inner zone was then considerably more extensive in area, the dichotomy between core and periphery was certainly much more sharply drawn (as a comparison with Tables 22 and 23 below will indicate).

65. Nevertheless, in spite of the Witwatersrand's more simply structured and less spatially complex economy then obtaining, the Johannesburg City Council authorized a regional survey in 1956 because, it stated, "In the last few years the Council has instituted an increasing number of *ad hoc* enquiries into its municipal organization and services, and it has become evident that this piecemeal attack upon constantly arising problems of city government needs to be supported by a comprehensive investigation of their underlying causes. Without doubt, these originate in the rapid growth of a complex metropolitan region, centring on Johannesburg and extending to the east and west along the Reef".⁶ The *ad hoc* enquiries referred to, concerned "public transport, traffic and highways, traffic control, electricity supplies, non-European administration (especially departmental organization, influx control and housing), the siting of a new produce market and abattoir, the extension of city boundaries to include outlying townships, the organization and provision of health and welfare services, the establishment of parks and open spaces, and aspects of town planning".⁷ In a heightened form, most of these issues still remain on the agenda of metropolitan planning and administration on the Witwatersrand,⁸ and, to a large extent, their origins still lie in the changing functions and organization of its economic development.

⁶Quoted in L.P. Green, *Provincial Metropolis*, op.cit., p.32.

⁷Ibid., p.32.

⁸cf. Proceedings, *Symposium: Focus on Metropolitan Areas*, Institute of Urban Studies, Rand Afrikaans University, Johannesburg, May, 1973. See also, N.N. Patricios, op.cit., pp.34 and 35.

The Economy in 1963/64

66. Table 20 shows the Witwatersrand to have generated at ruling prices an annual G.G.P. of R1 595 million in 1963/64, or nearly R710 per head. Of this product, 11% was contributed by the primary sector, 34% by the secondary sector and 55% by the tertiary sector, so that significant structural changes had taken place in the regional economy during the previous decade. An absolute decline in the value of mining production since 1954/55 had been more than off-set by absolute increases in all other major activities, and especially in manufacturing. The proportionate contribution made by secondary industry had in fact risen from 23% to 29%, thus indicating that the region as a whole had now definitely entered upon this phase of its urbanization. Indeed, the percentage contributions being made by each of the three major sectors to its total product in 1963/64 were very similar to the percentage contributions being made by these same sectors to the G.G.P. of the inner metropolitan zone alone in 1954/55.

67. On its part, the inner metropolitan zone had advanced still further along the path of metropolitan development. As shown in Table 20, its G.G.P. of R1 167 million at ruling prices (or R740 per head) now depended for less than 4% upon the primary sector, for 33% upon the secondary sector, and for as much as 63% upon the tertiary sector. Moreover, the contribution of manufacturing had risen from under 26% in 1954/55 to 28% of the overall total; whereas commerce continued to generate 23%, commerce, finance and transport together contributed 39% (which was much the same proportion as in 1954/55), and the only other major activities to show appreciable relative increases were finance and private

and public services (whose combined contribution had risen from 24% to 28% of G.G.P.). By contrast, although the contribution of the primary sector to the outer zone's G.G.P. had declined absolutely since 1954/55, it still accounted for as much as 31% of that zone's total product of R428 million in 1963/64, and the tertiary sector's contribution had risen to only 33%. Thus, the secondary sector now accounted for as much as 37% of G.G.P., and the abnormal sectoral structure suggested that this zone could be facing serious problems of transition from a mining to a metropolitan economy.

68. This diagnosis is confirmed in part by Table 21, which analyses the situation in 1963/64 by subsidiary zones. On the Far East Rand, mining still accounted for nearly 46% of G.G.P., and although manufacturing had doubled its contribution to 23%, commerce continued to be responsible for only 7%, and the tertiary sector as a whole generated no more than 26% of the overall total of R178 million. On the West Rand, however, the tertiary sector had developed much more rapidly and now contributed 41% of a G.G.P. of R149 million, as against 27% by the secondary sector and 32% by the primary sector. An absolute decrease in mining, which was much steeper than experienced on the Far East Rand, had been met in part by a relatively more rapid increase in manufacturing and commerce, which now accounted for 22% and 11% respectively of G.G.P. Thus, the transitional economic problems appeared to be greater on the Far East than the West Rand; nevertheless, in both zones, commercial growth was lagging well behind the development of manufacturing.

69. This differential sectoral progress was even more marked in the remaining areas of the outer

metropolitan zone falling within the East Rand. By 1963/64, the secondary sector was generating no less than 51% of the East Rand's G.G.P. of R368 million; the primary sector's contribution had fallen to 12%, and the tertiary sector's contribution to 37%. Manufacturing alone was now producing 45% of the zone's wealth, and the absolute growth in this activity since 1954/55 had been equalled only in Johannesburg. Here, however, the main sectoral changes had been a continuing relative fall in the primary sector's contribution - to no more than 2% of a G.G.P. of R942 million - and a relative rise in the tertiary sector's contribution to 69% of that total. *Prima facie*, a tendency towards economic specialization thus appeared to be developing between the Johannesburg and East Rand zones, the former concentrating proportionately more on tertiary growth, and the latter proportionately more on secondary growth.

70. Analysis of Tables 19 and 21, however, shows Johannesburg's increased concentration on the tertiary sector to have been a function not so much of transport and commercial development (which together continued to generate 35% of G.G.P. as in 1954/55), as of growth in financial activities and public and private services. This growth, which also characterized the inner zone as a whole, thus involved activities which are especially typical of the central business districts of maturing metropolitan regions.⁹ The tables further suggest that, national considerations apart, Johannesburg was

⁹cf. N.N. Patricios, *op.cit.*, at p.2, where Gras is cited as identifying four typical stages of development in metropolitan economies, viz: (i) a marketing and commercial stage, (ii) an industrial stage, (iii) a transport services stage, and (iv) a financial services stage.

developing these financial and service activities for the West and the Far East Rand as well as for the East Rand; while, at the same time, it continued to provide region-wide commercial and transport services at a level which, in relative terms, was comparable to that reached ten years earlier and commensurate with the growth of the regional economy as a whole. There is, indeed, no doubt that the headquarters of most major new businesses throughout the Witwatersrand, whether secondary or tertiary, were being located and expanded in the metropolitan core. In such case, pressure on office space could be expected to have been building up rapidly in Johannesburg's C.B.D., resulting in mounting problems of expansion and access which were consequences of metropolitan and not merely city development.

71. This kind of pressure was, in fact, already leading to a quickening extension northwards of the city's C.B.D. into Braamfontein, while new urban motorways were being constructed by the Johannesburg City Council designed to relieve difficulties of central access,¹⁰ and the volume of road traffic crossing the municipal boundaries and heading mainly to and from downtown was climbing from 78 000 vehicles a day in 1954 to over 180 000 vehicles a day ten years later. The burgeoning problems of planning and administration associated with these developments thus ultimately sprang from deep-seated economic causes, associated with the accelerating transition from a mining to a metropolitan economy.

¹⁰ cf. Forward Planning Branch, Johannesburg City Council, *Metropolitan Johannesburg*, 1966.

The Economy in 1970/71

72. Today, as reflected in Table 22 for the year 1970/71, the economy of the Witwatersrand metropolitan region is generating an annual G.G.P. of about R 2 544 million (at ruling prices), or well over R960 per head. The primary sector accounts for not more than 5% of this total, the secondary sector for 41% and the tertiary sector for 54%. The major structural changes since 1963/64 have thus been a further, steep absolute decline in the primary sector (because of the progressive closing down of the gold mines throughout the Witwatersrand), and a further and highly significant increase in manufacturing, which is now responsible for nearly 35% of the region's G.G.P. (as against 29% in 1963/64). Commerce, finance and transport combined continue to hold much the same relative position as then (i.e. 32% of G.G.P.); and public and private services have tended to reduce their relative contribution - essentially because of the inexorable development of manufacturing, which has clearly become the dominant activity in the metropolitan economy.

73. The inner metropolitan zone is generating a G.G.P. of R1 838 million at 1970/71 prices (or well over R990 per head), of which the primary sector accounts for 2%, the secondary sector for 40% and the tertiary sector for 58%. The most important change since 1963/64 has thus been a sharply growing concentration on manufacturing, which is now responsible for 33% of the zone's total product - a concentration which has not only off-set the continuing absolute fall in the contribution made by mining, but has overshadowed the continuing absolute growth of all other major economic activities in this zone. No doubt, the surge of investment in manufacturing reflected in this development has national as well as regional origins, as

it is associated with the Republic's own advances in the secondary sector; but it clearly indicates that even the Witwatersrand's inner zone is not yet approaching the threshold of the post-industrial phase in its urbanization. The outer metropolitan zone, with a G.G.P. of R706 million in 1970/71 (at ruling prices), is still further dominated by manufacturing. A severe, absolute decline in the contribution of the primary sector to under 12% of its total product, has been accompanied by absolute increases of the secondary and tertiary sectors to contributions of 44% each. In the tertiary sector, commerce, finance and transport combined now account for well over 23% of G.G.P., and public and private services for 12%; but in the secondary sector, manufacturing has advanced its contribution to well over 38%.

74. The breakdown in Table 23 shows all of the subsidiary metropolitan zones to have participated in this recent up-surge of secondary industry. In Johannesburg, where the zonal G.G.P. has expanded to over R1 458 million (in 1970/71 and at then ruling prices), an absolute decline in the primary sector's contribution to under 1% of G.G.P. has been more than matched by a very substantial rise in the secondary sector's contribution to nearly 37%. This has been accompanied by a relative fall in the tertiary sector's contribution to 63%, owing mainly to a relative decrease in the share of public and private services from 22% in 1963/64 to 16% in 1970/71. Thus, while Johannesburg's economy today continues to be overwhelmingly tertiary in composition, with commerce, finance and transport combined alone accounting for 39% of the annual wealth produced, the contribution made by manufacturing to that wealth is by no means

declining, either absolutely or relatively. On the contrary, it has continued to rise over the last two decades, and at an accelerating rate.

75. The employment effects of this unslackening growth will be analysed in the next chapter; other effects are revealed in the present tables, which reflect a substantially increased activity in the construction industry since 1963/64, and a rising contribution of fixed property to the zonal G.G.P. The general implication of this growth is that even the Johannesburg zone, in which urbanization has proceeded farthest on the Witwatersrand, has yet to witness the commencement of that net deconcentration of employment which is now beginning to characterize the "inner cities" of the London, Manchester and Birmingham metropolitan regions. In this respect, the present analysis shows the First Report to have been premature in suggesting that Johannesburg may have already passed beyond the industrial phase of urbanization.¹¹

76. The East Rand has experienced a similar growth of manufacturing since 1963/64, which has been proportionately steeper than between 1954/55 and that year. But this growth has been accompanied by a relative increase in the share of wealth generated by the tertiary sector to nearly 40% of G.G.P., instead of a relative decrease as experienced in Johannesburg. Thus, the close economic complementarity formerly obtaining between these two zones now undoubtedly appears to have been relaxed by the

¹¹*First Report: The Southern Transvaal,*
op.cit., p.7.

injection of a competitive element. The East Rand's G.G.P. in Table 23 amounts to R673 million, which is equivalent to over 26% of the metropolitan total, and its manufacturing areas alone generate nearly 13% of that total, and nearly 49% of its own zonal aggregate. In consequence, these areas, and the zone's growing commercial centres, are beginning to attract sufficient daily commuting to differentiate the East Rand as a distinct subsidiary metropolitan zone of movement in Chapter 2 above. Nevertheless, the economic links between Johannesburg and the East Rand remain very strong indeed.

77. The increasing complexity in the functions and structure of the metropolitan economy implied in this growing distinction are also reflected in the peripheral development of the West and the Far East Rand, but in other directions. In the former case, a G.G.P. of R227 million in 1970/71 results from a declining contribution of 16% from the primary sector, a relatively small increase in the contribution of the secondary sector (from 27% to 30%), and a relatively large rise in the contribution of the tertiary sector (from 41% to nearly 54%). Apart from a continuing decrease in mining, the operative factors in these structural changes are a modest growth in manufacturing to 24% of G.G.P., and a much higher growth in commerce, finance and transport combined to 27%. Public and private services are not so buoyant, but high rates of increase in the wealth accruing from fixed property and the construction industry tend to confirm an economic development which has a momentum that is becoming less internally than externally generated. In brief, it appears that, as the East Rand's economy tends towards an increasing differentiation from Johannesburg's, the West Rand's

economy tends towards an increasing dependence on it.

78. By contrast, Table 23 shows the Far East Rand's G.G.P. of R245 million in 1970/71 to continue to owe much to the primary sector (25%) - although this reflects a considerably reduced contribution - and while the tertiary sector has significantly raised its contribution from 26% to nearly 41%, the secondary sector has also increased its contribution substantially, from 23% to nearly 30%. The development of this peripheral zone thus appears to be less dependent than that of the West Rand on Johannesburg as a prime mover, and manufacturing has undoubtedly grown faster on the Far East Rand than on the West Rand since 1963/64, by 80% as against 61%.

79. As far as available data permit, the major metropolitan consequences of this differential economic development from zone to zone will be analysed later in this report, in connection with the differential zonal physical development of the Witwatersrand in recent years, with the current rates and orientation of the consumption of land for residential, industrial and other purposes from zone to zone, with the current volumes and patterns of inter-zonal passenger and goods traffic by road and rail resulting from growth and change in the mosaic of land uses, and with the current trends in the demands being made on economic infrastructure throughout the Witwatersrand. *Here, it is necessary only to emphasize the economic causes of these metropolitan consequences: the latter spring from fundamental sectoral and spatial tendencies in the economic development of the Witwatersrand as a whole. To attempt to plan against these tendencies will but invite failure; to ignore them will but invite a further escalation of long-established problems of land use, transportation and infrastructure without devising viable means for their solution. Even in the barest outline, the future physical*

development of the Witwatersrand cannot be planned without constant reference to the mainsprings of the region's economic development, which are now overwhelmingly metropolitan in character, both sectorally and spatially. As stated in the First Report,¹² earning power and job opportunities directly influence where people work and live. This present chapter has been concerned with the analysis of growth and change in overall earning power according to economic activities and metropolitan zones; the next chapter will be concerned with the analysis of growth and change in work opportunities according to the same categories.

Conclusions

80. While the economic development of the Witwatersrand is basically a function of its external earning power, not only do its basic export activities need the growing support of non-basic, non-export activities if they are to retain their competitiveness in external markets, but both kinds of activities generate the region's wealth, the non-basic in fact contribute much more than the basic to regional gross geographic product, and the region's evolution as an urban complex is fundamentally dependent upon their total combined effect over time. This effect, which has spatial as well as sectoral aspects, is thus of great significance for urban and regional planning; but its full ramifications may be uncovered only by and through an analysis of the region's economic development as a whole.

¹²*First Report: The Southern Transvaal, op.cit., p.62.*

81. As shown in Table 24 and Figure 8, between 1954/55 and 1970/71, the wealth produced annually by the Witwatersrand (measured in terms of G.G.P. *at constant prices*) rose from nearly R1 202 million to over R1 933 million, or by a little under 61%. Up to 1963/64, the rate of growth averaged 2,4% per annum; after that year, it averaged 3,9% per annum. Making every allowance for national trends, as shown in Figure 9 these differing growth rates reflect a sectoral transformation of the Witwatersrand's economy from one formerly very much dependent on gold mining, to that of a maturing metropolitan region now very much dependent for its present and future growth on the development of its secondary and tertiary sectors. This transformation has not been effected without some strain. Table 24 shows the region's annual G.G.P. per head (at constant prices) to have risen from R653 to no more than R657 during the first nine years of the period under review, as against comparable national figures of R313 and R350 respectively. During the following seven years, however, the annual G.G.P. per head (at constant prices) rose to R733 as against a comparable national figure of R405. The overall structural change has now been completed, therefore; the region's overall economic development is already well into its secondary industrial stage (as Figure 9 clearly demonstrates); and overall urbanization has entered upon a truly metropolitan phase.

82. Nevertheless, the rate and degree of structural economic change have varied significantly from zone to zone within the Witwatersrand, and continue to do so. As indicated in Figure 9, for all practical purposes, by 1954/55 the inner metropolitan zone had already effected the transition from a high dependence on the primary sector. It had been led in this advance by Johannesburg, the metropolitan core, and Figure 9 suggests a very close

relationship between the economic development of the inner zone and Johannesburg, sector by sector, during the next two decades; although, from 1963/64 onwards, the East Rand appears to exert a growing influence on the sectoral development of the inner zone (*via* Germiston and Alberton). The East Rand itself undoubtedly follows Johannesburg's lead, and its momentum of change, already rising in the 1950s, rapidly accelerates in the next decade, spearheaded by significant progress in secondary industry. Unlike all other zones, however, the tertiary sector continues to contribute less than the secondary sector to its zonal G.G.P.

83. By contrast, both the West and the Far East Rand, which in Figure 9 clearly demonstrate a fundamental economic change between 1954/55 and 1970/71, have yet to experience a secondary take-off. In neither case is there evidence of a significant upsurge in the momentum of secondary development between these years. As the primary sector declines, it is rather the tertiary sector which increases its tempo of growth on the West Rand. On the Far East Rand, too, although the secondary sector undoubtedly experiences greater progress, it is again the tertiary sector which advances most quickly after 1963/64. Evidently, the economies of these two peripheral zones have still to complete a full transition to the metropolitan phase, although they have both begun to cross its threshold.

84. Figures 8 and 9 also confirm that, with overall urbanization on the Witwatersrand now well embarked on its secondary industrial phase, there is a growing concentration of economic activity in and around the metropolitan core. It is true that, as the rate of

tertiary development accelerates in the other subsidiary zones after 1963/64, it tends to decrease in Johannesburg; but Tables 19 to 23 show this slowing down in the rate of development to be very much a function of public and private services in Johannesburg itself (in which domestic service plays an important rôle), and of tertiary growth on the East Rand. Thus, tertiary development in the inner zone as a whole continues to take place at the same rate as before 1963/64; Figure 8 reflects higher rates of increase in G.G.P. for the inner zone and Johannesburg than for any other zone; and the same figure yields a rate of increase in G.G.P. per head between 1954/55 and 1970/71 of 15% in Johannesburg, as against 5% on the West Rand, 10% on the East Rand, 12% on the Far East Rand, and 12% for both the Witwatersrand and its inner zone (because the latter accounts for 72% of the region's total product).

85. Except for the Far East Rand, where the primary sector continues to make a significant contribution to G.G.P. in 1970/71, these rates reflect a regional hierarchy of productive capacities, which reaches its apex in the metropolitan core and falls progressively towards the periphery. As Table 24 indicates, this hierarchy has been created during the last two decades of economic transition. On the one hand, throughout this period G.G.P. per head has not only been higher in the inner zone than the outer zone, but has attained its peak in Johannesburg. On the other hand, in 1954/55, G.G.P. per head was higher in the peripheral West Rand and Far East Rand zones than in the more central East Rand zone, and it is not until 1970/71 that secondary and tertiary development in the latter zone firmly places it above the West Rand in the metropolitan hierarchy. The Far East Rand continues to have a G.G.P. per head which is the second highest to Johannesburg's but, as its primary sector is presently

declining rapidly, there appears to be good reason to expect the productive capacity of this zone to assume a rank subordinate to that of the East Rand in the near future. The overall metropolitan structure of the Witwatersrand's economy will then be fully established, on both a spatial and sectoral basis, and urbanization throughout its zones will be wholly metropolitan in character.

85. *Clearly, this final conclusion implies that it is essential for the future development of the Witwatersrand to be planned on a truly metropolitan scale. It is essential that the planning of the development of land uses for secondary and tertiary economic activities (and for allied residential and communication purposes), of requisite physical infrastructure, and of complementary means of transportation, should no longer be undertaken on a lesser, town scale. At a minimum, planning on the Witwatersrand needs to be undertaken at the level of the subsidiary metropolitan zones; and, even so, it needs to be undertaken within the framework of firm, overall metropolitan guidelines formulated for the entire region as a fully-integrated, urban complex. The structure of the newly-established metropolitan economy is no longer determined by mainly gold mining. The economic bases of the towns originally created and located for mining purposes are now motivated by secondary industry and tertiary services which form integral, linked parts of a hierarchical metropolitan economy, upon the onward development of which their own future growth vitally depends. Without courting failure, it is not possible to plan the future development of the Reef towns except as part and parcel of the future development of the Witwatersrand metropolitan region as a whole.*

TABLE 18.

GROSS GEOGRAPHIC PRODUCT, THE WITWATERSRAND, 1954/55
(at factor cost and including Nigel magisterial district)

Sector	Witwatersrand		Inner Zone		Outer Zone	
	R million	%	R million	%	R million	%
<u>Primary</u>						
Agriculture	11,8	1,1	4,1	0,5	7,7	2,5
Mining	194,7	18,8	54,9	7,5	139,8	45,9
	206,5	19,9	59,0	8,0	147,5	48,4
<u>Secondary</u>						
Manufacturing	239,4	23,1	186,3	25,5	53,1	17,4
Construction	33,9	3,3	26,4	3,6	7,5	2,5
Electricity etc.*	28,2	2,7	21,9	3,0	6,3	2,1
	301,5	29,1	234,6	32,1	66,9	22,0
<u>Tertiary</u>						
Transport	82,2	7,9	68,0	9,3	14,2	4,7
Commerce	192,8	18,6	168,0	23,0	24,8	8,2
Finance	47,6	4,6	43,3	5,9	4,3	1,4
Property	34,9	3,4	26,3	3,6	8,6	2,8
Services	170,5	16,5	132,4	18,1	38,1	12,5
	528,0	51,0	438,0	59,9	90,0	29,6
T o t a l	1 036,0	100,0	731,6	100,0	304,4	100,0

*Electricity, gas and water.

Note: Because of rounding and the inclusion of Nigel magisterial district, the totals for the Witwatersrand differ slightly from those appearing in Table 15 of the First Report (*The Southern Transvaal*).

Sources: Table 15, *First Report: The Southern Transvaal*.

1954/55 G.G.P. statistics by magisterial districts prepared by the Prime Minister's Economic Advisory Council.

TABLE 19.

GROSS GEOGRAPHIC PRODUCT, SUBSIDIARY METROPOLITAN ZONES, 1954/55
(at factor cost)

Sector	West Rand		Johannesburg		East Rand		Far East Rand*	
	R million	%	R million	%	R million	%	R million	%
Primary								
Agriculture	3,7	3,5	1,6	0,2	3,2	0,4	3,7	2,7
Mining	55,2	52,3	24,7	4,2	49,2	21,0	85,6	62,1
	58,9	55,8	26,3	4,4	52,4	22,4	89,3	64,8
Secondary								
Manufacturing	10,9	10,4	144,0	24,3	71,6	30,7	15,2	11,1
Construction	1,5	1,4	20,4	3,5	10,1	4,3	2,1	1,5
Electricity etc.**	1,3	1,2	17,0	2,9	8,4	3,6	1,8	1,3
	13,7	13,0	181,4	30,7	90,1	38,6	19,1	13,9
Tertiary								
Transport	2,8	2,6	54,0	9,1	23,7	10,1	2,1	1,5
Commerce	8,6	8,2	154,6	26,1	23,3	10,0	9,1	6,6
Finance	1,6	1,5	41,3	7,0	3,4	1,5	1,7	1,2
Property	4,0	3,8	21,2	3,6	7,9	3,4	3,0	2,2
Services	15,9	15,1	112,8	19,1	32,7	14,0	13,5	9,8
	32,9	31,2	383,9	64,9	91,0	39,0	29,4	21,3
Total	105,5	100,0	591,6	100,0	233,5	100,0	137,8	100,0

* Including Nigel magisterial district.

** Electricity, gas and water.

Sources: see Table 18.

TABLE 20.

GROSS GEOGRAPHIC PRODUCT, THE WITWATERSRAND, 1963/64
(at factor cost and including Nigel magisterial district)

Sector	Witwatersrand		Inner Zone		Outer Zone	
	R million	%	R million	%	R million	%
Primary						
Agriculture	13,0	0,8	4,0	0,3	9,0	2,1
Mining*	162,7	10,2	40,9	3,5	121,8	28,5
	175,7	11,0	44,9	3,8	130,8	30,6
Secondary						
Manufacturing	464,7	29,1	325,1	27,8	139,6	32,7
Construction	37,7	2,4	27,7	2,4	10,0	2,3
Electricity etc.**	39,9	2,5	32,4	2,8	7,5	1,7
	542,3	34,0	385,2	33,0	157,1	36,7
Tertiary						
Transport	117,5	7,4	103,9	8,9	13,6	3,2
Commerce	307,6	19,3	267,1	22,9	40,5	9,5
Finance	93,4	5,8	85,3	7,3	8,1	1,9
Property	52,6	3,3	39,6	3,4	13,0	3,0
Services	305,8	19,2	241,5	20,7	64,3	15,1
	876,9	55,0	737,3	63,2	139,6	32,7
Total	1 594,9	100,0	1 167,4	100,0	427,5	100,0

*Value of gold and uranium production only.

**Electricity, gas and water.

Note: Because of rounding and the inclusion of Nigel magisterial district, the secondary and tertiary sector totals for the Witwatersrand differ slightly from those appearing in Table 17 of the First Report (*The Southern Transvaal*). As regards the primary sector, gold mining values are given for 1964/65 and include uranium output at the average 1960 price, whereas the latter table gives gold mining values for 1963/64 and omits uranium output.

Source: Table 17, *First Report: The Southern Transvaal*.

1963/64 G.G.P. statistics by magisterial districts prepared by the Prime Minister's Economic Advisory Council.

TABLE 21. GROSS GEOGRAPHIC PRODUCT, SUBSIDIARY METROPOLITAN ZONES, 1963/64
(at factor cost)

Sector	West Rand		Johannesburg		East Rand		Far East Rand*	
	R million	%	R million	%	R million	%	R million	%
Primary								
Agriculture	4,2	2,8	2,0	0,2	3,9	1,0	3,5	2,0
Mining**	42,8	28,7	15,3	1,6	40,8	11,1	80,9	45,5
	47,0	31,5	17,3	1,8	44,7	12,1	84,4	47,5
Secondary								
Manufacturing	33,4	22,4	234,2	24,9	165,3	44,9	40,8	22,9
Construction	3,6	2,4	20,4	2,2	11,4	3,1	3,1	1,8
Electricity etc.**	4,1	2,7	23,9	2,5	10,8	2,9	4,1	2,3
	41,1	27,5	278,5	29,6	187,5	50,9	48,0	27,0
Tertiary								
Transport	4,7	3,2	82,0	8,7	27,9	7,6	3,5	1,9
Commerce	17,0	11,4	246,1	26,1	35,0	9,5	12,6	7,1
Finance	3,5	2,3	81,7	8,7	5,9	1,6	2,8	1,6
Property	6,0	4,0	32,1	3,4	11,7	3,2	4,5	2,5
Services	30,0	20,1	204,7	21,7	55,7	15,1	22,0	12,4
	61,2	41,0	646,6	68,6	136,2	37,0	45,4	25,5
T o t a l	149,3	100,0	942,4	100,0	368,4	100,0	177,8	100,0

* Including Nigel magisterial district.

** Value of gold and uranium production only, and for 1964/65.

Sources: see Table 20.

TABLE 22.

ESTIMATED GROSS GEOGRAPHIC PRODUCT, THE WITWATERSRAND, 1970/71
(at factor incomes and including Nigel municipality)

Sector	Witwatersrand		Inner Zone		Outer Zone	
	R million	%	R million	%	R million	%
Primary						
Agriculture	12,4	0,5	3,9	0,2	8,5	1,2
Mining*	115,8	4,5	41,1	2,3	74,7	10,6
	128,2	5,0	45,0	2,5	83,2	11,8
Secondary						
Manufacturing	877,9	34,5	606,2	33,0	271,7	38,5
Construction	96,2	3,8	68,6	3,7	27,6	3,9
Electricity etc.**	70,5	2,8	57,3	3,1	13,2	1,9
	1 044,6	41,1	732,1	39,8	312,5	44,3
Tertiary						
Transport	195,8	7,7	138,9	7,5	56,9	8,1
Commerce	467,8	18,4	384,6	20,9	83,2	11,8
Finance	144,3	5,7	118,6	6,5	25,7	3,6
Property	206,7	8,1	148,8	8,1	57,9	8,2
Services	356,4	14,0	270,1	14,7	86,3	12,2
	1 371,0	53,9	1 061,0	57,7	310,0	43,9
T o t a l	2 543,8	100,0	1 838,1	100,0	705,7	100,0

* Value of gold and uranium production only (uranium at the average 1960 price adjusted for the change in the value of the rand).

** Electricity, gas and water.

Note: A revised estimate of national gross domestic product has been used in compiling these estimates, which thus differ slightly from those appearing in Table 32 in the First Report (*The Southern Transvaal*). The main difference in the secondary and tertiary sectors appears in manufacturing, where the estimated G.G.P. totals only R861 million in the latter table. In addition, the present table wholly excludes Oberholzer magisterial district but includes Nigel municipality, and includes the value of uranium production under mining in the primary sector. The percentage distribution, however, is very much the same in both tables. The estimates have been made on the bases of sectoral employment ratios, except in the cases of mining and property. Property has been estimated on the bases of White population ratios.

Sources: Transvaal and O.F.S. Chamber of Mines, *Annual Reports*, 1969 and 1970.
Department of Statistics, *Statistical News Release*, Pretoria, September 12, 1972.
1960 and 1970 Censuses (Population and Employment).
1967/68 Census of Industries.

TABLE 23.

ESTIMATED GROSS GEOGRAPHIC PRODUCT,
SUBSIDIARY METROPOLITAN ZONES, 1970/71
(at factor incomes)

Sector	West Rand		Johannesburg		East Rand		Far East Rand*	
	R million	%	R million	%	R million	%	R million	%
Primary								
Agriculture	6,0	2,6	2,2	0,1	3,2	0,5	1,9	0,8
Mining**	31,5	13,9	8,7	0,6	31,6	4,7	59,0	24,0
	37,5	16,5	10,9	0,7	34,8	5,2	60,9	24,8
Secondary								
Manufacturing	53,8	23,7	432,3	29,6	328,4	48,8	72,9	29,7
Construction	8,5	3,8	60,8	4,2	23,0	3,4	6,4	2,6
Electricity etc.***	4,9	2,2	42,2	2,9	20,5	3,1	5,6	2,3
	67,2	29,7	535,3	36,7	371,9	55,3	84,9	34,6
Tertiary								
Transport	17,0	7,5	116,7	8,0	49,9	7,4	19,2	7,8
Commerce	31,8	14,0	349,5	24,0	67,0	10,0	27,2	11,1
Finance	12,2	5,4	101,5	7,0	24,5	3,6	8,5	3,5
Property	26,8	11,8	110,7	7,6	57,0	8,5	18,8	7,7
Services	34,2	15,1	233,8	16,0	67,7	10,0	25,9	10,5
	122,0	53,8	912,2	62,6	266,1	39,5	99,6	40,6
T o t a l	226,7	100,0	1 458,4	100,0	672,8	100,0	245,4	100,0

* Including Nigel municipality.

** Value of gold and uranium production only (uranium at 1960 price adjusted for the change in the value of the rand).

*** Electricity, gas and water.

Note: For the methods of estimation, see Table 22.

Sources: see Table 22.

TABLE 24.

TRENDS IN GROSS GEOGRAPHIC PRODUCT AT
CONSTANT PRICES,* 1954/55 - 1970/71

*1960 value of the rand

Year	Witwatersrand		Inner Metropolitan Zone		Outer Metropolitan Zone	
	G.G.P.	G.G.P. per head	G.G.P.	G.G.P. per head	G.G.P.	G.G.P. per head
	R million	R	R million	R	R million	R
1954/55	1 201,76	652,70	848,66	676,13	353,10	602,52
1963/64	1 483,26	656,68	1 085,68	690,00	397,58	580,17
1970/71	1 933,29	733,18	1 396,96	755,87	536,33	686,92

Year	Johannesburg		West Rand		East Rand		Far East Rand	
	G.G.P.	G.G.P. per head	G.G.P.	G.G.P. per head	G.G.P.	G.G.P. per head	G.G.P.	G.G.P. per head
	R million	R	R million	R	R million	R	R million	R
1954/55	686,26	685,28	122,38	592,27	270,86	578,23	159,85	643,33
1963/64	876,43	700,17	138,85	564,34	342,61	567,04	165,35	646,16
1970/71	1 108,38	787,23	172,29	618,41	511,33	635,66	186,50	720,09

Sources: Tables 18 to 23.

1951, 1960 and 1970 Censuses of Population.

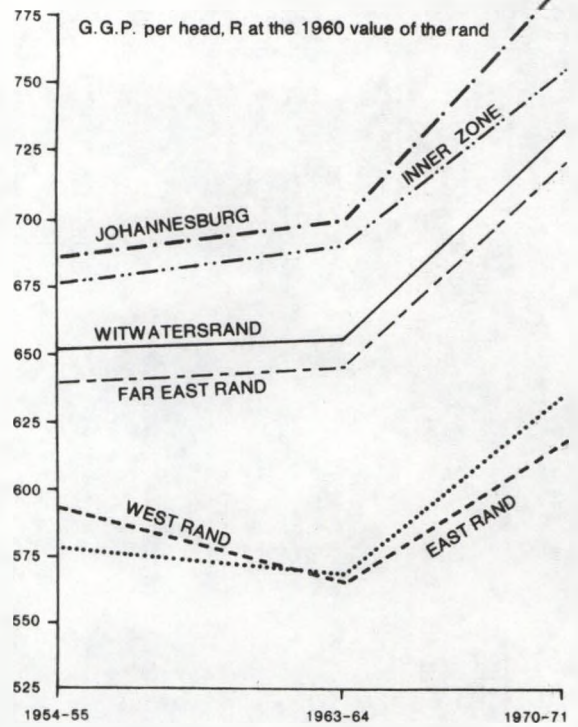
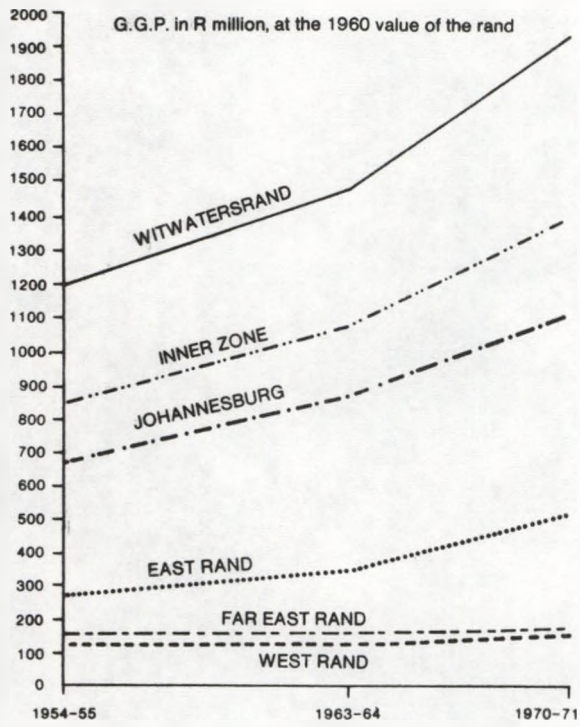


Figure 8.

Trends in G.G.P.: The Witwatersrand and Constituent Zones, 1954/55 to 1970/71

(Source: Table 24)

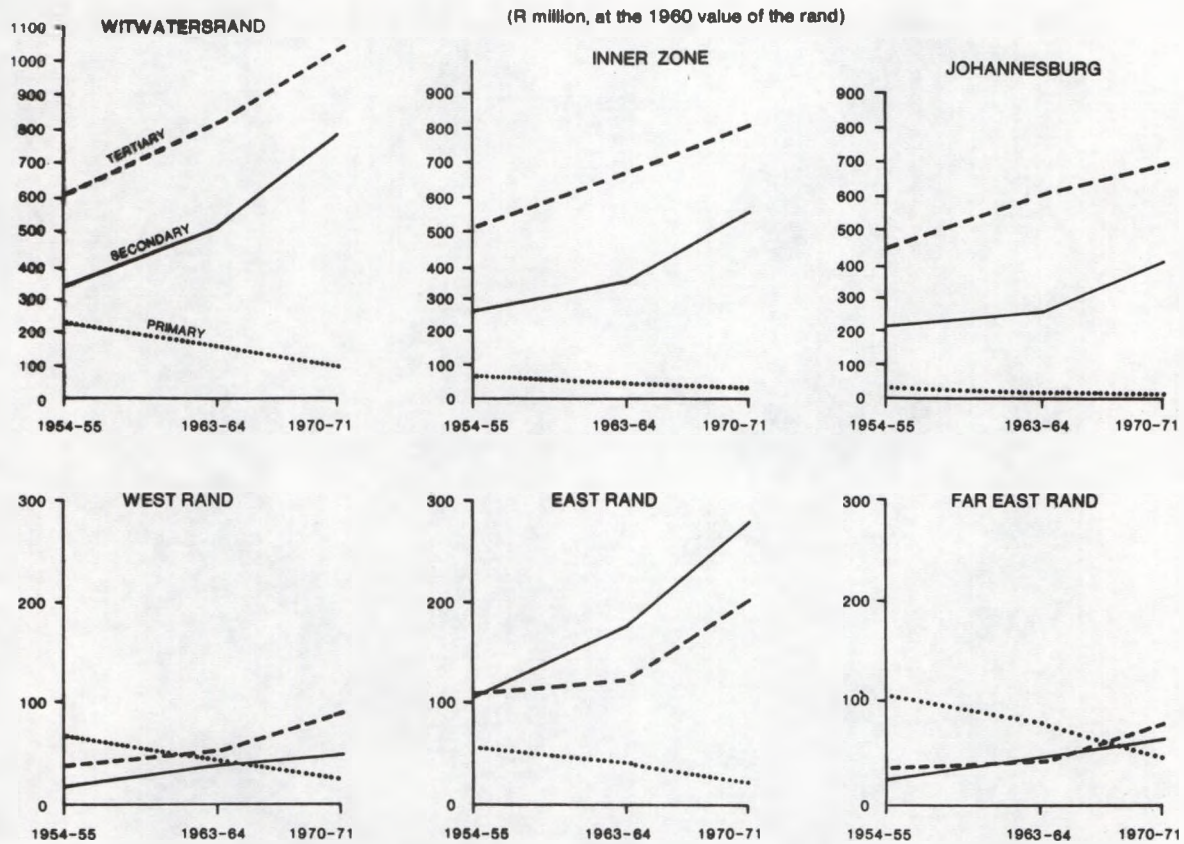


Figure 9.

Sectoral Trends in G.G.P.: The Witwatersrand and Constituent Zones, 1954/55 to 1970/71

(Source: Table 24)

CHAPTER 5.EMPLOYMENTIntroduction

86. The cumulative repercussions of economic development on sectoral and spatial trends in urban work opportunities, on the growth, racial composition and distribution of urban populations, and on the multiplying needs for land for residential, industrial and commercial uses in expanding urban areas may, for many practical purposes, best be analysed and quantified by way of employment effects. As concluded in the First Report,¹ overall population consequences of economic development in the Southern Transvaal urban region have closely followed the pattern of overall employment effects in recent years. "In so far as (potential) job opportunities and earning power directly influence where people work and live, the growth, spatial distribution and movement of the regional... population are being increasingly affected by the growth, spatial distribution and needs of manufacturing and commerce... and, to a lesser extent, of public and private services", especially as manifested quantitatively by and through employment trends from sector to sector and area to area of the region's space economy.

87. The prime need here, therefore, is to determine the broad employment effects of economic development on the Witwatersrand for each major category of activity and according to each metropolitan and subsidiary zone, as well as for the region as a whole. Unfortunately, as

¹*First Report: The Southern Transvaal*, op.cit., pp.60-63.
See also paragraph 79 above.

pointed out in paragraph 38 above, census data on employment, by principal type of activity and either magisterial district or economic region, refer to the places of residence of the persons concerned and not to their places of work. Given the possibility of breaking down to magisterial districts 1970 employment statistics so far published for economic regions only - which is a difficult enough task in itself - to estimate from these statistics the work opportunities actually obtaining within each of these districts is thus not possible, without inter-district journey-to-work data referring to movements which are contemporaneous with the census data on employment by place of residence.

88. Fortunately, it is reasonable to assume that inter-district movements made by White employees for purposes of agriculture and mining are not significant, especially beyond the boundaries of the subsidiary metropolitan zones as defined in Chapter 2 above; and the censuses of industries do provide data on employment by place of work, although for White, Bantu and total employees only. Thus, since, as shown in Figure 6 above, the major journeys to work of Bantu employees have so far been confined by Government policy to *intra*-zonal movements, and since Bantu mine-workers are housed on the mines themselves, reasonable estimates of primary and secondary sector employment of White and Bantu workers according to their place of work can be made, especially on a zonal basis. Tertiary sector employment, however, cannot be so estimated for each major census year; although available municipal returns of Bantu workers employed in each municipality may be used to break down census statistics published by economic region only, and, for reasons already cited, movements of Bantu workers employed in tertiary activities in one zone but residing

in another zone are unlikely to be significant. Unfortunately, too, the 1970 employment statistics omit certain smaller pockets of Coloured and Asian workers, whose numbers must thus be estimated on the bases of 1960 population and employment data, and 1970 population returns.

89. Employment Tables 25 to 32 below have been compiled for 1951, 1960 and 1970 on these bases, as further described in the notes appended to each table. The tables are thus reasonably accurate from the standpoint of place of work as far as employees in the primary and secondary sectors are concerned; they are also reasonably accurate from this standpoint as far as Bantu employees in the tertiary sector are concerned. But the tables are undoubtedly inaccurate from the standpoint of place of work as far as White employees in the tertiary sector are concerned; although the degree of error involved at the level of the inner and outer metropolitan zones is minimal, as Tables 1 to 3 above indicate that the net journey to work from the outer to the inner zone has not normally involved large volumes of White workers. As regards the subsidiary metropolitan zones - where the inaccuracies are certainly significant as far as the places of work of White tertiary employees are concerned - some indication of the probable error involved, zone by zone, has already been given in the notes to Tables 10 to 17 above for 1951 and 1970. The estimates appearing in these notes are incorporated in the text of the present chapter, but not in Tables 25 to 32, as there are no traffic data for 1960 which are comparable to those used to adjust the 1951 and 1970 White tertiary employment statistics in Tables 10 to 17. As regards Asian and Coloured employment, since the 1970 statistics and industrial censuses are deficient in this respect, the tables focus attention on the two largest race groups, White and Bantu, and necessarily omit any further

breakdown of work opportunities. The omission does not invalidate the argument of this chapter, but does render it less comprehensive than it should be.

The Witwatersrand

90. (i) Total Employment. Given the above provisos and deficiencies, Tables 25 and 32 reflect the following main trends in overall employment between 1951, 1960 and 1970. At the beginning of the period, employment on the Witwatersrand totals 971 580 persons, of whom over 32% work in the primary sector (overwhelmingly in gold mining), over 24% work in the secondary sector (principally in manufacturing) and over 43% work in the tertiary sector (including nearly 17% in commerce² and transport, and over 25% in public and private services). Thus, in 1951, 58% of the region's work opportunities are created by mining and services, although these activities produce only 35% of the region's G.G.P.; and since much service employment is in fact domestic,³ the principal spatial economic influence on the development of residential as well as industrial land uses is still the location of mining activity (which is reflected in Figure 1 above).

91. Region-wide, this conclusion continues to hold much truth in 1960, as mining and services yet account for nearly 52% of a total of 1 037 850 work opportunities (although for only 29% of G.G.P.). But, by 1970, employment in the primary sector has fallen to under 10%

²Throughout this chapter, its figures and tables, *commerce includes financial services*.

³See the footnote to paragraph 31 above.

of an aggregate work force of 1 211 290 persons, secondary employment has risen to over 37% and tertiary employment to nearly 53%. In particular, work opportunities in manufacturing have increased by over 63% since 1960, and in commerce and transport by over 65%. Thus, it is these activities, - the combined locations of which are shown in Figure 2 - which are now certainly bringing the greatest economic influence to bear on the evolution and configuration of the region's residential and industrial land uses. Moreover, unlike mining and services, their aggregate contribution to the Witwatersrand's G.G.P. (45%) is of much the same order as their contribution to its work opportunities (56%), so that their effective impact is considerably strengthened.

92. (ii) White Employment. Trends in White employment between 1951 and 1970 by no means conform to those of aggregate employment, and the resulting implications for urban development also differ. In 1951, out of a total of 268 550 workers, the primary sector accounts for only 14%, the secondary sector for 35% and the tertiary sector for 51%. Furthermore, manufacturing, commerce and transport already combine to create nearly 61% of all work opportunities for Whites. By 1960, out of a total of 307 230 workers, mining now employs no more than 9%, as against over 62% in manufacturing, commerce and transport; and commerce by itself has increased its work opportunities by nearly 26% in nine years. During the next decade, White employment in commerce expands even more rapidly - by 73% - so that, by 1970, out of a total work force of 415 390 Whites, it alone employs over 33%. Commerce, manufacturing and transport together now provide over 71% of all work opportunities, and their generative capacity is reflected in a high rate of increase in the construction industry.

Indeed, throughout the period under review, it is these three modernizing activities which, through wide-ranging employment effects, exert by far the major impact on the location and development of White residential and work areas. Furthermore, they continue to strengthen this impact as time passes, especially by and through a rapid expansion of commercial employment after 1960, in contrast to an absolute decline in mining and a relative stagnation in services (in which White employment grows by under 5% during the last decade). On this economic evidence, White urbanization on the Witwatersrand already appears to have been passing through the secondary industrial phase of its development by 1951, and seems to have begun to enter the post-industrial phase by 1970. In that case, a tendency towards a spatial deconcentration of White population may be expected to be gathering way - if only in relative terms - and expressing itself physically in the changing pattern of residential land uses.⁴

93. (iii) Bantu Employment. By contrast, over 41% of a total of 670 900 Bantu workers are employed in the primary sector in 1951, and nearly 40% in the tertiary sector, as against only 19% in the secondary sector. Together, mining and public and private services alone account for over 68% of the region's entire work force. Moreover, in spite of a progressive closing down of gold

⁴See *First Report: The Southern Transvaal*, op.cit., p.105: "Proportionately, employment will tend to shift from manufacturing (and commerce) towards tertiary services and quaternary technologies demanding less massive concentrations of work areas and work forces. As a corollary, future residential areas and densities will no longer need to be so concentrated as in the industrial stage of development". See also paragraphs 105 and 113 below.

mines on the Witwatersrand, in 1960 mining alone continues to provide nearly 37% of a total of 695 840 work opportunities for Bantu, while manufacturing, commerce and transport are responsible for only 29%. Thus, it is only during the next decade that a major sectoral change begins to be initiated in Bantu employment. This very significant transformation is reflected in the statistics for 1970, where Table 25 now shows the primary sector to employ less than 15% of a regional work force of 738 250 Bantu, as against 35% in the secondary sector and 50% in the tertiary sector. Manufacturing, commerce and transport together create nearly 47% of all Bantu work opportunities; and while employment in services has increased from 29% in 1960 to nearly 33% in 1970, during the same period employment in these three activities has risen by nearly 70%, compared with an overall growth of only 6% in the aggregate Bantu work force.

94. This swift and remarkable sectoral transformation has all the more fundamental implications for Bantu urbanization on the Witwatersrand in view of the contention of the First Report that "Bantu employees of the gold mines... are designated as urban by the census on other than economic or social grounds".⁵ In such case, in 1951, only 59% of the Bantu work force may be described as engaged in urban employment; in 1970, 86% or 632 140 employees may be so described, and urban job opportunities for this race group have thus grown by over 60%. It is true that such an increase is proportionately less than the 74% increase in urban White job opportunities between 1951 and 1970; but Table 25 indicates that, since 1960, in the particular activities of manufacturing, commerce and transport, Bantu employment has risen by no less than

⁵Ibid., p.29.

70% while White employment has risen by 55%. These three activities are all urban-forming, in contrast to the primary activities of agriculture and mining, which are by no means urban-oriented as far as the Bantu population is concerned.

95. It follows that the economic development of the Witwatersrand during its present secondary industrial phase of urbanization is resulting in far more disturbing employment effects for Bantu urbanization than for White urbanization. Moreover, as pointed out in the First Report,⁶ although the overall increase in urban Bantu employment on the Witwatersrand during the last decade has in fact taken place at a rate below that experienced by the Republic as a whole, and also below that of the region's own urban White employment, the absolute number of workers involved is high. In 1970, the region's secondary and tertiary sectors provide over 632 000 work opportunities for Bantu, which have been expanding at a rate of 3,7% a year since 1960. Hence, for instance, "a principal task facing the planning of physical development... over the next two decades must... be the provision of housing for the Bantu involved, and of means of movement between their residential and work areas by road and rail".⁷ As indicated below, however, the problems involved in this exercise will undoubtedly differ greatly in degree and kind from zone to zone of the Witwatersrand, because of the differential economic development being experienced by these zones as they progressively pass through the various stages of urbanization in their evolution.

⁶Ibid., p.55.

⁷Ibid., pp.55 and 56.

The Inner and Outer Metropolitan Zones

96. (i) Total Employment. This latter conclusion is immediately borne out by Tables 26 and 27 relating to the inner and outer metropolitan zones respectively, although they omit the rising net commuting of White workers from zone to zone. Between 1951 and 1960, total employment grows from 642 090 to 669 050 workers, or by over 4%, in the inner zone; it grows from 329 490 to 368 800 workers, or by nearly 12%, in the outer zone. By contrast, between 1960 and 1970, total employment rises to 863 670 workers, or by 29%, in the inner zone; it *falls* to 347 620 workers, or by nearly 6%, in the outer zone.

97. The relatively slow rate of increase characterizing the growth of employment in the inner zone during the first decade results from a 22% contraction of work opportunities in the primary sector, which is barely off-set by an expansion of 10% in the secondary and tertiary sectors. The relatively high rate of increase experienced by this zone during the following decade results from growths of 54% and 35% in secondary and tertiary work opportunities respectively, which easily counter a 36% fall in the primary sector. In the outer zone, however, a large primary sector employment remains buoyant until 1960 (falling by less than 1%), while a relatively small secondary and tertiary employment rises by 30% during the same period. In the second decade, on the other hand, work opportunities in the primary sector contract so rapidly - by no less than 64% - that an expansion of nearly 57% in other work opportunities cannot compensate for the loss, and the total work force falls by over 21 000 employees (in contrast to a rise of nearly 195 000 in the inner zone).

98. (ii) White Employment. As might be anticipated

from the overall analysis of the Witwatersrand's work force, this differential zonal development is not so much a function of White employment as of Bantu employment. In the inner zone, White employment in mining accounts for less than 7% of a total work force of 203 610 persons in 1951, as against 30% in manufacturing, 26% in commerce and nearly 10% in transport. Already, therefore, the transition from the primary industrial to the secondary industrial phase of urbanization has been effected as far as this group is concerned. Subsequent sectoral development to 1970, merely consolidates the change. The principal consolidation occurs after 1960, when it is headed by growth in commercial work opportunities of 69%, and in manufacturing work opportunities of nearly 28%; and it is reflected in a high increase of 74% in employment in the construction industry.

99. In the outer zone, too, although the major decrease in White primary employment takes place between 1960 and 1970 - when it falls from 26% to under 7% of the work force - manufacturing, commerce and transport already account for over 45% of total White employment by 1951. In 1970, they account for 70% of a total work force which has grown from 64 940 persons in 1951 to 108 300, or by nearly 70%, and employment in construction shows a high rate of increase during the last decade. There is certainly no sectoral restructuring of White employment in these statistics, sufficient to suggest major, innovating repercussions on the general form and degree of White urbanization obtaining in the outer zone.

100. (iii) Bantu Employment. It follows that the differential trends in employment characterizing the

inner and outer zones between 1951 and 1970 are principally functions of changes in the sectoral distribution of Bantu work opportunities. Tables 26 and 27 confirm this conclusion. On the one hand, Bantu employment in the inner zone *remains stationary* between 1951 and 1960 at some 412 000 workers, and then rises to 511 020 by 1970, or by 24%, in spite of a loss of 37 530 mine workers. On the other hand, Bantu employment in the outer zone *rises* from 259 120 to 283 930 workers between 1951 and 1960, or by nearly 10%, before *falling* sharply to 227 230 workers in 1970, or by almost 20%. This contraction of overall work opportunities results from a precipitous fall in Bantu mining employment, from 152 070 to 45 880 workers in a single decade.

101. From the standpoint of urbanization, however, the severe decline in the more stereotyped and locality-tied work opportunities of the mines is not especially significant. Of far greater significance is the opening-up of new work opportunities in the more foot-loose secondary and tertiary sectors, and especially in the three modernizing fields of manufacturing, commerce and transport. Here, Bantu employment rises steeply in the inner zone after 1960, by as much as 73%; in the outer zone it rises by 68%, but to a total of only 92 080 workers as against 247 520 in the inner zone. These employment effects are undoubtedly prime movers in the differential growth of the urban Bantu population in the inner and outer metropolitan zones, and the innovating nature of these effects are not to be underestimated. The current growth of the urban Bantu population is not founded on the exploitation of a place-bound, primary resource requiring a relatively narrow technology and having a naturally-limited optimum output. It is founded on a development of manufacturing, commerce and transport, which is limited only by the size of an

expanding market for the goods and services produced, which has ever-widening technological horizons, and which, unlike the primary resource development, is free to concentrate in the inner metropolitan zone.

102. The fuller implications of this fundamental shift in the Witwatersrand's space economy - from dependence on a relatively stereotyped, spatially immobile and narrow-ranging sector having a natural ceiling to the work opportunities it is able to create, to a number of modernizing, spatially mobile and wide-ranging sectors having no such natural ceiling - are spelled out below in connection with an analysis of employment trends in the subsidiary metropolitan zones. There is no doubt, however, that one of the cardinal implications for metropolitan planning today lies in the fact that this sectoral shift currently holds far greater connotations for Bantu urbanization than for White urbanization, since (i) the vast majority of White work opportunities were already being created by the secondary and tertiary sectors over twenty years ago, and (ii) as has been argued above, there are good grounds for classifying Bantu employment on the mines as being essentially non-urban in character.

Johannesburg

103. (i) Total Employment. As the fulcrum of economic development on the Witwatersrand, the principal node of the region's traffic network, and the apex of its urban hierarchy, the Johannesburg subsidiary zone necessarily experiences the fullest employment effects of metropolitan growth and change. For 1951, Table 28 wholly reflects the volumes of employment in the primary and secondary sectors, but, for reasons already

given,⁸ understates them in the tertiary sector in the case of White workers in commerce, transport and public and private services. Using the commuting statistics very conservatively estimated in Table 10, a slight modification may be made to Table 28 which then yields the following breakdown of work opportunities being created in Johannesburg in 1951, viz: primary sector 11%, secondary sector 29% and tertiary sector 60%, out of an estimated total of 492 750 work opportunities.⁹

104. Clearly, the metropolitan core is already distinguished by a much higher proportion of tertiary employment than obtains in the inner zone as a whole. Indeed, commerce and transport together account for an estimated 26% of Johannesburg's total work force. As manufacturing accounts for a further 21%, and construction and electricity for 7%, there can be no doubt that the sectoral structure of the zone's employment as a whole already reflects maturing metropolitan characteristics, in spite of a large Bantu element. By 1970, when employment has risen by 43% to an estimated total of 703 280 workers,¹⁰ these proportions have grown to 34% in the case of commerce and transport combined, and to 25% in the case of manufacturing. Moreover, work opportunities in the former activities have expanded by at least 60% since 1960, and they have expanded by over 49% in the latter. This expansion accounts for over 88% of the aggregate net increase in total employment in the Johannesburg

⁸See paragraph 38.

⁹Instead of 480 550 as given in Table 28.

¹⁰See Table 11 for the modifications needed to Table 28 in respect of White commuters to Johannesburg in 1970, increasing the total of 654 890 workers given in the latter table by 48 390.

zone during the last ten years, and for the zone's continued dominance in the region's consolidating urban hierarchy.

105. (ii) White Employment. Such a progressive concentration on those sectors of the metropolitan economy which are most immediately associated with growth and change in urbanization has direct repercussions on White employment, which rises from an estimated 169 830 workers in 1951 to an estimated 276 240 in 1970, or by 63%. Spatially, only two-thirds of this increase is accommodated within Johannesburg's own residential boundaries, and one-third spills over into the rest of the Witwatersrand, mainly to other residential areas of the inner metropolitan zone located in Roodepoort, Krugersdorp, Alberton and Germiston. Sectorally, over two-thirds of the increase is accounted for by commerce and transport, and one-third in equal proportions by manufacturing and construction, on the one hand, and public and private services, on the other. Thus, the estimated sectoral breakdown of White work opportunities changes from primary 6%, secondary 35% and tertiary 59% in 1951, to primary 2%, secondary 31% and tertiary 67% in 1970. By the latter year, the three modernizing activities of commerce, manufacturing and transport account for well over 70% of all White employment in the Johannesburg zone. Today, they overwhelmingly comprise the principal economic influences in the development of its patterns of commuting and residential growth.

106. (iii) Bantu Employment. Unlike the Witwatersrand's employment as a whole, in 1951 less than 16% of Bantu employment in the metropolitan core is accounted for by the primary sector. Even so, mining and services alone provide over 56% of a total of

298 040 work opportunities in that year, and manufacturing, commerce and transport less than 36%. Hence, the fundamental sectoral change in fact occurs between 1960 and 1971, when Bantu primary employment falls by 47%, but secondary employment rises by 58% and tertiary employment by 32%, resulting in a total work force of 383 060 persons by the end of the period. Of these, over 39% continue to be employed in public and private services, but manufacturing, commerce and transport now combine to employ nearly one-half of all Bantu workers; and if so large a proportion of these workers were not still employed in domestic service, the sectoral breakdown would closely resemble that of White employment in Johannesburg two decades earlier.

107. From this comparison, there are grounds for concluding that, *in economic terms*, Bantu urbanization in the Johannesburg zone is now fast approaching the stage reached by White urbanization in the early 1950s. Reasonable inferences may thus be drawn about the probable implications for metropolitan planning in the short run. For example, the next decade is likely to experience a strong tendency towards an acceleration of Bantu employment in those secondary and tertiary activities which have been concentrating increasingly in and around the metropolitan core. Such a tendency must result in mounting pressure being placed on the zone's Bantu transportation system, housing industry and supporting urban infrastructure, involving Soweto and Alexandra Township in particular. Employment in the more centralized activities of commerce and finance is likely to grow at a substantially faster rate than in the less centralized activity of manufacturing, thus escalating present problems of peak-hour commuting to and from Johannesburg's C.B.D., not only by bus and train but also by private car as incomes rise with the overall sectoral shift in employment. In

general, Bantu urbanization will tend to compound metropolitan problems¹¹ already besetting the region's core as a consequence of the mounting pressures of White urbanization on its local spatial, physical, financial and organizational resources. It will also tend to change their character, because of the wide differences in the standards of wealth and living enjoyed by these two groups of people. For instance, the problems will involve public rather than private transport, public rather than private housing, public high density residential development rather than private low and medium density development, and national rather than local or provincial government policy in regard to the location and control of that development.

The West Rand

108. (i) Total Employment. Table 29 shows economic development on the West Rand to have far less significant employment effects, although a major structural change begins to take place in its economy during the period reviewed. In 1951, some 65% of the zone's estimated total work force of 119 780 persons¹² is employed in the primary sector, as against 24% in the tertiary sector and only 11% in the secondary sector. Together, mining and services account for an estimated 80% of all work opportunities being created; and, from an economic standpoint, urbanization thus remains in its primary

¹¹For a summary of the most common problems arising in metropolitan regions, which particularly affect their central cities, see N.N. Patricios, op.cit., pp.27-34.

¹²Allowing for the net commuting of 2 800 Whites to the Johannesburg zone, for which see Table 12. The unmodified total given in Table 29 is 122 580.

industrial phase in this zone. Structurally, Table 29 shows no great change by 1960, even allowing for a growing White commuting to work in Johannesburg; and the work force is still overwhelmingly dependent on employment in mining and services - for as much as 70% of all work opportunities in Table 29. By 1970, however, only 33% of an estimated total employment of 121 790 persons¹³ is accounted for by the primary sector, as against 42% by the tertiary sector and 25% by the secondary sector. Manufacturing, commerce and transport now provide over one-third of all work opportunities. As far as its own, local development is concerned, therefore, the phasing-in of secondary industrial urbanization has now begun on the West Rand, but only in recent years and in strong contrast to development in the Johannesburg zone, which is so much further advanced.

109. (ii) White Employment. Once again, however, this general conclusion reflects Bantu employment rather than White employment. In 1951, some 35% of a total estimated work force of 22 920 Whites is employed in the primary sector, while over 40% is employed in the tertiary sector and 25% in the secondary sector. This breakdown is very similar to that obtaining for the *total* work force of the West Rand twenty years later, and thus indicates that, in economic terms, White urbanization has in fact recently entered its secondary industrial phase. By 1970, out of an estimated aggregate work force of 29 610 persons, primary employment now accounts for 13%, secondary for 35% and tertiary for 52%; manufacturing, commerce and transport together create nearly 62% of all White work

¹³Allowing for the net commuting of 19 740 Whites to the Johannesburg zone, for which *see* Table 13. The unmodified total given in Table 29 is 141 530.

opportunities; the zone's own White urbanization is now well advanced economically; and that advance is being further influenced by large-scale commuting to Johannesburg.

110. (iii) Bantu Employment. By contrast, Bantu employment in 1970 still depends on the primary sector for over 41% of all work opportunities, the tertiary sector accounts for a further 38%, and the secondary sector is limited to 20%. Moreover, total employment now aggregates only 88 910 persons, against 93 970 in 1951 and 127 510 in 1960. This severe contraction in work opportunities is a direct result of a fall of 55 240 employees in gold mining during the last decade, a fall which manufacturing, commerce and transport quite fail to offset as their combined growth creates no more than 10 100 new jobs. Together, these three modernizing activities now account for only 24% of total Bantu employment. Nevertheless, they account for under 8% in 1951, and under 10% in 1960. Thus, a sectoral change in work opportunities has in fact been initiated by the end of the period; but, as far as Bantu urbanization is concerned, the employment effects of economic development on the West Rand remain relatively weak and very different indeed from those being experienced in the Johannesburg zone. In this respect, the West Rand's problems of Bantu urbanization can in no way be compared to those of Soweto in the metropolitan core, and even the removal of Government restraints on Bantu commuting to Johannesburg from the West Rand is most unlikely to have significant adverse repercussions on the zone's own problems of planning and administration.

The East Rand

111. (i) Total Employment. As Table 30 indicates, the East Rand is also to be strongly contrasted with the West Rand. The modified work force in 1951 totals 248 670 employees,¹⁴ of whom 42% are accounted for by the primary sector, 31% by the tertiary sector and 27% by the secondary sector. By 1970, a remarkable transformation has been accomplished, and of a modified work force of 302 580 persons¹⁵ no more than 11% are now employed in the primary sector as against over 52% in the secondary sector and nearly 37% in the tertiary sector. Moreover, manufacturing (45%), commerce (11%) and transport (5%) together presently create 61% of all work opportunities - a proportion of *total* employment which is equivalent to that of *White* employment alone on the West Rand, and which in economic terms thus places urbanization on the East Rand as a whole at a stage equivalent to that of *White* urbanization alone on the West Rand (although the former zone's economy is dominated by secondary industry, whereas the latter zone's is dominated by tertiary activities). Clearly, therefore, *in economic terms*, the East Rand now stands second to the Johannesburg zone in the evolutionary time-scale of urbanization on the Witwatersrand, and in advance of the more peripheral West Rand. In consequence, its contemporary problems of metropolitan planning - physical and social as well as economic - may be expected to be considerably more complex, urgent and sophisticated, particularly because of the economic metamorphosis this

¹⁴Allowing for the net commuting of 9 400 Whites to the Johannesburg zone, for which *see* Table 14. The unmodified total given in Table 30 is 258 070.

¹⁵Allowing for the net commuting of 27 650 Whites to the Johannesburg zone, for which *see* Table 15. The unmodified total given in Table 30 is 330 230.

zone has experienced in the short space of twenty years.

112. (ii) White Employment. Necessarily, the employment effects of this fundamental sectoral change in the East Rand's economy have been far-reaching for both major race groups. For example, Table 30 (unmodified) records an upsurge of over 93% in White manufacturing employment between 1960 and 1970, and of 102% in commercial employment, involving the creation of over 37 000 new work opportunities in these modernizing, foot-loose activities. Figures 1 and 2 graphically portray the resulting multiplication and extension of land uses in this zone for residential and work purposes, and the parallel expansion of the communications network. On its part, Table 30 (modified)¹⁶ reflects a growth in the White work force from an estimated 54 210 persons in 1951 to an estimated 87 760 in 1970, in spite of a loss of 9 270 work opportunities in mining. During the last ten years, therefore, White employment increases at a rate of at least 4,5% per annum, and between 1951 and 1970 the distribution of the work force changes from 24% primary, 31% tertiary and 45% secondary, to under 4% primary, 35% tertiary and no less than 61% secondary.

113. Without doubt, therefore, White urbanization on the East Rand is by now fully emancipated from the place-bound, primary industrial phase of its development. As a result, metropolitan planning must have a principal regard for the needs of the increasingly mobile secondary industrial phase of the zone's urbanization, in which considerations of access to work areas, labour supplies and markets, of the economic advantages of

¹⁶The unmodified totals in Table 30 are 63 610 and 115 410 respectively.

agglomeration, and of efficient local and regional transportation systems assume an over-riding importance. The First Report¹⁷ has already drawn attention to the "far greater mixture of competing and conflicting land uses on the East Rand... than on the West Rand", and to the "confused nucleus of mining, industrial and White residential areas encircled to the north, east and south by large pockets of non-White residential development", that has resulted from the liberation of this zone from the spatial constraints of gold mining. And to the consequences of this economic development must be added those of growth and change in the metropolitan core, which entail a spilling-over into the East Rand of residential accommodation for tens of thousands of White commuters who are employed in Johannesburg but live in Alberton, Benoni, Boksburg, Brakpan, Germiston and Kempton Park.

114. (iii) Bantu Employment. The pockets of non-White residential development referred to are shown in Figures 2 and 6 above; they consist chiefly of Bantu townships, and their locations have been planned¹⁸ in relation to the zone's work areas. In the case of Bantu urbanization on the East Rand, therefore, its spatial manifestations have in fact been controlled; but this control does not invalidate the conclusion to be drawn from Table 30 that it has undergone far-reaching changes since 1951, *via* the employment effects of a wide-ranging economic transformation. At the beginning of the period under review, over 49% of the Bantu work force of 185 040 persons is employed in the primary sector, 30% in the tertiary sector and over 20% in the secondary sector. By 1970, the primary sector is employing less than 15% of a work force

¹⁷*First Report: The Southern Transvaal*,
op.cit., pp.11 and 13.

¹⁸As indicated in paragraph 21 above.

of 207 690 persons, the tertiary sector under 37%, and the secondary sector nearly 49%. Thus, there is no extraordinary rise in overall employment, as the number of mine workers falls steeply by 61 240; but, undoubtedly, there is an exceptional sectoral shift in work opportunities, the proportion of Bantu workers employed in manufacturing is now almost precisely the same as the proportion of White workers so employed, and manufacturing, commerce and transport together employ 54% of the total work force.

115. Even so, the problems of planning and administration raised by the swift emergence of the secondary industrial phase of Bantu urbanization on the East Rand are not to be compared with those so rapidly accumulating in the metropolitan core. Manufacturing accounts for over 41% of all work opportunities, but commerce for under 9%; the zone's Bantu residential areas are directly connected by road and rail with its industrial areas; the East Rand's Bantu workers are prevented by Government regulation from commuting to Johannesburg; and there is no massive peaking of traffic to and from a metropolitan C.B.D. comparable to that of Johannesburg's, in the growth of which Bantu employees may be expected to play an increasing rôle. In short, as the East Rand does not stand at the apex of the metropolitan region's urban hierarchy, its economy is not being progressively dominated by those commercial and financial activities which are most responsible for the rising nodality of the metropolitan core, and the employment effects of the zone's economic advance on its Bantu population are necessarily being confined mainly to those of secondary industry. Furthermore, while White urbanization on the East Rand is certainly being directly influenced by commercial and financial development in Johannesburg, Bantu

urbanization is not. This does not entail that planning on the East Rand is not faced with major problems of Bantu urbanization; it entails only that those problems are significantly different economically from the problems arising, for example, in Soweto, and in connection with the relationships being forged between Soweto and the rest of the Johannesburg zone.

The Far East Rand

116. (i) Total Employment. As a peripheral zone having a somewhat greater degree of economic independence from the metropolitan core than either the East or the West Rand, the Far East Rand's urbanization may be expected to reflect somewhat different employment effects that are more locally generated and oriented. In 1951, its primary sector employs 68% of the total work force of 166 740 persons, its tertiary sector 20% and its secondary sector less than 12%. Mining and services alone account for nearly 81% of all work opportunities, which is a higher proportion than obtains on even the West Rand, although it assumes no net White commuting to Johannesburg (and therefore understates the true position). By 1970, at least 30% of the zone's modified work force of 109 780 persons¹⁹ is still accounted for by the primary sector, as against 32% by the secondary sector and 38% by the tertiary sector. Thus, although mining has sustained a loss of 82 590 work opportunities, mining and services yet provide nearly 47% of the overall estimated total, which is a very much higher proportion than obtains on

¹⁹Allowing for net commuting of 4 570 Whites to the Johannesburg zone, for which see Table 17. The unmodified total given in Table 31 is 114 350.

the West Rand. Paradoxically, however, manufacturing, commerce and transport now create 45% of the zone's work opportunities, which is also a much higher proportion than obtains on the West Rand.

117. Clearly, in 1970, employment on the Far East Rand has a rather untypical structure for the Witwatersrand, in so far as its sectoral composition is evenly balanced and, for example, mining and manufacturing *both* account for a little over one-quarter of the estimated work opportunities created. From an economic standpoint, therefore, the zone's urbanization still stands at the point of transition from the primary industrial phase to the secondary industrial phase; whereas the West Rand has recently made that transition, because of its closer proximity to the metropolitan core and its progressive absorption into the inner metropolitan zone. The severe and progressive decline in mining employment on the Far East Rand between 1960 and 1970 suggests, however, that the primary sector will further contract in the near future, precipitating the zone into its secondary industrial phase of urbanization, and emphasizing those metropolitan aspects of its economic development which are already firmly established but are presently masked by its lingering primary industry.

118. (ii) White Employment. In 1951, White employment is far more dominated by the primary sector than elsewhere on the Witwatersrand. This sector accounts for 41% of a total work force of 27 490 Whites, the tertiary sector accounts for 35% and the secondary sector for 25%. By 1970, however, a fundamental change has taken place in this structure. The primary sector now provides employment for no more than 12% of an

estimated work force of 27 900 Whites,²⁰ the tertiary sector for 43% and the secondary sector for no less than 46%. Moreover, manufacturing, commerce and transport combine to create nearly 68% of all White work opportunities. This economic transformation, hardly initiated prior to 1960, thus appears to be swifter and more complete than the change experienced on the West Rand, in spite of the latter's closer links to Johannesburg. Having a strong manufacturing and recent commercial bias, it certainly suggests a relatively virile White urbanization, which is locally oriented although economically integrated into the metropolitan region as a whole, which is to be contrasted with peripheral White development on the West Rand (where the metropolitan core so largely dominates), and which is currently establishing an emergent urban growth point in the outer metropolitan zone. Undoubtedly, this conclusion holds considerable significance for metropolitan planning.

119. (iii) Bantu Employment. The sectoral transformation in White employment has not by-passed Bantu employment on the Far East Rand. In 1951, the latter is overwhelmingly primary in structure, 74% of the work force of 138 060 persons being contributed by the primary sector, 17% by the tertiary sector and only 9% by the secondary sector. A drastic fall in primary employment ensues, however, so that, in 1970, a work force of no more than 79 820 persons is now dependent on the primary sector for little more than 37% of its total work opportunities, on the tertiary sector for 35% and on the secondary sector for 30%. Thus, while the

²⁰The unmodified total given in Table 31 is 32 470.

transformation in Bantu employment has not been so spectacular as in White employment, today 36% of all Bantu work opportunities are being created by manufacturing, commerce and transport; and, in economic terms, Bantu urbanization has now begun to follow White urbanization into the secondary industrial phase of its evolution.

120. These recent employment effects of current economic development on the Far East Rand are unlikely to be creating imminent problems for the planning and administration of Bantu urbanization which are comparable in kind and degree to those already arisen in the metropolitan core; but local, sub-metropolitan pressures will no doubt build up faster than on the West Rand, because of the emphasis now being placed on commercial as well as manufacturing growth, and because of the repercussions this growth is exerting on Bantu as well as White employment. *In this sense, the Far East Rand tends to stand above the West Rand but below the East Rand in the hierarchy of Bantu planning priorities. These priorities clearly reach their peak in the Johannesburg zone, where, in economic terms, the urbanization of the region's Bantu population has by now proceeded far into its secondary industrial phase.*

Conclusions

121. For many practical purposes, the changing impact of economic development on trends in the growth and distribution of population and land uses, for both residence and work, may best be analysed and quantified by way of employment effects. As the First Report

concludes,²¹ in connection with tendencies in urbanization in the Southern Transvaal, "the key elements are trends in White and Bantu population growth rates which are closely associated with trends in White and Bantu employment opportunities". For the Witwatersrand, the employment effects of its radical economic development between 1951 and 1970 are summarized in Tables 32 and 33, and Figures 10 and 11, by sector, zone and major race group.

122. Figure 10 reflects a growth in total employment on the Witwatersrand from 971 580 to 1 211 290 workers between 1951 and 1970, at rates of 0,7% per annum up to 1960, and of 1,5% per annum thereafter. It is clear that, national trends apart, these relatively slow regional growth rates result principally from a fundamental change in the sectoral structure of the Witwatersrand's space economy. Employment in the primary sector falls progressively from over 32% to under 10% of the regional total, at rates of -1,0% per annum up to 1960, and of -4,7% per annum during the next decade. By contrast, employment in the secondary sector rises from 24% to 37%, at rates of 2,1% per annum up to 1960, and of nearly 4,8% per annum in the following ten years. Employment in the tertiary sector also rises, from 43% to nearly 53% of the regional total, at rates of 1,1% per annum up to 1960, and of 3,1% per annum thereafter. Most significantly, employment in manufacturing, commerce and transport combined rises from under 37% of the regional total in 1951 to nearly 57% in 1970, at rates of 1,8% per annum up to 1960, and of 5,1% per annum between then and 1970.

123. In the short period of only two decades, therefore,

²¹*First Report: The Southern Transvaal*,
op.cit., p.62.

the Witwatersrand's swift transformation from a gold mining area into a maturing metropolitan region, dependent for its future economic development on the activities of manufacturing, commerce and transport, results in extremely important consequences for the sectoral structure of regional employment. It has equally important repercussions on the *spatial* structure of employment, and, *via* changes in the zonal distribution and growth of work opportunities, on the configuration and composition of the region's population and land uses. *The economy switches irreversibly from domination by a single, primary activity that is place-bound, is not of necessity progressively urban-forming, and has little scope or need for major technological innovation - to domination by secondary and tertiary activities that are mainly foot-loose and agglomerating, have the fullest scope and need for technological innovation, and are prime movers in a take-off into the secondary industrial phase of urbanization leading to metropolitan status.*

124. Figure 10 shows this economic transformation to have had more disturbing repercussions on Bantu employment than on White employment and, *via* employment effects, on Bantu urbanization than on White urbanization. At the beginning of the period reviewed, White employment is already largely emancipated from dependence on the primary sector, which employs less than 14% of the region's White workers; and by the end of the period, White primary employment falls to a little over 3% of that total. At the same time, White employment in manufacturing, commerce and transport rises from 61% to 72% of total White employment, and in commerce and transport alone to nearly 42%. *In economic terms, therefore, White urbanization on the Witwatersrand has already embarked on the secondary*

industrial phase of its evolution by 1951, and by 1970 is beginning to cross the threshold of the post-industrial phase. Bantu employment, on the other hand, is dependent on the primary sector for 41% of its work opportunities in 1951, while manufacturing, commerce and transport account for only 25%; and it is not until between 1960 and 1970 that a radical structural change begins. This comprehensive change still leaves over 14% of Bantu employment dependent on the primary sector in 1970; but manufacturing, commerce and transport presently account for nearly 47% of all Bantu work opportunities and, *in economic terms*, Bantu urbanization on the Witwatersrand has thus itself now entered upon the secondary industrial phase.

125. Certain significant urban consequences necessarily flow from these differential employment effects. On the one hand, Table 32 shows the overall ratio between White and Bantu employment to change from 28 : 69 in 1951 to 34 : 61 in 1970, in favour of White employment; but this change is chiefly a reflection of the rapid decline in mining. It is true that "the overall growth in urban Bantu employment and population is taking place considerably more slowly... on the Witwatersrand than elsewhere in South Africa... (because of) increasing concentration on (a) manufacturing industries requiring less Bantu employees per unit of output, and (b) commercial and financial activities demanding those higher technical, professional and administrative skills which are more readily available amongst the White than the Bantu sections of the population".²² Yet, only in the case of commercial and financial activities does White employment on the

²²*First Report: The Southern Transvaal*,
ibid., p.54.

Witwatersrand grow faster than Bantu employment between 1951 and 1970, by 119% as against 85%. In manufacturing, Bantu employment grows faster than White, by 122% as against 66%, and the ratio of White to Bantu employment in manufacturing, commerce and transport combined changes from 46 : 48 to 43 : 50, in favour of Bantu employment.

126. This initial consequence of a radical economic transition has widely different repercussions from metropolitan zone to metropolitan zone of the Witwatersrand, as Table 33 and Figure 11 clearly indicate. Because of the centripetal tendencies towards agglomeration inhering in the relatively foot-loose manufacturing, commercial and transport activities of urban economies, by 1970 the inner metropolitan zone accounts for nearly 73% of all work opportunities on the Witwatersrand, as against less than 68% in 1951. While the zone's primary work opportunities fall sharply from 13% to 4% of the regional total, its secondary and tertiary opportunities rise swiftly, from 19% to 26%, and from 36% to 42%, respectively; in manufacturing, commerce and transport combined, they rise from 31% to nearly 43% of the regional total. Moreover, in spite of the steep decline in the primary sector, Bantu work opportunities continue to amount to 42% of the regional total, as in 1951, and White opportunities rise from under 23% to nearly 27% of that total. In both cases, the principal factor is the very significant growth in manufacturing, commercial and transport activities of all kinds.

127. At the metropolitan core, the central Johannesburg zone necessarily experiences the most wide-ranging employment effects of the Witwatersrand's economic development. Between 1951 and 1970, total

work opportunities rise from under 51% to as much as 58% of the regional aggregate; manufacturing, commercial and transport opportunities combined rise from 24% to 35%; and *both* Bantu and White opportunities increase, from under 31% to nearly 32%, and from under 18% to 23%, respectively. Furthermore, after 1960, commerce alone accounts for over 45% of the increase in all work opportunities taking place in this zone, and becomes the leading element in its export base.

128. In complete contrast, work opportunities on the peripheral West Rand fall from 12% to 10% of the regional total, because White opportunities remain stationary at 2% while Bantu opportunities fall from nearly 10% to 7%, in spite of an expansion in manufacturing, commercial and transport opportunities combined from 2% to 4%. The Far East Rand experiences an even greater fall, from 17% to 9% of all work opportunities, mainly because of a very severe contraction in the primary sector which has serious negative repercussions on both White and Bantu employment as a whole. But here, local work opportunities in manufacturing, commerce and transport in fact begin to grow faster than on the West Rand between 1960 and 1970.^{2 3} Nevertheless, only the more centrally located East Rand remains relatively resilient in the face of comprehensive structural economic changes. Here, total work opportunities continue to account for between 25% and 26% of the metropolitan aggregate, in spite of a contraction in the primary sector which, in terms of employment, is comparable to that of the Far East Rand's, and far more severe than the West Rand's. Especially because of a buoyant secondary sector, in which work opportunities rise from 7% to over 13% of the regional total, White opportunities increase from under 6% to over 7%, and Bantu opportunities decrease only from 19% to 17%.

^{2 3}See paragraph 117 above.

For *both* race groups, therefore, work opportunities on the East Rand now exceed those of the West Rand and the Far East Rand *combined*.

127. *It follows that, of particular importance for urbanization, the basic sectoral changes in the economy of the Witwatersrand have brought in their train centralizing employment effects, which result in the progressive creation of most new work opportunities in and around the metropolitan core. By 1970, the Johannesburg zone is alone generating many more work opportunities for both the White and Bantu employees than the whole of the remaining zones of the Witwatersrand, and it is alone increasing total work opportunities for Bantu as well as Whites. In the innovating spheres of manufacturing, commerce and transport - which together act as principal modernizing agents of urbanization in its secondary industrial phase - not only is Johannesburg presently creating one-third more work opportunities than the rest of the metropolitan region, but during the last two decades it has raised its share of these opportunities from one-quarter to over one-third of the entire metropolitan total.*

130. *It also follows that the resulting problems of urbanization now escalating in the Johannesburg zone are different both in kind and degree from those besetting even the East Rand. They are being progressively associated with the zone's fast-developing Bantu population, upon whose growing work opportunities the economic transformation of the Witwatersrand has exerted its most disturbing influence. Unlike the Bantu population of the other subsidiary zones, which finds its expanding work opportunities mainly in manufacturing and services, Johannesburg's is now being drawn into*

those commercial and financial activities which reach their peak of intensity in the city's central business district. Its Bantu population is thus fast following in the path already trodden by its White population, which increasingly finds its work opportunities in the Johannesburg zone and its residential opportunities outside that zone. Serious problems of congested traffic and transportation (especially at peak hours), of pressures upon limited space by competing land uses arising from growing needs of business, residence, communications and recreation, and of the increasingly costly provision of physical infrastructure and environmental services beyond the financial capacity of city government,²⁴ are being exacerbated. Moreover, as the section of the population now being drawn into these tertiary economic activities has lower standards of living and income, an increasing emphasis is being placed on public rather than private development of transport, land uses, housing, health, education and urban facilities of all kinds.

131. *The consequences for metropolitan planning of the current economic development of the Witwatersrand are, therefore, of a different kind and order in and around its metropolitan core than in its more peripheral areas. They are more complex, urgent and sophisticated on the centrally located East Rand, than on the West Rand or Far East Rand, where, in economic terms, urbanization has advanced less further into its secondary industrial phase. They are, perhaps, tending to accumulate faster on the Far East Rand than the West Rand, now that the former is beginning to emerge as an imminent growth point in the outer metropolitan zone. The developing physical reflection of*

²⁴ See Address by the Mayor of Johannesburg, Annual Conference, Institute of Town Clerks of Southern Africa, June 11, 1973.

these differential consequences, in terms of multiplying land uses and expanding networks of highways, water and power supplies and other engineering infrastructure, and the developing demographic reflection of such consequences in terms of growth and change in the racial composition and spatial distribution of the metropolitan population, will be described and analysed in Part Two of this Second Report: the results in terms of changes in the volumes and orientation of traffic, and in supplies of water and power, will be dealt with in the next chapter, prior to drawing general conclusions flowing from this present examination of trends in the Witwatersrand's space economy.

TABLE 25.

EMPLOYMENT BY ECONOMIC SECTORS : THE WITWATERSRAND, 1951, 1960 AND 1970

Race	Year	Primary Sector						Secondary Sector						Tertiary Sector						Total					
		Agriculture		Mining		Total		Manufacturing		Construction		Electricity, etc.		Total		Commerce*		Transport				Services		Total	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All Races	1951	14 580	1,50	300 210	30,00	314 790	32,40	183 100	18,84	42 040	4,33	10 480	1,08	235 620	24,25	131 390	13,51	40 870	4,21	248 910	25,62	421 170	43,35	971 580	100,00
	1960	32 130	3,09	253 850	24,46	285 980	25,55	221 930	21,38	50 920	4,91	11 590	1,12	284 440	27,41	153 220	14,76	42 210	4,07	272 000	26,21	467 430	45,04	1 037 850	100,00
	Change	17 550 ⁺	120,52	-46 360	-15,44	-28 810	-9,15	38 830	21,21	8 880	21,12	1 110	10,59	48 820	20,72	21 830	16,61	1 340	3,30	23 090	9,27	46 260	10,98	66 270	6,82
	1970	26 640	2,20	93 690	7,73	120 330	9,93	363 550	30,01	78 550	6,49	10 790	0,89	452 890	37,39	261 610	21,60	61 800	5,10	314 660	25,98	638 070	52,68	1 211 290	100,00
Change	-5 490	-17,09	-160 160	-63,09	-165 650	-57,92	141 620	63,81	27 630	54,26	-800	-6,90	168 450	59,22	108 390	70,74	19 590	46,41	42 660	15,68	170 640	36,51	173 440	16,71	
White	1951	2 370	0,88	35 130	13,08	37 500	13,96	74 990	27,92	16 750	6,24	2 190	0,82	93 930	34,98	63 620	23,69	24 540	9,14	48 960	18,23	137 120	51,06	268 550	100,00
	1960	3 370	1,10	27 160	8,84	30 530	9,94	84 080	27,37	18 660	6,07	3 270	1,06	106 010	34,50	80 130	26,08	27 450	8,94	63 110	20,54	170 690	55,56	307 230	100,00
	Change	1 000 ⁺	42,19	-7 970	-22,69	-6 970	-18,59	9 090	12,12	1 910	11,40	1 080	49,32	12 080	12,86	16 510	25,95	2 910	11,86	14 150	28,90	33 570	24,48	38 680	14,40
	1970	2 810	0,68	10 930	2,63	13 740	3,31	124 590	29,99	33 500	8,07	4 040	0,97	162 130	39,03	138 980	33,46	34 480	8,30	66 060	15,90	239 520	57,66	415 390	100,00
Change	-560	-16,62	-16 230	-59,76	-16 790	-55,00	42 030	50,91	14 840	79,53	770	23,55	57 640	55,16	58 850	73,44	7 030	25,61	2 950	4,67	68 830	40,32	108 160	35,20	
Bantu	1951	11 850	1,77	264 720	39,46	276 570	41,23	95 390	14,22	23 880	3,56	8 290	1,23	127 560	19,01	57 910	8,63	15 810	2,36	193 050	28,77	266 770	39,76	670 900	100,00
	1960	28 450	4,09	226 200	32,51	254 650	36,60	122 140	17,55	30 910	4,44	8 300	1,19	161 350	23,18	64 610	9,29	14 190	2,04	201 040	28,89	279 840	40,22	695 840	100,00
	Change	16 600 ⁺	140,08	-38 520	-14,55	-21 920	-7,93	26 750	28,04	7 030	29,44	10	0,12	33 790	26,49	6 700	11,57	-1 620	-10,25	7 990	4,14	13 070	4,90	24 940	3,72
	1970	23 630	3,20	82 480	11,17	106 110	14,37	211 840	28,70	41 960	5,68	6 700	0,91	260 500	35,29	107 190	14,52	24 320	3,29	240 130	32,53	371 640	50,34	738 250	100,00
Change	-4 820	-16,94	-143 720	-63,54	-148 540	-58,33	88 080	71,17	11 050	35,75	-1 600	-19,28	97 530	59,85	42 580	65,90	10 130	71,39	39 090	19,44	91 800	32,80	42 410	6,09	

* Including workers whose employment was "not adequately described" in the 1951 Census.

⁺ Inflated owing to the substitution of magisterial district statistics for municipal area statistics.

Sources: 1951 (unpublished), 1960 and 1970 Censuses of Employment;

1949/50, 1959/60 and 1967/68 Industrial Censuses;

1951, 1960 and 1970 Population Censuses;

Chamber of Mines;

Bantu Employment returns of the Witwatersrand Municipalities, 1972/73.

Note. Except in the case of manufacturing, these statistics refer to municipal areas in 1951 and to magisterial districts in 1960 and 1970 (except for Nigel, for which estimates have been made for the municipal area in 1970). The error involved is negligible except in the case of agriculture. As employment statistics for 1970 are available for economic regions only and omit small numbers of Coloured and Asian workers, estimates (except in the case of manufacturing) have been made for magisterial districts on the bases, where applicable, of municipal returns of Bantu employment, the 1960 Census (Population and Employment), the 1970 Population Census, and Chamber of Mines data. In the case of manufacturing, the totals for all races have been taken from the Industrial Censuses of 1949/50 (for 1951), of 1959/60 (for 1960) and of 1967/68 (for 1970), and are for magisterial districts; but the breakdown into White and Bantu employees has been made on the basis of the relevant Census of Employment. The Industrial Censuses invariably produce a higher number of manufacturing employees for the Witwatersrand than do the relevant Censuses of Employment, and their use may thus impart a bias in favour of manufacturing in this Table. On the other hand, the Industrial Censuses give employment by place of work, whereas the Censuses of Employment give employment by place of residence only. The former are thus more meaningful for the analysis undertaken in this chapter (as well as in Chapter 3, where they are also used instead of the Censuses of Employment). The apparently capricious trend in Bantu employment in transport between 1950 and 1960 can be neither explained nor eliminated using the data available.

Table 26.

EMPLOYMENT BY ECONOMIC SECTORS : INNER METROPOLITAN ZONE, 1951, 1960 AND 1970

Race	Year	Primary Sector						Secondary Sector						Tertiary Sector						Total					
		Agriculture		Mining		Total		Manufacturing		Construction		Electricity, etc.		Total		Commerce*		Transport				Services		Total	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All Races	1951	7 430	1,16	113 900	17,74	121 330	18,90	143 000	22,27	33 050	5,15	9 350	1,46	185 400	28,88	110 300	17,18	32 520	5,06	192 540	29,99	335 360	52,22	642 090	100,00
	1960	11 190	1,67	83 240	12,44	94 430	14,11	158 080	23,63	38 010	5,68	9 420	1,41	205 510	30,72	127 100	19,00	30 820	4,61	211 190	31,56	369 110	55,17	669 050	100,00
	Change	3 760 ⁺	50,61 ⁺	-30 660	-26,92	-26 900	-22,17	15 080	10,55	4 960	15,01	70	0,75	20 110	10,84	16 800	15,23	-1 700	-5,23	18 650	9,69	33 750	10,06	26 960	4,20
	1970	8 370	0,97	42 120	4,88	50 490	5,85	251 060	29,07	56 010	6,49	8 770	1,01	315 840	36,57	215 050	24,90	43 820	5,07	238 470	27,61	497 340	57,58	863 670	100,00
Change	-2 820	-25,20	-41 120	-49,40	-43 940	-36,22	92 980	58,82	18 000	47,36	-650	-6,90	110 330	53,69	87 950	69,20	13 000	42,18	27 280	12,92	128 230	34,74	194 620	29,09	
White	1951	1 460	0,72	13 970	6,86	15 430	7,58	61 290	30,10	13 120	6,44	1 840	0,91	76 250	37,45	52 940	26,00	19 490	9,57	39 500	19,40	111 930	54,97	203 610	100,00
	1960	1 460	0,64	8 900	3,90	10 360	4,54	64 560	28,27	14 270	6,25	2 770	1,21	81 600	35,73	67 170	29,41	19 950	8,74	49 270	21,58	136 390	59,73	228 350	100,00
	Change	-	-	-5 070	-36,29	-5 070	-32,86	3 270	5,34	1 150	8,77	930	50,54	5 350	7,02	14 230	26,88	460	2,31	9 770	24,73	24 460	21,85	24 740	12,15
	1970	1 290	0,42	5 360	1,75	6 650	2,17	82 860	26,98	24 970	8,13	3 060	0,99	110 890	36,11	113 600	36,99	25 730	8,38	50 220	16,35	189 550	61,72	307 090	100,00
Change	-170	-11,64	-3 540	-39,78	-3 710	-35,81	17 960	27,67	10 700	74,98	290	10,47	28 950	35,33	46 430	69,12	5 780	28,97	950	1,93	53 160	38,98	78 740	34,48	
Bantu	1951	5 860	1,43	99 750	24,22	105 610	25,65	70 320	17,08	18 600	4,51	7 500	1,82	96 420	23,41	49 330	11,98	12 620	3,07	147 800	35,89	209 750	50,94	411 780	100,00
	1960	9 620	2,33	74 130	18,00	83 750	20,33	79 600	19,32	22 690	5,51	6 640	1,61	108 930	26,44	52 800	12,82	10 440	2,54	155 990	37,87	219 230	53,23	411 910	100,00
	Change	3 760 ⁺	64,16 ⁺	-25 620	-25,68	-21 860	-20,70	9 280	13,20	4 090	21,99	-860	-11,47	12 510	12,97	3 470	7,03	-2 190	-17,34	8 190	5,54	9 480	4,52	130	0,03
	1970	6 970	1,37	36 600	7,16	43 570	8,53	141 450	27,68	29 640	5,80	5 540	1,08	176 630	34,56	89 280	17,47	16 790	3,29	184 750	36,15	290 820	56,91	511 020	100,00
Change	-2 650	-27,55	-37 530	-50,63	-40 180	-47,98	61 480	76,88	6 950	30,63	-1 100	-16,57	67 330	61,60	36 480	69,09	6 350	60,82	28 760	18,44	71 590	32,66	99 110	24,06	

* Including workers whose employment was "not adequately described" in the 1951 Census.

⁺ Inflated owing to the substitution of magisterial district statistics for municipal area statistics.

Sources: see Table 25.

Note: For the method of compilation of this table, see the notes to Table 25. In the present case, because of irreconcilable census statistics, White and Bantu workers in manufacturing in 1960 have been estimated on the basis of proportionate increases between the 1950 and 1960 Censuses of Employment. The totals for all races, however, are those of the 1949/50 and 1959/60 Industrial Censuses. This procedure has eliminated an apparently capricious negative trend in White employment in manufacturing between 1951 and 1960 (all other trends in this sub-sector being positive). The remaining apparently capricious trend in Bantu employment in transport between 1951 and 1960 can be neither explained nor eliminated using the data available. No allowance has been made in this table for the net movement of primarily tertiary sector workers to the Inner Metropolitan Zone from the Outer Zone, as journey-to-work data have never been obtained by the Employment Censuses.

TABLE 27.

EMPLOYMENT BY ECONOMIC SECTORS : OUTER METROPOLITAN ZONE, 1951, 1960 AND 1970

Race	Year	Primary Sector						Secondary Sector						Tertiary Sector						Total					
		Agriculture		Mining		Total		Manufacturing		Construction		Electricity etc.		Total		Commerce*		Transport				Services		Total	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All Races	1951	7 150	2,17	186 310	56,55	193 460	58,72	40 100	12,17	8 990	2,73	1 130	0,34	50 220	15,24	21 090	6,40	8 350	2,53	56 370	17,11	85 810	26,04	329 490	100,00
	1960	20 940	5,68	170 610	46,26	191 550	51,94	63 850	17,31	12 910	3,50	2 170	0,59	78 930	21,40	26 120	7,08	11 390	3,09	60 810	16,49	98 320	26,66	368 800	100,00
	Change	13 790 ⁺	192,87 ⁺	-15 700	-8,43	-1 910	-0,99	23 750	59,23	3 920	43,60	1 040	92,04	28 710	57,17	5 030	23,85	3 040	36,41	4 440	7,88	12 510	14,58	39 310	11,93
	1970	18 270	5,25	51 570	14,84	69 840	20,09	112 490	32,36	22 540	6,49	2 020	0,58	137 050	39,43	46 560	13,39	17 980	5,17	76 190	21,92	140 730	40,48	347 620	100,00
Change	-2 670	-12,75	-119 040	-69,77	-121 710	-63,54	48 640	76,18	9 630	74,59	-150	-6,91	58 120	73,63	20 440	78,25	6 590	57,86	15 380	25,29	42 410	43,13	-21 180	-5,74	
White	1951	910	1,40	21 160	32,58	22 070	33,98	13 700	21,10	3 630	5,59	350	0,54	17 680	27,23	10 680	16,44	5 050	7,78	9 460	14,57	25 190	38,79	64 940	100,00
	1960	1 910	2,42	18 260	21,15	20 170	25,57	19 520	24,75	4 390	5,57	500	0,63	24 410	30,95	12 960	16,43	7 500	9,51	13 840	17,54	34 300	43,48	78 880	100,00
	Change	1 000 ⁺	109,89 ⁺	-2 900	-13,71	-1 900	-8,61	5 820	42,48	760	20,94	150	42,86	6 730	38,07	2 280	21,35	2 450	48,51	4 380	46,30	9 110	36,17	13 940	21,47
	1970	1 520	1,41	5 570	5,14	7 090	6,55	41 730	38,53	8 530	7,88	980	0,90	51 240	47,31	25 380	23,43	8 750	8,08	15 840	14,63	49 970	46,14	108 300	100,00
Change	-390	-39,00	-12 690	-69,50	-13 080	-64,85	24 070	136,30	4 140	94,31	480	96,00	28 690	127,23	12 420	95,83	1 250	16,67	2 000	14,45	15 670	45,69	31 280	40,61	
Bantu	1951	5 990	2,31	164 970	63,67	170 960	65,98	25 070	9,68	5 280	2,04	790	0,30	31 140	12,02	8 580	3,31	3 190	1,23	45 250	17,46	57 020	22,00	259 120	100,00
	1960	18 830	6,63	152 070	53,56	170 900	60,19	42 540	14,98	8 220	2,90	1 660	0,58	52 420	18,46	11 810	4,16	3 750	1,32	45 050	15,87	60 610	21,35	283 930	100,00
	Change	12 840 ⁺	214,36	-12 900	-7,82	-60	-0,04	17 470	69,68	2 940	55,68	870	110,13	21 280	68,34	3 230	37,65	560	17,55	-200	-0,44	3 590	6,30	24 810	9,57
	1970	16 660	7,33	45 880	20,19	62 540	27,52	70 390	30,98	12 320	5,42	1 160	0,51	83 870	36,91	17 910	7,88	7 530	3,32	55 380	24,37	80 820	35,57	227 230	100,00
Change	-2 170	-11,52	-106 190	-69,83	-108 360	-63,41	26 600	60,74	4 100	49,88	-500	-30,12	30 200	56,27	6 100	51,65	3 780	100,80	10 330	22,93	20 210	33,34	-56 700	-19,97	

* Including workers whose employment was "not adequately described" in the 1951 Census.

⁺ Inflated owing to the substitution of magisterial district statistics for municipal area statistics.

Sources: see Table 25.

NOTE: For the method of compilation of this table, see the note to Table 25, with the proviso that in the cases of Randfontein and Krugersdorp municipal areas in 1951, the statistics of manufacturing employees are those of the 1951 Census of Employment. This proviso also applies to Table 25, and eliminated apparently capricious negative trends in White employment in manufacturing between 1951 and 1960 on the West Rand outside Roodoort. For the breakdown into White and Bantu workers in manufacturing in all other cases, see the note to Table 26, with the proviso that here the breakdown in 1960 has also been weighted by data from the 1959/60 Industrial Census. The remaining apparently capricious trend in Bantu employment in services between 1951 and 1960 can be neither explained nor eliminated using the data available. No allowance has been made in this table for the net movement of primarily tertiary sector workers from the Outer Metropolitan Zone to the Inner Zone, as journey-to-work data have never been obtained by the Employment Censuses.

TABLE 28.

EMPLOYMENT BY ECONOMIC SECTORS : JOHANNESBURG SUBSIDIARY ZONE, 1951, 1960 AND 1970

(comprising Johannesburg magisterial district and the municipalities of Edenvale and Bedfordview)

Race	Year	Primary Sector						Secondary Sector						Tertiary Sector						Total					
		Agriculture		Mining		Total		Manufacturing		Construction		Electricity etc.		Total		Commerce*		Transport				Services		Total	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All Races	1951	4 040	0,84	52 400	10,90	56 440	11,74	105 230	21,90	26 870	5,59	8 050	1,68	140 150	29,17	99 240	20,65	22 490	4,68	162 230	33,76	283 960	59,09	480 550	100,00
	1960	5 620	1,12	37 940	7,56	43 560	8,68	119 910	23,89	27 950	5,57	6 960	1,39	154 820	30,85	109 300	21,78	21 850	4,35	172 380	34,34	303 530	60,47	501 910	100,00
	Change	1 580*	39,11*	-14 460	-27,60	-12 880	-22,82	14 680	13,95	1 080	4,02	-1 090	-13,54	14 670	10,47	10 060	10,14	-640	-2,85	10 150	6,26	19 570	6,89	21 360	4,44
	1970	4 640	0,71	19 780	3,02	24 420	3,73	179 020	27,34	44 090	6,73	5 690	0,87	228 800	34,94	178 900	27,32	27 910	4,26	194 860	29,75	401 670	61,33	654 890	100,00
Change	-980	-17,44	-18 160	-47,87	-19 140	-43,94	59 110	49,30	16 140	57,75	-1 270	-18,25	73 980	47,78	69 600	63,68	6 060	27,73	22 480	13,04	98 104	32,32	152 980	30,48	
White	1951	990	0,63	8 690	5,51	9 680	6,14	47 560	30,17	10 600	6,73	1 370	0,87	59 530	37,77	41 390	26,26	13 060	8,28	33 970	21,55	88 420	56,09	157 630	100,00
	1960	900	0,51	4 850	2,73	5 750	3,24	49 690	27,98	10 850	6,11	2 030	1,14	62 570	35,23	56 310	31,71	12 740	7,18	40 210	22,64	109 260	61,53	177 580	100,00
	Change	-90	-9,09	-3 840	-44,19	-3 930	-40,60	2 130	4,48	250	2,36	660	48,18	3 040	5,11	14 920	36,05	-320	-2,45	6 240	18,37	20 840	23,57	19 950	12,66
	1970	800	0,35	3 510	1,54	4 310	1,89	58 150	25,52	20 470	8,98	2 200	0,97	80 820	35,47	90 230	39,60	14 020	6,16	38 470	16,88	142 720	62,64	227 850	100,00
Change	-100	-11,11	-1 340	-27,63	-1 440	-25,04	8 460	17,03	9 620	88,66	170	8,37	18 250	29,17	33 920	60,24	1 280	10,05	-1 740	-4,33	33 460	30,63	50 270	28,31	
Bantu	1951	2 980	1,00	43 590	14,63	46 570	15,63	51 230	17,19	15 120	5,07	6 680	2,24	73 030	24,50	45 630	15,31	9 080	3,05	123 730	41,51	178 440	59,87	298 040	100,00
	1960	4 650	1,56	32 990	11,08	37 640	12,64	56 650	19,02	16 260	5,46	4 930	1,66	77 840	26,14	46 570	15,63	8 720	2,93	127 050	42,66	182 340	61,22	297 820	100,00
	Change	1 670*	56,04*	-10 600	-24,32	-8 930	-19,18	5 420	10,58	1 140	7,54	-1 750	-26,20	4 810	6,59	940	2,06	-360	-3,96	3 320	2,68	3 900	2,19	-220	-0,07
	1970	3 750	0,98	16 220	4,23	19 970	5,21	97 300	25,40	22 030	5,75	3 460	0,90	122 790	32,05	76 290	19,92	12 760	3,33	151 250	39,49	240 300	62,74	383 060	100,00
Change	-900	-19,35	-16 770	-50,83	-17 670	-46,94	40 650	71,76	5 770	35,49	-1 470	-29,82	44 950	57,75	29 720	63,82	4 040	46,33	24 200	19,05	57 960	31,79	85 240	28,62	

* Including workers whose employment was "not adequately described" in the 1951 Census.

* Inflated owing to the substitution of magisterial district statistics for municipal area statistics.

Sources: see Table 25.

Note: For the method of compilation of this table, see the note to Table 25. For the breakdown into White and Bantu workers in manufacturing, see the note to Table 26. No allowance has been made in this table for the substantial net movement of mainly tertiary sector White workers into the Johannesburg zone from all other subsidiary zones, as journey-to-work data have never been obtained by the Employment Censuses. Tertiary sector employment in particular in the Johannesburg zone is thus considerably under-represented in this table, and by probably some 42 000 White workers in 1970.

TABLE 29.

EMPLOYMENT BY ECONOMIC SECTORS : WEST RAND SUBSIDIARY ZONE, 1951, 1960 AND 1970

(comprising the magisterial districts of Krugersdorp, Randfontein and Roodspoor).

Race	Year	Primary Sector						Secondary Sector						Tertiary Sector						Total					
		Agriculture		Mining		Total		Manufacturing		Construction		Electricity etc.		Total		Commerce*		Transport				Services		Total	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All Races	1951	1 590	1,30	75 980	61,98	77 570	63,28	9 740	7,95	3 400	2,77	400	0,33	13 540	11,05	7 570	6,18	3 780	3,08	20 120	16,41	31 470	25,67	122 580	100,00
	1960	12 480	7,49	89 430	53,67	101 910	61,16	12 870	7,72	5 550	3,33	980	0,59	19 400	11,64	11 940	7,17	5 220	3,13	28 170	16,90	45 330	27,20	166 640	100,00
	Change	10 890 [†]	684,90	13 450	17,70	24 340	31,38 [†]	3 130	32,14	2 150	63,24	580	145,00	5 860	43,28	4 370	57,73	1 440	38,10	8 050	40,01	13 860	44,04	44 060	35,94
	1970	12 910	9,12	27 890	19,71	40 800	28,83	22 270	15,73	8 700	6,15	960	0,68	31 930	22,56	24 950	17,63	8 530	6,03	35 320	24,95	68 800	48,61	141 530	100,00
	Change	430	3,45	-61 540	-68,81	-61 110	-59,96	9 400	73,04	3 150	56,76	-20	-2,04	12 530	64,59	16 010	134,09	3 310	63,41	7 150	25,38	23 470	51,78	-25 110	-15,07
White	1951	280	1,09	7 830	30,44	8 110	31,53	3 950	15,36	1 470	5,71	120	0,47	5 540	21,54	4 710	18,31	3 160	12,29	4 200	16,33	12 070	46,93	25 720	100,00
	1960	1 290	3,49	9 140	24,69	10 430	28,18	5 060	13,67	2 280	6,16	220	0,59	7 560	20,42	7 460	20,15	4 450	12,02	7 120	19,23	19 030	51,40	37 020	100,00
	Change	1 010 [†]	360,71 [†]	1 310	16,73	2 320 [†]	28,61 [†]	1 110	28,10	810	55,10	100	83,33	2 020	36,46	2 750	58,39	1 290	40,82	2 920	69,52	6 960	57,66	11 300	43,93
	1970	1 080	2,18	2 900	5,88	3 980	8,06	8 670	17,57	3 320	6,73	420	0,85	12 410	25,15	16 560	33,56	6 900	13,98	9 500	19,25	32 960	66,79	49 350	100,00
	Change	-210	-16,28	-6 240	-62,27	-6 450	-61,84	3 610	71,34	1 040	45,61	200	90,91	4 850	64,15	9 100	121,98	2 450	55,06	2 380	33,43	13 930	73,20	12 330	33,31
Bantu	1951	1 270	1,35	68 070	72,44	69 340	73,79	4 520	4,81	1 780	1,89	280	0,30	6 580	7,00	2 150	2,29	570	0,61	15 330	16,31	18 050	19,21	93 970	100,00
	1960	11 050	8,66	80 190	62,89	91 240	71,55	7 550	5,92	3 100	2,43	760	0,60	11 410	8,95	3 840	3,01	710	0,56	20 310	15,93	24 860	19,50	127 510	100,00
	Change	9 780 [†]	770,08	12 120	17,81	21 900	31,58	3 030	67,04	1 320	74,16	480	171,43	4 820	73,25	1 690	78,60	140	24,56	4 980	32,49	6 810	37,73	33 540	35,69
	1970	11 770	13,24	24 950	28,06	36 720	41,30	12 620	14,19	5 050	5,68	540	0,61	18 210	20,48	7 510	8,45	1 470	1,65	25 000	28,12	33 980	38,22	88 910	100,00
	Change	720	6,52	-55 240	-68,89	-54 520	-59,75	5 070	67,15	1 950	62,90	-220	-28,95	6 800	59,60	3 670	95,57	760	107,04	4 690	23,09	9 120	36,69	-38 600	-30,27

* Including workers whose employment was "not adequately described" in the 1951 Census.

† Inflated owing to the substitution of magisterial district statistics for municipal statistics.

Sources: see Table 25.

Note: For the method of compilation of this table, see the notes to Tables 25 and 27, with particular reference to manufacturing employment in Randfontein and Krugersdorp in 1951. For the breakdown into White and Bantu workers in manufacturing, see the notes to Tables 26 and 27.

No allowance has been made in this table for the substantial net movement of mainly tertiary sector White workers from the West Rand zone into the Johannesburg subsidiary zone, as journey-to-work data have never been obtained by the Employment Censuses. Tertiary sector employment in particular in the West Rand zone is thus considerably inflated in this table, and probably by some 18 000 White workers in 1970.

TABLE 30.

EMPLOYMENT BY ECONOMIC SECTORS : EAST RAND SUBSIDIARY ZONE, 1951, 1960 AND 1970
(comprising the magisterial districts of Alberton, Benoni, Boksburg, Brakpan, Germiston and Kempton Park, less the municipalities of Edenvale and Bedfordview)

Race	Year	Primary Sector						Secondary Sector						Tertiary Sector								Total			
		Agriculture		Mining		Total		Manufacturing		Construction		Electricity etc.		Total		Commerce*		Transport		Services				Total	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All Races	1951	7 410	2,95	97 860	37,92	105 470	40,87	55 800	21,62	9 830	3,81	1 880	0,73	67 510	26,16	19 640	7,61	13 210	5,12	52 240	20,24	85 090	32,97	258 070	100,00
	1960	9 100	3,45	67 210	25,46	76 310	28,91	73 710	27,92	15 310	5,80	3 060	1,16	92 080	34,88	25 180	9,54	13 210	5,00	57 190	21,67	95 580	36,21	263 970	100,00
	Change	1 490*	19,58*	-30 650	-31,32	-29 160	-27,65	17 910	32,10	5 480	55,75	1 180	62,77	24 570	36,39	5 540	28,21	-	-	4 950	9,48	10 490	12,33	5 900	2,29
	1970	6 960	2,11	27 350	8,28	34 310	10,39	136 030	41,19	22 460	6,80	3 690	1,12	162 180	49,11	46 500	14,08	21 350	6,47	65 890	19,95	133 740	40,50	330 230	100,00
Change	-2 140	-23,52	-39 860	-59,31	-42 000	-55,04	62 320	84,55	7 150	46,70	630	20,59	70 100	76,13	21 320	84,67	8 140	61,62	8 700	15,21	38 160	46,82	66 260	25,10	
White	1951	940	1,48	11 990	18,85	12 930	20,33	19 850	31,20	4 100	6,45	620	0,97	24 570	38,62	10 270	16,15	7 440	11,70	8 400	13,20	26 110	41,05	63 610	100,00
	1960	810	1,09	7 350	9,91	8 160	11,00	24 950	33,64	4 890	6,59	920	1,24	30 760	41,47	13 480	18,18	9 130	12,31	12 640	17,04	35 250	47,53	74 170	100,00
	Change	-130	-13,83	-4 640	-38,70	-4 770	-36,89	5 100	25,69	790	19,27	300	48,39	6 190	25,19	3 210	31,26	1 690	22,72	4 240	50,48	9 140	35,01	10 560	16,60
	1970	650	0,56	2 720	2,35	3 370	2,91	48 210	41,69	8 430	7,29	1 290	1,12	57 930	50,10	27 250	23,57	12 690	11,16	14 170	12,26	54 110	46,99	115 410	100,00
Change	-160	-19,75	-4 630	-62,99	-4 790	-58,70	23 260	93,23	3 540	73,29	370	40,22	27 170	88,33	13 770	102,15	3 560	41,40	1 530	12,10	19 080	54,13	41 240	55,90	
Bantu	1951	5 700	3,08	85 730	46,33	91 430	49,41	31 200	16,86	5 380	2,91	1 270	0,69	37 850	20,46	7 780	4,20	5 680	3,07	42 300	22,86	55 760	30,13	185 040	100,00
	1960	8 200	4,43	59 600	32,21	67 800	36,64	47 550	25,69	10 130	5,47	2 130	1,15	59 810	32,31	10 630	5,74	3 970	2,15	42 860	23,16	57 460	31,05	185 070	100,00
	Change	2 500*	43,86*	-26 130	-30,48	-23 630	-25,84	16 350	52,40	4 750	88,29	860	67,72	21 960	58,02	2 850	36,63	-1 710	-30,11	560	1,32	1 700	3,05	30	0,02
	1970	6 290	3,03	24 490	11,79	30 780	14,82	85 680	41,25	12 940	6,23	2 390	1,15	101 010	48,63	17 830	8,58	8 420	4,06	49 650	23,91	75 900	36,55	207 690	100,00
Change	-1 910	-23,29	-35 110	-58,91	-37 020	-54,60	18 130	80,19	2 810	27,74	260	12,21	41 200	68,88	7 200	67,73	4 450	112,09	6 790	15,84	18 440	32,09	22 620	12,22	

* Including workers whose employment was "not adequately described" in the 1951 Census.

* Inflated owing to the substitution of magisterial district statistics for municipal area statistics.

Note: For the method of compilation of this table, see the note to Table 25. For the breakdown into White and Bantu workers in manufacturing, see the note to Table 26. No allowance has been made in this table for the substantial net movement of mainly tertiary sector White workers into the Johannesburg zone from the East Rand zone, as journey-to-work data have never been obtained by the Employment Censuses. Tertiary sector employment in particular in the East Rand zone is thus considerably inflated in this table, and probably by some 21 000 White workers in 1970.

Sources: see Table 25.

TABLE 31.

EMPLOYMENT BY ECONOMIC SECTORS : FAR EAST RAND SUBSIDIARY ZONE, 1951, 1960 AND 1970
(comprising the magisterial districts of Brakpan and Springs, and the municipality of Nigel)

Race	Year	Primary Sector						Secondary Sector						Tertiary Sector						Total					
		Agriculture		Mining		Total		Manufacturing		Construction		Electricity & tc.		Total		Commerce*		Transport				Services		Total	
		Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
All Races	1951	2 210	1,33	111 570	66,91	113 780	68,24	15 060	9,03	3 700	2,22	850	0,51	19 610	11,76	8 340	5,00	2 340	1,40	22 670	13,60	33 350	20,00	166 740	100,00
	1960	6 090	4,17	84 330	57,82	90 420	61,99	17 520	12,01	3 190	2,19	1 120	0,77	21 830	14,97	9 780	6,71	3 150	2,16	20 670	14,17	33 600	23,04	145 850	100,00
	Change	3 880*	175,57*	-27 240	-24,42	-23 360	-20,53	2 460	16,33	-510	-13,78	270	31,76	2 220	11,32	1 440	17,27	810	34,62	-2 000	-8,82	250	0,75	-20 890	-12,53
	1970	4 000	3,50	28 980	25,34	32 980	28,84	30 170	26,39	5 360	4,69	860	0,75	36 390	31,83	15 600	13,64	6 230	5,45	23 150	20,24	44 980	39,33	114 350	100,00
Change	-2 090	-34,32	-55 350	-65,63	-57 440	-63,53	12 650	72,20	2 170	68,03	-260	-30,59	14 560	66,70	5 820	59,51	3 080	97,78	2 480	12,00	11 380	23,87	-31 500	-21,60	
White	1951	290	1,06	10 980	39,94	11 270	41,00	5 220	18,99	1 230	4,47	200	0,73	6 650	24,19	4 280	15,57	1 660	6,04	3 630	13,20	9 570	34,81	27 490	100,00
	1960	490	1,81	8 470	31,25	8 960	33,06	5 300	19,56	1 180	4,35	230	0,85	6 710	24,76	4 620	17,05	2 050	7,56	4 760	17,57	11 430	42,18	27 100	100,00
	Change	200*	68,97*	-2 510	-22,86	-2 310	-20,50	80	1,53	-50	-4,07	30	15,00	60	0,90	340	7,94	390	23,49	1 130	31,13	1 860	19,44	-390	-1,42
	1970	370	1,14	2 900	8,93	3 270	10,07	10 990	33,85	2 160	6,65	300	0,93	13 450	41,43	8 050	24,79	2 890	8,90	4 810	14,81	15 750	48,50	32 470	100,00
Change	-120	-24,49	-5 570	-65,76	-5 690	-63,50	5 690	107,36	980	83,05	70	30,43	6 740	100,44	3 430	7,14	840	40,98	50	1,05	4 320	37,80	5 370	19,82	
Bantu	1951	1 900	1,37	100 530	72,82	102 430	74,19	9 560	6,93	2 380	1,72	650	0,47	12 590	9,12	3 740	2,71	660	0,48	18 640	13,50	23 040	16,69	138 060	100,00
	1960	5 580	4,77	75 810	64,72	81 390	69,49	11 530	9,84	1 930	1,65	890	0,76	14 350	12,25	4 800	4,10	1 090	0,93	15 500	13,23	21 390	18,26	117 130	100,00
	Change	3 680*	193,68*	-24 720	-24,59	-21 040	-20,54	1 970	20,61	-450	-18,91	240	3,08	1 760	13,98	1 060	28,34	430	6,52	-3 140	-16,85	-1 650	-7,16	-20 930	-15,16
	1970	3 600	4,51	26 000	32,57	29 600	37,08	18 680	23,40	3 110	3,90	550	0,69	22 340	27,99	6 780	8,49	3 280	4,11	17 820	22,33	27 880	34,93	79 820	100,00
Change	-1 980	-35,48	-49 810	-65,70	-51 790	-63,63	7 150	74,79	1 180	61,14	-340	-38,20	7 990	55,68	1 980	41,25	2 190	200,92	2 320	14,97	6 490	30,34	-37 310	-31,85	

* Including workers whose employment was "not adequately described" in the 1951 Census.

* Inflated owing to the substitution of magisterial district statistics for municipal area statistics.

Note: For the method of compilation of this table, see the note to Table 25. For the breakdown into White and Bantu workers in manufacturing, see the note to Table 26. No allowance has been made in this table for the net movement of mainly tertiary sector White workers into the Johannesburg zone from the Far East Rand zone, as journey-to-work data have never been obtained by the Employment Censuses. Tertiary sector employment in particular in the Far East Rand zone is thus inflated in this table, and probably by some 4 000 White workers in 1970.

TABLE 32.

PROPORTIONATE TRENDS IN EMPLOYMENT BY ETHNIC GROUPS AND ECONOMIC SECTORS : INNER ZONE, OUTER ZONE AND THE WITWATERSRAND,
1951 1960 AND 1970

Region and Group	Primary Sector			Secondary Sector			Tertiary Sector												Total			
							Total			Commerce			Transport			Services						
	1951 %	1960 %	1970 %	1951 %	1960 %	1970 %	1951 %	1960 %	1970 %	1951 %	1960 %	1970 %	1951 %	1960 %	1970 %	1951 %	1960 %	1970 %	1951 %	1960 %	1970 %	
Inner Zone																						
White	12,7	11,0	13,2	41,1	39,7	35,1	33,4	37,0	38,1	48,0	52,8	52,8	59,9	64,7	58,7	20,5	23,3	21,1	31,7	34,1	35,6	
Bantu	87,0	88,7	86,3	52,0	53,0	55,9	62,5	59,4	58,5	44,7	41,5	41,5	38,8	33,9	38,3	76,8	73,9	77,5	64,1	61,6	59,2	
All Races	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	
Outer Zone																						
White	11,4	10,5	10,2	35,2	30,9	37,4	29,4	34,9	35,5	50,6	49,6	54,5	60,5	65,8	48,7	16,8	22,8	20,8	19,7	21,4	31,2	
Bantu	88,4	89,2	89,5	62,0	66,4	61,2	66,4	61,6	57,4	40,7	45,2	38,5	38,2	32,9	41,9	80,3	74,1	72,7	78,6	77,0	65,4	
All Races	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	
Witwatersrand																						
White	11,9	10,7	11,4	39,9	37,3	35,8	32,6	36,5	37,7	48,4	52,3	53,1	60,0	65,0	57,8	19,7	23,2	21,0	27,6	29,6	34,4	
Bantu	87,9	89,0	88,2	54,1	56,7	57,5	63,3	59,9	58,3	44,1	42,2	41,0	38,7	33,6	40,2	77,6	73,9	76,3	69,1	67,0	61,0	
All Races	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	
West Rand																						
White	10,5	10,2	9,8	40,9	39,0	38,9	38,4	42,0	47,9	62,2	62,5	66,4	83,6	85,2	80,9	20,9	25,3	26,9	21,0	22,2	34,9	
Bantu	89,4	89,5	90,0	48,6	58,8	57,0	57,4	54,8	49,4	28,4	32,2	30,1	15,1	13,6	17,2	76,2	72,1	70,8	76,7	76,5	62,8	
All Races	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	
Johannesburg																						
White	17,2	13,2	17,6	42,5	40,4	35,3	31,1	36,0	35,5	41,7	51,5	50,4	58,1	58,3	50,2	20,9	23,3	19,7	32,8	35,4	34,8	
Bantu	82,5	86,4	81,8	52,1	50,3	53,7	62,8	60,1	59,8	46,0	42,6	42,6	40,4	39,9	45,7	76,3	73,7	77,6	62,0	59,3	58,5	
All Races	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	
East Rand																						
White	12,3	10,7	9,8	36,4	33,4	35,7	30,7	36,9	40,6	52,3	53,5	58,6	56,3	69,1	59,4	16,1	22,1	21,5	24,6	28,1	34,9	
Bantu	86,7	88,8	89,7	56,1	65,0	62,3	65,5	60,1	56,9	39,6	42,2	38,3	43,0	30,1	39,4	81,0	74,9	75,4	71,7	70,1	62,9	
All Races	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	
Far East Rand																						
White	9,9	9,9	9,9	33,9	30,7	37,0	28,7	34,0	35,0	51,3	47,2	51,6	70,9	65,1	46,4	16,0	23,0	20,8	16,5	18,6	28,4	
Bantu	90,0	90,0	89,8	64,2	65,7	61,4	69,1	63,7	62,0	44,8	49,1	43,5	28,2	34,6	52,6	82,2	75,0	77,0	82,8	80,3	69,8	
All Races	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	

Sources: Tables 25 to 30.

TABLE 33.

ESTIMATED WORK OPPORTUNITIES BY ZONES AND SECTORS, 1951 AND 1970
(as percentages of all work opportunities on the Witwatersrand)

Year	Primary Sector	Secondary Sector	Tertiary Sector	Total	Manufacturing, Commerce and Transport
	%	%	%	%	%
Inner Zone					
All Races					
1951	12,5	19,1	36,1	67,7	31,0
1970	4,2	26,3	42,1	72,6	42,8
Whites					
1951	1,6	7,8	13,1	22,5	15,2
1970	0,5	9,4	16,7	26,6	19,1
Bantu					
1951	10,9	9,9	21,6	42,4	13,6
1970	3,6	14,6	24,0	42,2	20,4
Outer Zone					
All Races					
1951	19,9	5,2	7,2	32,3	5,6
1970	5,7	11,1	10,6	27,4	13,9
Whites					
1951	2,3	1,8	1,0	5,1	1,5
1970	0,6	4,0	3,1	7,7	5,6
Bantu					
1951	17,6	3,2	5,9	26,7	3,8
1970	5,1	6,9	6,7	18,7	7,9
Johannesburg					
All Races					
1951	5,8	14,4	30,5	50,7	24,2
1970	2,0	19,4	36,6	58,0	34,9
Whites					
1951	1,0	6,1	10,4	17,5	11,3
1970	0,4	7,2	15,2	22,8	16,4
Bantu					
1951	4,8	7,5	18,4	30,7	10,9
1970	1,6	10,2	19,8	31,6	15,4
West Rand					
All Races					
1951	8,0	1,4	2,9	12,3	2,0
1970	3,4	2,5	4,2	10,1	4,0
Whites					
1951	0,8	0,6	0,9	2,3	1,0
1970	0,3	0,9	1,2	2,4	1,4
Bantu					
1951	7,1	0,7	1,9	9,7	0,7
1970	3,0	1,5	2,8	7,3	1,8
East Rand					
All Races					
1951	10,9	6,9	7,8	25,6	8,5
1970	2,8	13,1	9,1	25,0	15,1
Whites					
1951	1,3	2,5	1,7	5,5	3,2
1970	0,3	4,4	2,5	7,2	5,5
Bantu					
1951	9,4	3,9	5,7	19,0	4,6
1970	2,5	8,3	6,3	17,1	9,2
Far East Rand					
All Races					
1951	11,7	2,0	3,4	17,1	2,6
1970	2,7	2,9	3,4	9,0	4,0
Whites					
1951	1,1	0,7	1,0	2,8	1,1
1970	0,3	1,0	1,0	2,3	1,5
Bantu					
1951	10,5	1,3	2,4	14,2	1,4
1970	2,4	1,9	2,3	6,6	2,4

N.B. Brakpan magisterial district is included in both the East Rand and the Far East Rand.

Sources: Tables 10 to 17 and 25 to 30 above.

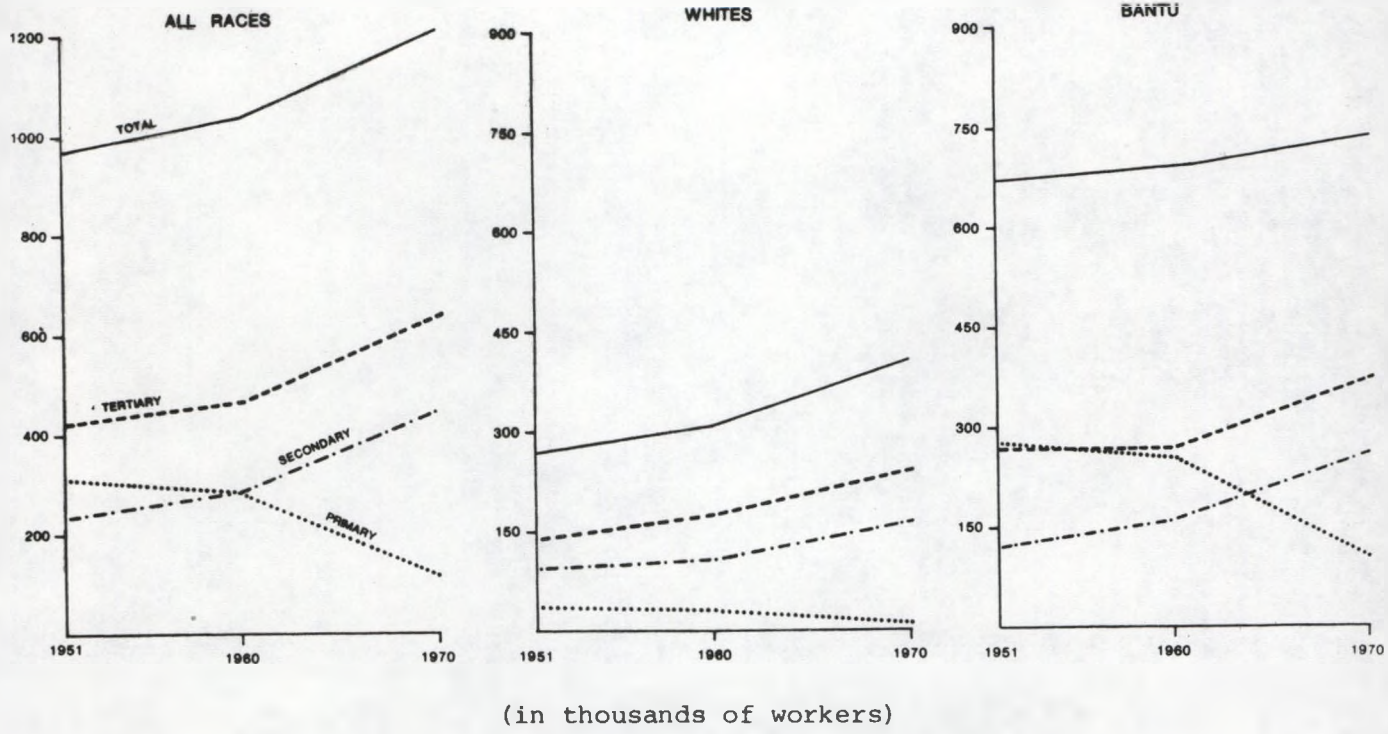
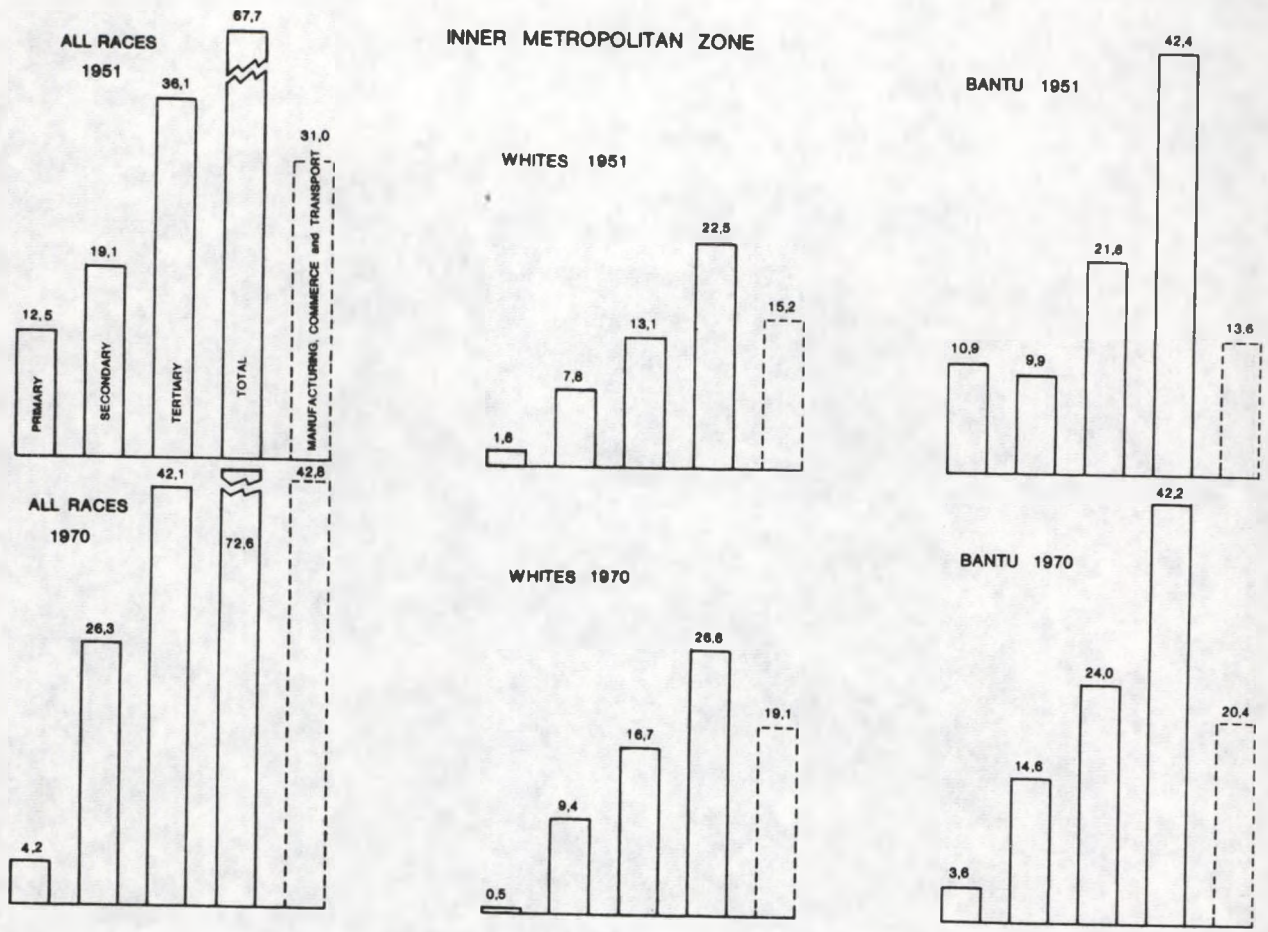


Figure 10.

Employment by Sectors: The Witwatersrand, 1951, 1960 and 1970

(Source: Table 25)

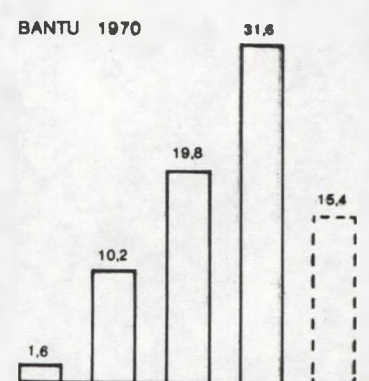
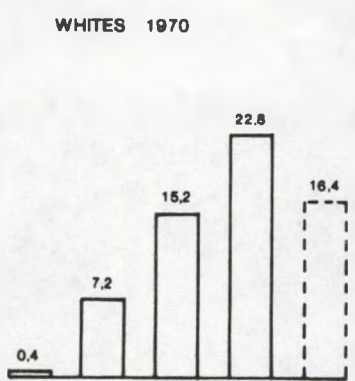
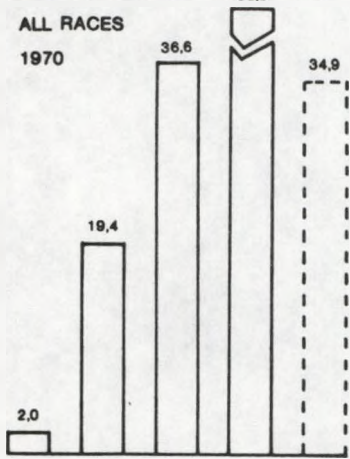
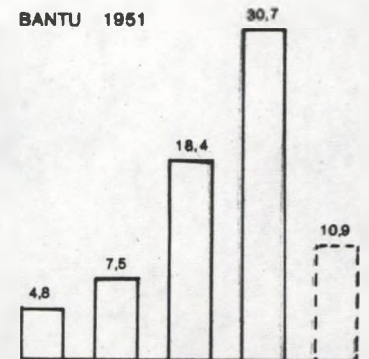
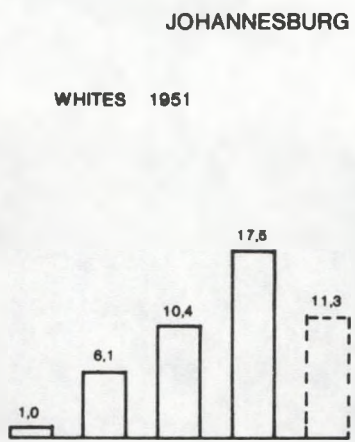
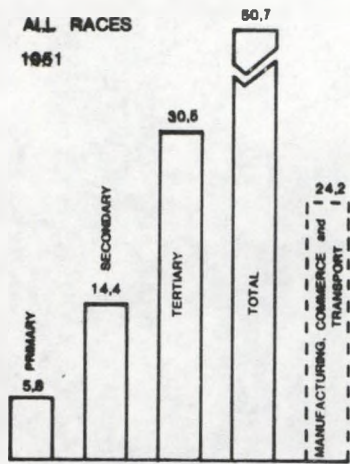


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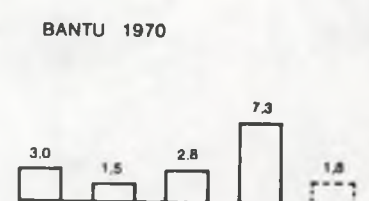
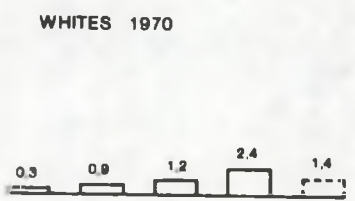
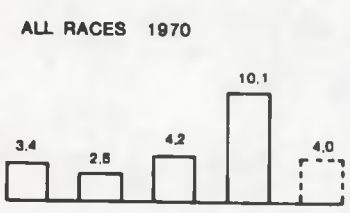
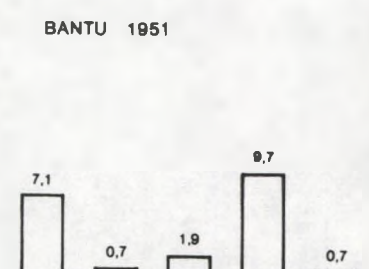
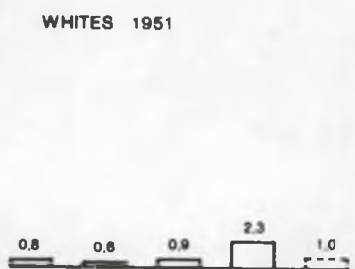
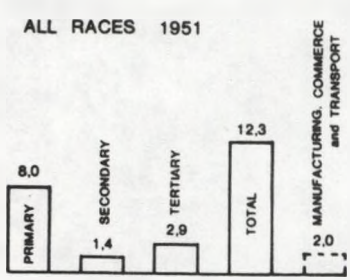
Figure 11.

Work Opportunities by Zones and Sectors, 1951 and 1970
 (as percentages of all work opportunities on the
 Witwatersrand)

(Source: Table 32)

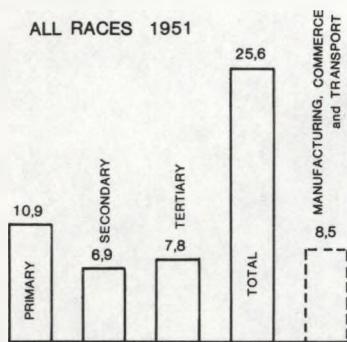


WEST RAND

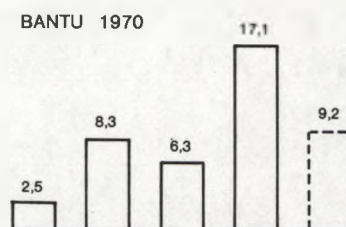
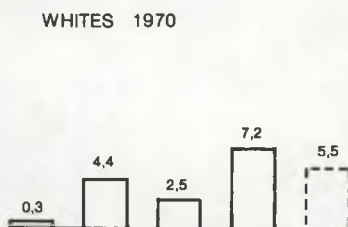
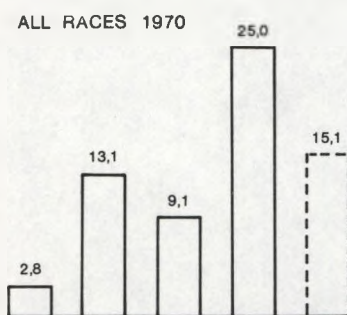
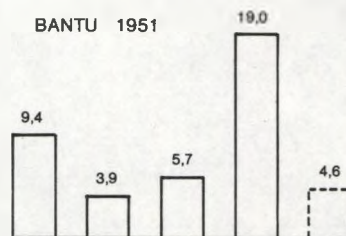
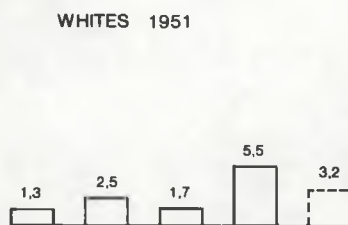


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Figure 11 (Cont'd)



EAST RAND



FAR EAST RAND

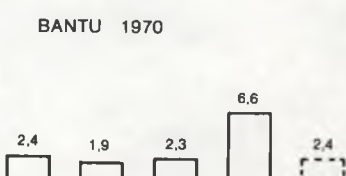
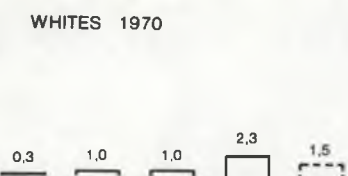
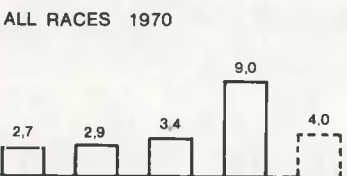
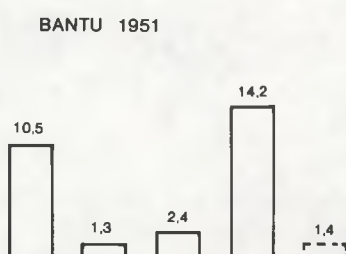
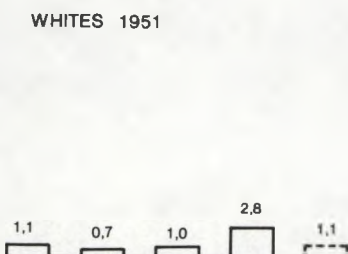
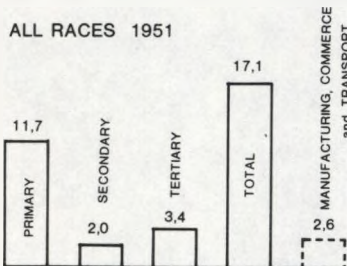


Figure 11 (Cont'd)

CHAPTER 6.SUPPORTING ECONOMIC INFRASTRUCTUREIntroduction

132. As the Southern Transvaal's economic development "has rapidly progressed, the demands of its people and economy have become not only greater but more sophisticated, and the provision of an appropriate infrastructure of communications, water and power has been required at rates considerably higher than either the rate of population increase or the pace of economic growth".¹ The relationship between the rate of economic development, on the one hand, and rates of growth in passenger and goods traffic and the consumption of power and water, on the other hand, is indeed an intimate one. "The link between employment and transportation is both powerful and delicate";² demand for water is a function of "the continuous rise and movement in population, the quantities of water which that population demands by way of a rising standard of living, and the rapidly rising requirements of industry";³ and the volume of electric power consumed is a sensitive indicator of economic strength. As far as available data permit, therefore, it is the object of this chapter to analyse by sector and zone the changing rates of growth in the Witwatersrand's supporting economic infrastructure during the last two decades, as a prologue to the study

¹*First Report: The Southern Transvaal*, op.cit., p.64.

²R.N. Davidson, "The Pattern of Employment Densities in Glasgow", *Urban Studies*, vol. 7, no. 1, February 1970; p.75.

³L. Mills, "Demands for Water Supply in Britain", *Town and Country Planning*, vol. 40, no. 9, September 1972; p.420.

of the development of the region's urban economy since the early 1950s and as a prelude to an examination of growth and change in its demographic and physical organization in recent years, including the physical extension of its communications, power and water networks.

Electric Power

133. The continuing decline in employment in the electricity industry on the Witwatersrand since 1951⁴ is certainly no indicator of the trend in the region's consumption of electric power. Tables 34 and 35 reflect a rise in its consumption from 5 635,1 kWh in 1955 to 10 990,8 kWh in 1972, at a rate of 4,1% per annum. These overall totals, however, mask a steep *decline* in primary sector consumption from 3 156,3 kWh to 1 837,2 kWh, or by a rate of -3,2% per annum during the period reviewed, and a steeper *rise* in secondary and tertiary sector consumption⁵ from 2 478,8 kWh to 9 153,6 kWh, or by no less than 8,0% per annum (which is not only comparable to the overall rate of increase experienced in the Republic as a whole, but is the same as the average annual growth rate in world consumption between

⁴See Table 25.

⁵Including consumption of power for domestic household purposes, secondary industry and tertiary services. "Escom's figures relating to industrial supplies do not present a complete picture since they do not include supplies of electricity furnished to industrial consumers by municipalities or supplies generated by industrial undertakings for their own use" (*Forty-Ninth Annual Report, 1971*, Electricity Supply Commission, April 1972; p.11). It is thus not possible to separate out sectoral consumption, nor consumption by manufacturing, commerce and transport combined. To this extent, the analysis made here can be no more than approximate only, and contains some anomalies, as shown in paragraph 136 below.

1961 and 1970).⁶ Moreover, the secondary and tertiary sectors' combined rate of increase in consumption climbs from 7,6% per annum between 1955 and 1960, to as much as 9,2% per annum between 1970 and 1972. This rising tempo of power consumption in the modernizing sectors of the Witwatersrand's space economy, undoubtedly confirms the latter's transition from the primary industrial phase of its development to the secondary industrial phase. In fact, Table 34 shows mining to account for 56% of the total regional consumption in 1955, whereas in 1972 it accounts for under 17% of the metropolitan total.

134. Tables 35 and 36 reveal that, while this fundamental *sectoral* change is taking place in the regional economy as a whole, an equally significant *zonal* change is also under way. Power consumption in the inner metropolitan zone rises by 4,8% per annum between 1955 and 1972; in the outer metropolitan zone it rises by 3,2% per annum. Thus, whereas the inner zone is responsible for only 47% of total consumption in 1955, and the outer zone for 53%, by 1972 the positions are reversed; now, the inner zone accounts for as much as 54% and the outer zone for as little as 46%. Table 36 suggests the main causes of the overall trends to be, firstly, a severe contraction in the primary sector - which is formerly by far the largest consumer, with its major demands for power located in the outer zone - and, secondly, a strong expansion in the secondary and tertiary sectors - which tend to concentrate their power demands in the inner zone. As a result, by 1972, one-half of the Witwatersrand's total consumption of power is accounted for by the secondary and tertiary activities of the latter zone alone.

⁶World Energy Supplies, 1961 - 1970, Statistical Office, United Nations, New York, 1973.

135. Consumption in the subsidiary metropolitan zones naturally reflects these overall trends, with Johannesburg advancing its total power intake from 29% to 34% of the regional aggregate, while the peripheral Far East Rand, which in 1955 is the highest zonal consumer because of its mining requirements, reduces its intake from 30% to 16%, and consumption in the equally peripheral West Rand falls from 18% to 16%. By contrast, the more centrally located East Rand increases its total consumption from 30% in 1955 to well over 36% in 1972, when it becomes the Witwatersrand's largest subsidiary consumer of power. Its zonal aggregate, however, still includes a relatively high mining element, so that Johannesburg actually remains the leading consumer of electric power for secondary and tertiary purposes, at nearly one-third of the Witwatersrand's total consumption.

136. Nevertheless, Table 36 also uncovers a broad trend in the combined consumption of the secondary and tertiary sectors which reflects a tendency towards a higher aggregate rate of growth in these sectors *outside* the metropolitan core than *within* it. Unfortunately, the available data do not permit a further breakdown facilitating the identification of trends in the consumption of power for manufacturing, commercial, transport, service, and domestic household purposes separately. It is thus not possible to discover if the overall trend results mainly from (i) an increasing concentration on commercial, transport and service consumption relative to manufacturing and domestic consumption in the Johannesburg zone, (ii) an increasing concentration on manufacturing (and commercial) consumption on the East Rand, (and, to a lesser extent, on the West Rand and the Far East Rand), and (iii) a relative deconcentration of domestic power requirements

from Johannesburg towards the West, the East and the Far East Rand which is closely connected with a centrifugal tendency in the growth of White residential areas. From the evidence of Chapters 3 to 5 above, it is probable that these sectoral and spatial changes in power requirements are in fact currently taking place, with trends in manufacturing and domestic consumption being the major influences, and with consequent differential changes in demands for electric power from zone to zone, both as regards their rates of increase and their proportionate industrial, commercial and domestic composition. But the metropolitan and sub-regional planning of power supplies needs surer statistical foundations than indirect inferences such as these. As concluded in the First Report,⁷ "there is a growing need for means of anticipating the volumes and locations of new demands well in advance of actual requirements". A first step in this direction would be to make available recent data on current power consumption under categories which are more appropriate for metropolitan and sub-regional sectoral and spatial analysis, if it is at all possible to do so.

Water Supplies

137. Similar fundamental deficiencies in Table 37 prevent the analysis of water consumption on the Witwatersrand beyond the elementary stages of Tables 38 and 39. As far as the present statistical breakdown permits, the analysis reveals sectoral and spatial trends that are essentially similar to those of electric power

⁷*First Report: The Southern Transvaal*,
op.cit., p.76.

consumption. Over the Witwatersrand as a whole, Tables 37 and 38 show water consumption to rise from 481,801 megalitres a day in 1955 to 881,219 megalitres a day in 1972, at an average rate of 3,6% per annum. This generally rising trend, however, is a compound of a sharp *fall* in primary sector (mining) demands from 172,933 to 67,819 megalitres a day (or by an average rate of -5,7% per annum), and an equally sharp *rise* in secondary and tertiary sector demands⁸ from 308,868 to 813,400 megalitres a day (or by an average rate of 5,9% per annum). In addition, consumption of water by the secondary and tertiary sectors combined rises from a growth rate of 6,2% per annum between 1955 and 1960 to one of 10,6% per annum between 1970 and 1972. There is thus a striking parallel between trends in power and water demands by these two sectors during the period under review.

138. Furthermore, Tables 37 and 38 show the consumption of water in the inner metropolitan zone to rise at an average rate of 4,7% per annum between 1955 and 1972, as against an average rate of only 1,7% per annum in the outer zone. Hence, in Table 39 the inner zone not only accounts for 60% of the Witwatersrand's aggregate demand for water in 1955, but increases its share to 71% by 1972; and while its primary sector needs fall from 12% to 3% of that demand, its secondary and tertiary sector requirements rise from 48% to nearly 68% of the metropolitan total. Clearly, the same factors are in operation here as in the case of power consumption, i.e. firstly, a progressive

⁸Including consumption of water for domestic household purposes, as well as secondary industry and tertiary services. The Rand Water Board supplies water in bulk to the municipal distributors, and is thus unable to differentiate consumption for these purposes.

contraction in demand on the part of mining, which in 1955 consumes twice as much water in the outer zone as in the inner zone; and, secondly, a progressive expansion of demand by municipal and other consumers, which tends to be concentrated overwhelmingly in the inner zone.

139. In the subsidiary metropolitan zones, Johannesburg raises its demand for water from under 48% to 56% of the regional total between 1955 and 1972, in significant contrast to a decline on the West Rand from 15% to 10%, and on the Far East Rand from 19% to 10%. The East Rand, however, off-sets a severe contraction of demand in the primary sector by a swift expansion in the secondary and tertiary sectors, so that its aggregate requirements rise from 24% to 26% of the regional total. Even so, in volume these requirements remain less than half those of the metropolitan core which, in contrast to its consumption of power, now accounts for well over one-half of the total metropolitan consumption of water for all purposes. Moreover, the relative fall in Johannesburg's share of the region's combined secondary and tertiary *water* consumption - from 65% in 1955 to 59% in 1972 - is not so great as the relative fall in its share of secondary and tertiary *power* consumption. In addition, the Far East Rand increases its share of water consumption by these two sectors from 8,5% to 8,9% only, as against a power increase of from 9,3% to 12,4%; the increase in the East Rand's share of water consumption by these sectors is also lower than the increase in its share of power consumption; and the West Rand's share of water consumption falls, although its share of power consumption by the secondary and tertiary sectors rises.

140. While the data do not permit a direct explanation of these differing zonal trends in the consumption of power and water, the comparisons do suggest that domestic

household demand may be a more significant factor in differential consumption from zone to zone and sector to sector in the case of water supplies than in the case of electric power supplies. By contrast, it is possible that manufacturing demand is more significant in the case of power supplies. It is undoubtedly imperative for metropolitan planning that hypotheses such as these should be capable of being tested empirically. For example, if domestic requirements are in fact a relatively important element in the demand for water,⁹ the changing population effects of metropolitan economic development on the Witwatersrand may well bear relatively heavily on existing infrastructure for the supply and disposal of water in general. In Great Britain,¹⁰ it is expected that the present domestic consumption of 168 litres per head per day will probably rise to 273 litres by the year 2000. On the Witwatersrand, because the existing level of Bantu water consumption is lower, the domestic demand

⁹There is reason to believe that domestic demand does play a major rôle in variations in water consumption on the Witwatersrand. For example, "The variation within the weekly cycle (of water consumption) is affected, to a limited degree, by mining and industrial users, but the large hourly, daily and seasonal variations are caused by domestic users... In recent years, the ratio between the highest 7-day demand and the average weekly demand over the year, of the Rand Water Board has shown a rising trend from 120% in October, 1954, to 135% in October, 1968. This diverging trend is ascribed to the change in relationship between consumption for domestic purposes and consumption for industrial and mining purposes". (R.J. Laburn, "The Efficient Distribution of Water to an Urban and Industrial Region", *Convention: Water For the Future*, S.A. Water Year, 1970; pp.2 and 3).

¹⁰L. Mills, op.cit., p.421. The per capita consumption of water on the Witwatersrand *for all purposes* averaged 325 litres a day in 1970 as against 155 litres a day in 1940 (R.J. Laburn, *ibid.*).

for water per head of the urban Bantu population may tend to rise more quickly than this, and to affect consumption in Johannesburg more than in the remaining subsidiary zones. By contrast, the rising domestic consumption of the Witwatersrand's White inhabitants may tend to have greater repercussions in zones peripheral to Johannesburg than in the metropolitan core itself, because of a growing relative deconcentration of this section of the region's population from its core to its periphery. Unfortunately, these possibilities cannot be tested empirically by means of available current data.

Road Traffic

141. Metropolitan Development and the Transportation Network. Because of the "powerful and delicate" transportation link between areas of work and areas of residence, which is so fundamental a feature of modern urbanization that in most cities some 80% of all daily motor vehicle trips begin and end in their residential areas,¹¹ and because access to and from these areas of work and residence is so important a factor in the development of urban land uses, the metropolitan configuration of such uses is very much a function of the supporting transportation network. Nevertheless, this network's economic significance, and its changing patterns and densities, are in turn greatly influenced by structural changes in the space economy it serves. For instance, as observed in the First Report in connection with the Southern Transvaal as a whole, "The rôle played by the transportation system has... assumed an increasing

¹¹B.S. Bergman and Partners, *Benoni Traffic Plan*, 1968. Some 70% are home-to-work trips: see Scott and de Waal, *Kempton Park Traffic Study*, 1970.

significance as gold mining has declined in importance and the metropolitan stage of urbanization has been reached".¹² To take another example, Warnes'¹³ analysis of journey-to-work data in North-Western England between 1921 and 1966 has revealed a major re-orientation of road and rail traffic in conformity with a transformation in the economic foundations of urbanization in and around Manchester, from primary mining and cotton manufacturing to more sophisticated secondary and tertiary activities. "Traditional commuting patterns have to a large extent ended on the South Lancashire coalfield... and have recently been undergoing rapid change in the old cotton spinning districts... Employment is becoming increasingly concentrated into a small number of large urban areas, while in the remainder of the region the residential function is becoming increasingly dominant".¹⁴

142. In its essentials, as indicated in Chapter 2 above and substantially confirmed by subsequent economic analysis, a similar transformation of traffic appears to have been taking place on the Witwatersrand, and for similar economic reasons. This is not all, however. Recent alterations in the journey-to-work pattern in and around Manchester "suggest that although both employment and population are decentralizing within the urban complex, they are doing so at unequal rates. At the periphery... commuting distances are rising quickly, because population is increasing much faster than employment and greater numbers are having to travel towards the centre - if not to it - for work. In the inner suburbs, on the other hand, the evidence is

¹² *First Report: The Southern Transvaal*, op.cit., p.78.

¹³ N.M. Warnes, "Estimates of Journey-to-Work Distances from Census Statistics", *Regional Studies*, vol. 6, no. 3, September 1972; pp.315-326.

¹⁴ *Ibid.*, p.323.

that commuting distances are declining, and this may be attributed to static or even declining populations and a more buoyant supply of jobs; in other words, job ratios are increasing and fewer people have to travel long distances to find work".¹⁵ As shown below, trends such as these, especially in connection with the location of White employment and residence, have undoubtedly been manifesting themselves on the Witwatersrand in recent years, if only in relative terms. The problem is to quantify such trends, in the absence of census statistics on the journey to work which are comparable to those made available for North-Western England.

143. The Witwatersrand Network. One method of approach to this problem is to examine the growth in the volume of road traffic¹⁶ within the framework of the hierarchical systems of movement established in Chapter 2 above, i.e. in terms of the Witwatersrand's first-order regional system as a whole, its second-order system of inner and outer metropolitan zones, and its third-order system of subsidiary zones which is itself hierarchical in character and focuses on the metropolitan core.¹⁷ These systems combine four different types of traffic movements, namely, (i) movements from residential areas to work areas, which are generated by the journey to shop, education and entertainment as well as by the commuting journey to work, (ii) movements between residential areas which are unconnected with these purposes, (iii) movements from work areas to residential areas, particularly in connection with commerce and public and private services, and (iv) movements between work areas, principally in connection

¹⁵Ibid., p.323.

¹⁶Comparative data on the volume of rail traffic are being compiled and will be incorporated in Part Two of this report in connection with the communications network.

¹⁷See paragraph 30 above.

with secondary industry and commercial services. The systems thus reflect much more than the changing pattern of daily commuting, which must subsequently be differentiated as far as available data permit, and they in fact constitute the principal traffic supports to the Witwatersrand's economic development as a whole.

144. For the period 1970-72, and on the basis of counts made by the Roads Department of the Transvaal Provincial Administration, by the Johannesburg City Council and by certain other municipalities, the volumes of road traffic generated within this systematic framework over a 24-hour day (except in Johannesburg) are reflected in Figure 12. Averaging the counts shown on the roads radiating from each of the distinguishable traffic nodes within the spatial limits set by Randfontein in the west, Nigel in the east, Halfway House in the north and the area north of Evaton and Meyerton in the south, the following pattern emerges. With one exception, a range of values lying between 3 000 and 14 000 vehicles a day results in connection with roads associated with the nodes located in the outer metropolitan zone as defined in Chapter 2 above, and of between 9 000 and 20 000 vehicles a day in connection with roads associated with the nodes located in the inner metropolitan zone around Johannesburg, the regional core. The exception to this differentiation between nodal traffic in this second-order system of inner and outer zones, is the very high volume experienced on the main artery leading from the vicinity of Jan Smuts airport (Kempton Park) to Johannesburg. Apart from this traffic, which is shown to vary from 20 000 to 34 000 vehicles a day and involves international, inter-metropolitan and inter-zonal movements, the mean value in the outer metropolitan zone is an average of 8 000 vehicles a day. The mean value in the inner

zone outside Johannesburg itself is an average of 15 000 vehicles a day, taking into account flows on roads leading into and out of Germiston's and Alberton's CBDs,¹⁸ which are omitted from Figure 12. There is thus a clear and unmistakable differentiation in zonal traffic volumes, which is a basic characteristic of metropolitan regions and is intimately associated with the structure of their economic foundations.¹⁹

145. Incorporated in these broad differences, however, are average-value ranges of traffic on roads in each of the third-order, subsidiary metropolitan zones of the Witwatersrand. On the Far East Rand, the average values range between 3 000 and 7 000 vehicles a day, with a mean of 5 000. On the West Rand, they range from 7 000 to 9 000, with a mean of 8 000. On the East Rand, they range between 7 000 and 14 000 (excluding the Jan Smuts - Johannesburg traffic), with a mean of 11 000. And around the perimeter of the Johannesburg zone, they range between 9 000 and 20 000, with a mean of 15 000 vehicles a day.²⁰

146. There is thus a hierarchy of mean zonal values extending from an average of 5 000 vehicles a day on the peripheral Far East Rand roads to an average of 15 000 a day at the entrances to the core Johannesburg zone, which

¹⁸ According to the City of Germiston, *Central Business District Report*, 1970 (Town Planning Section, City Engineer's Department), traffic flows of between 12 000 and 21 000 vehicles a day were experienced on the roads leading into and out of the C.B.D. in 1969. According to the *Alberton Civic Survey, 1968*, 53 000 vehicles a day used the six roads leading into and out of the town's central area in 1968, of which possibly 50% constituted national and inter-metropolitan traffic.

¹⁹ See Chapter 1 above.

²⁰ For twelve hours only, but including possibly 20 000 vehicles a 24-hour day crossing the southern metropolitan boundary and 22 000 crossing the northern metropolitan boundary, in both directions.

not only parallels economic development from zone to zone measured in terms of White employment opportunities and gross geographic product per head, but patently accentuates the hierarchical tendencies manifested in these measurements. Indeed, *with over 345 000 vehicles pouring across its perimeter daily, the rôle of Johannesburg as a generator of intra-metropolitan traffic far surpasses its rôle as a generator of metropolitan wealth or work opportunities, or as a consumer of power or water supplies.*

147. The Growth of the Network. The development of Johannesburg's traffic rôle over the last two decades is portrayed in Table 40. The number of vehicles entering the old municipal area of the city every 12-hour day rises from 31 900 in 1954 to 172 000 in 1972, or by 439% and at an average growth rate of 9,8% a year. Not only is this a very much higher rate of increase than any experienced by the metropolitan core in terms of wealth produced, employment created, power consumed or water reticulated; it is also an accelerating rate. Between 1954 and 1968, the volume of road traffic entering the city expands by 9,6% per annum; between 1968 and 1972, it expands by 10,5% per annum.

148. Undoubtedly, part of this accelerating increase in the volume of road traffic is to be attributed to the Southern Transvaal's central rôle in the development of the Republic's urban hierarchy, and to the rôles played by the Witwatersrand in general and Johannesburg in particular in the Southern Transvaal's own development, i.e., some of the traffic is national and inter-metropolitan in character, and some is international. But the analysis of traffic volumes made above suggests that only some 10% of the overall total may reasonably

be attributed to extra-metropolitan origins;²¹ that 90% is most probably being generated within the Witwatersrand itself in connection with its own, intra-metropolitan development; and that the rate of increase recorded in Table 40 is overwhelmingly a result of internal growth and change. This conclusion finds support in the table's breakdown of cordon counts. For example, the lowest rate of growth (7,9% per annum between 1954 and 1972) is recorded by the eastern cordon, which incorporates internationally and nationally-generated traffic flowing between Jan Smuts airport and Johannesburg. Indeed, the volume of traffic entering the city from the East Rand and Far East Rand falls from 46% of the total inflow in 1954 to 33% in 1972; and the highest rate of increase between 1968 and 1972 (averaging over 12% per annum) is recorded in the inflow from the West Rand, which undoubtedly receives very little extra-metropolitan, through traffic destined for Johannesburg.

149. Given the minor part played by extra-metropolitan traffic volumes in Table 40, the most striking features of the table are as follows:

- (i) the high and accelerating overall rate of growth in the Witwatersrand's road traffic entering the central city as the metropolitan region matures;
- (ii) the relative decline from 46% to 33% in the volume of traffic entering Johannesburg from the East Rand and Far East Rand between 1954 and 1972, apparently associated with a relative decline in

²¹See footnote 20 above, which suggests a total volume of 42 000 vehicles both entering and leaving the metropolitan region in a 24-hour day on roads directly leading to Johannesburg; in which case, the extra-metropolitan inflow in 12 hours should not exceed 18 000 vehicles.

daily commuting (*see* Table 2 above) and the westward shifting of the inner metropolitan zone; but including a rising growth rate between 1968 and 1972 (to 9,5% per annum, as against 7,4% per annum during the previous fourteen years), which is apparently to be associated with an increasing industrial traffic (*see* paragraphs 48 and 56 above);

(iii) the sustained high rate of expansion in traffic entering the city from the White dormitory areas of Randburg and Sandton in the north, which averages 11,6% per annum over two decades, grows from 26% to 35% of the total inflow, and is certainly and overwhelmingly commuting in character (*see* Table 2);

(iv) up to 1968, the high growth rate of 12,1% per annum in traffic entering from the south, which originates mainly from Soweto; and the lower growth rate of 9,0% per annum registered thereafter, which reduces the southern proportion of the total inflow from 17,4% to 16,5% between 1968 and 1972, and which, apart from any dampening effects of influx control, may well be connected with the lower income level of the Bantu population and the more adequate provision of public transport between Soweto and Johannesburg, by rail as well as by road; and

(v) the growth rate of 12,2% per annum experienced in the inflow of traffic from the West Rand since 1968, which is undoubtedly to be attributed chiefly to an expansion of White commuting, which raises the West Rand's share of the total inflow from 14,6% to 15,5% during the last four years, and which is to be associated with the westward extension of the inner

metropolitan zone into the north-eastern parts of Krugersdorp magisterial district.

150. Table 41, using the volumes of municipal motor vehicle licences issued by metropolitan region and zone as a surrogate for comparative traffic data, which are not available, confirms some of these inferences and suggests quite significant variations in the growth of the transportation network from zone to zone. These variations are associated especially with lengthening distances between places of work and places of residence on the part of White employees, and with the changing structure of the space economy. For example, between 1954 and 1971 the number of vehicles licensed on the Witwatersrand rises from 188 596 to 474 448, at an average annual growth rate of 7,7%. This rate is approximately twice the regional rate of growth in power and water consumption (4,1% and 3,6% per annum respectively), it is well over twice the rate of growth in the urban population,²² but it falls far short of the growth rate of 9,8% per annum in the volume of road traffic entering Johannesburg. These comparisons thus suggest that, while the pressure of metropolitan development on economic infrastructure in general is building up faster than the rate of growth in urban population, its greatest weight is being brought to bear on the transportation network. They also suggest that the traffic pressure on the metropolitan core is rising at a much faster rate than on the transportation network as a whole.

151. It may also be inferred from Table 41 that the

²²Tables 6, 11 and 13 of the *First Report: The Southern Transvaal*, op.cit., yield a growth rate in the Witwatersrand's urban White population of 2,1% per annum between 1951 and 1970, of 3,7% per annum in the non-gold mining Bantu population, and of 3,0% per annum overall (excluding Bantu mining employees).

relatively low rate of increase in the number of motor vehicle licences issued in the Johannesburg subsidiary zone - which averages 6,8% per annum as against the regional average of 7,7% - is to be associated with (i) the relative deconcentration of the White population from this zone to residential areas beyond its boundaries and mainly within the inner metropolitan zone, and (ii) the rising industrial activities of the East Rand. Such trends would explain the relatively high growth rate of 8,2% in the number of motor vehicle licences issued on the West Rand, which is undoubtedly to be associated with the high rate of increase in external commuting from that zone to Johannesburg in recent years, and is supported by the analysis of traffic volumes made in paragraphs 144 to 146 above. They would also explain the even higher growth rate of 9,7% in the number of motor vehicle licences issued on the East Rand, which is presumably to be associated with White population expansion there, increased internal commuting as portrayed in Table 3 above, and a rising industrial traffic; and which is also supported by the analysis made in paragraphs 144 to 146. The same trends and analysis further explain and support the relatively high growth rate of 9,0% per annum in the number of motor vehicle licences issued in the outer zone (as against 7,4% in the inner zone), in so far as White commuting to Johannesburg has been spreading into Krugersdorp since 1965 (which is excluded from the inner zone in Table 41), and the area of the East Rand now falling within the outer zone has experienced a rapid expansion of manufacturing in recent years. By contrast, the relatively low growth rate of 6,5% per annum in the number of motor vehicle licences issued on the Far East Rand (which accords with the traffic analysis made in paragraphs 144 to 146), may well be linked with a lower volume and tempo of industrialization than is being experienced on the East

Rand, and with a lower volume and tempo of external commuting than is taking place on the West Rand.

152. There is confirmation here, that, with employment becoming increasingly concentrated in Johannesburg city, on the one hand, and in the industrial areas of the East Rand, on the other hand, the residential areas of Roodepoort, Krugersdorp and Randfontein to the west of Johannesburg, of Randburg and Sandton to its north, and of Bedfordview and Edenvale to its north-east, have been increasingly developing as White dormitories for Johannesburg's workers; and that White residential areas have been growing apace within the East Rand, from Alberton, Germiston and Kempton Park to Boksburg, Benoni and Brakpan, to supply its own work needs as well as those of the metropolitan core. In both cases, commuting distances have been lengthening rapidly and the volume of industrial traffic has been quickly expanding. The transportation network has thus been faced with new and ever-rising needs of passenger and goods traffic, which has been growing at rates of between 7% and 12% per annum.

153. Undoubtedly, these trends are very similar to those accompanying metropolitan development in and around Manchester - as in most metropolitan regions²³ - and hold similar fundamental implications in connection with the reorientation of the road system, which in physical terms will be spelled out in Part Two of this report. It is clear, too, that the problems facing the development of that system vary enormously as between Johannesburg - the apex of the region's traffic hierarchy - the East Rand, and the two peripheral zones. If the principal object of the transportation network is to support the rapid industrial and commercial evolution of the Witwatersrand metropolitan region during its present, secondary

²³See N.N. Patricios, op.cit., pp.31 and 32.

industrial phase of urbanization, it is imperative that, for metropolitan and sub-regional planning purposes, the different, changing pressures being brought to bear on this network from zone to zone as a consequence of widening spatial variations in economic progress and residential growth, should be fully analysed and quantified, and functionally linked to those spatial variations as firmly as available data will permit.

154. This conclusion implies an urgent need to provide adequate and appropriate statistical information on the journey to work, industrial and commercial traffic, and journeys made for purposes of shopping, recreation and education (by rail as well as by road). It also implies that, during research and analysis for metropolitan planning, particular attention should be paid to the following:

- (i) major structural changes made in the transportation network itself, as presently being effected through the building of the system of national and provincial freeways discussed in Chapter 2 above and as proposed by the Johannesburg City Council for the metropolitan core in the form of an underground railway system, since innovations of this magnitude fundamentally influence the configuration and development of traffic patterns and land uses;
- (ii) the rôle of public passenger transport systems in the movement of people and goods throughout the Witwatersrand, and especially the movement of the lower-income Bantu, Coloured and Asian populations between places of residence and places of work within the Johannesburg and East Rand subsidiary zones; and

- (iii) the accelerating, changing ownership of private and commercial motor vehicles in South Africa according to race, which has risen (a), in the case of the White population, from 264 private vehicles and 55 commercial vehicles per 1 000 population in 1962, to 365 and 87 per 1 000 population respectively in 1970; (b), in the case of the Bantu population, from 3 to 5 private vehicles per 1 000 during the same period; and (c), overall, from 55 private vehicles and 13 commercial vehicles per 1 000 in 1962, to 72 and 19 per 1 000 respectively in 1970²⁴ - so that, while White ownership of both classes of vehicles is now reaching saturation level,²⁵ non-White ownership has full scope to expand greatly in the nation's metropolitan complexes, and to initiate significant changes in their existing patterns of traffic.

Conclusions

155. On the one hand, the development of economic infrastructure is a response to growth and change in the metropolitan economy which, without the support of complementary networks of communications (including transportation by road, rail and air, and postal and telephone services), power supplies, water supplies, drains and sewers, must come to a standstill. On the other hand, in so far as the response to the need for economic

²⁴C. Verburgh, P.J. Welgemoed and H.F.L. Cilliers, *The City and its Traffic*, Rand Afrikaans University, Johannesburg, 1973.

²⁵Ibid., in which saturation level is defined as 450 private vehicles and 100 commercial vehicles per 1 000 population.

infrastructure is adequately met, growth and change in its supporting networks provide sensitive indicators of the sectoral and spatial development of the metropolitan economy. In this chapter, attention is focused on growth and change in the Witwatersrand's networks of power supplies, water supplies and road traffic. Rail traffic, and the physical extension of infrastructure including drainage and sewerage, will be analysed in Part Two.

156. Power and Water Supplies. In spite of lack of data broken down to major economic sectors, it is possible to show that an overall increase of 95,3% in the Witwatersrand's electric power consumption between 1955 and 1972, results from a 41,8% fall in demand from the primary sector (mining) and a 269,3% rise in demand from the secondary and tertiary sectors combined (including domestic household consumption). Moreover, *the tempo of the secondary and tertiary sectors' combined demand is accelerating, in response to the quickening tempo of structural economic change. Because this structural change is spatial as well as sectoral, however, the overall rise in power consumption is occurring principally in the inner metropolitan zone, and especially in the Johannesburg and East Rand subsidiary zones.* These latter zones advance their consumption of power from 29% and 30% of the regional total respectively in 1955, to 34% and 36% respectively in 1972. Moreover, Johannesburg remains the leading zonal consumer of electric power for secondary and tertiary purposes combined. However, the rate of growth in the consumption of these two sectors tends to be higher *outside* the Johannesburg zone than *within* it. Although statistical confirmation is not available, it is possible that this contrasting trend results from (i) in the Johannesburg zone itself, an increasing emphasis on commercial, transport and service consumption

relative to manufacturing and domestic consumption, (ii) an increasing emphasis on manufacturing (and commercial) consumption elsewhere, especially on the East Rand, and (iii) a relative deconcentration of domestic power requirements from the metropolitan core, which is closely connected with a relative decentralization of growth in the White population from Johannesburg outwards.

157. As indicated in the First Report,²⁶ *these several tendencies in the growth and distribution of power consumption from sector to sector and zone to zone of the regional economy do not raise serious problems of overall supply, in so far as the elements of a national grid have already been established by ESCOM, "which will not only become increasingly integrated and ramifying as time passes, but which is planned to involve international connections with sources of power generation in Moçambique (Cabora Bassa), Swaziland and Lesotho within the near or foreseeable future". A similar conclusion is to be drawn in connection with growth and change in the Witwatersrand's overall water demands for industrial, commercial, service and domestic purposes. "Previously-held fears that, because of (the) continuing and rapid rise in consumption, future water needs in the region could not be met from local sources have been allayed. Earlier thinking by official bodies that the future development of the Southern Transvaal would have to be curtailed, and economic growth encouraged instead in areas with adequate supplies, has radically changed in recent years... This clearer and more optimistic view of the future water supplies to the region has been made possible by the use of more sophisticated analytical techniques, and by the grid concept of integrating a number of river basins to meet national and regional*

²⁶*First Report: The Southern Transvaal, op.cit., p.75.*

requirements more adequately and more flexibly".²⁷

158. Nevertheless, fundamental deficiencies in the statistics of water consumption on the Witwatersrand prevent more than an elementary analysis of overall demand by sector and zone, and, for sub-regional metropolitan planning purposes, inferences similar to those made above in connection with power consumption must be drawn on the basis of other data. As in the case of power, an overall rise in water consumption of 82,9% between 1955 and 1972, results from a 60,8% decline in the primary sector's demand (mining) and a 163,3% rise in the demand of the secondary and tertiary sectors combined (including domestic household needs). Furthermore, consumption in the inner metropolitan zone increases relatively to that of the outer zone. But, in contrast to power consumption, the Johannesburg zone's aggregate demand for water rises to as much as 56% of the regional total, and, while its proportionate share of water consumed by the secondary and tertiary sectors (including domestic households) throughout the Witwatersrand does tend to fall, the relative decline is far less than in the case of power consumption. The explanation of these contrasting trends appears to be that domestic household demand is the more significant factor in variations in water consumption, while manufacturing demand is the more significant factor in variations in electric power consumption. It is very necessary for the metropolitan planning of sub-regional power and water network capacities, that such an hypothesis should be capable of being tested empirically, if at all possible; particularly in view of the differential spatial changes that are taking place in the location and orientation of the region's White and Bantu

²⁷Ibid., p.72.

populations, and of its manufacturing industries.

Attempts should thus be made to improve statistical information about power and water supplies specifically for metropolitan and sub-regional research and analysis, both sectorally and spatially.

159. Road Traffic. Problems resulting from a dearth of suitable regional and sub-regional data also arise in connection with road traffic on the Witwatersrand, where comprehensive journey-to-work statistics are not available (except in connection with Johannesburg as shown in Table 2 above), and where comprehensive historical information on traffic volumes is generally lacking outside the central city. Nevertheless, from volume counts made by the Roads Department of the Transvaal Provincial Administration, from the Johannesburg City Council's own traffic research, and from statistics of motor vehicle licences issued by municipalities, it may be concluded that, given the minor part played by extra-metropolitan traffic volumes (which apparently account for not more than some 10% of the traffic entering Johannesburg city itself), the most significant features of the region's road transportation network appear to be as follows:

- (i) a high and accelerating overall rate of growth in the volume of traffic entering Johannesburg, the central city, from the rest of the Witwatersrand, which averages 9,6% a year between 1954 and 1968, and 10,5% a year between 1968 and 1972, so that inflowing volumes rise from 31 900 vehicles a 12-hour day in 1954 to 172 000 vehicles a day in 1972;
- (ii) a relative decline in the volume of traffic entering from the East Rand and Far East Rand - from 46% to 33% of the total inflow - which is apparently associated with a relative decline in daily commuting to the metropolitan core and

the westward shifting of the inner metropolitan zone, but incorporates a rising growth rate in recent years presumably resulting from an increasing industrial traffic between the two centrally-located, manufacturing zones;

- (iii) a sustained high rate of expansion in the volume of traffic entering from the White dormitories of Randburg and Sandton in the north, which grows from 26% to 36% of the total inflow and is overwhelmingly commuting in character;
- (iv) up to 1968, a high growth rate in the volume of traffic entering from the south and originating especially from Soweto, which thereafter declines (presumably because of the lower income level of the Bantu population and the more adequate provision of public road and rail transport), and reduces the proportion of the total inflow accounted for by the southern periphery from 17% to 16% by 1972;
- (v) after 1968, a high growth rate in the volume of traffic entering from the West Rand, which rises to over 15% of the total inflow by 1972, and is undoubtedly to be associated with a rapid expansion in White commuting and the westward extension of the inner metropolitan zone into north-eastern Krugersdorp;
- (vi) a high growth rate in the volume of traffic circulating *within* the East Rand zone, which is presumably to be associated with a rapid increase in its White population, a rising internal commuting between its fast-expanding White residential areas and work centres (*see* Table 3 above), and a swiftly accelerating industrial traffic;

- (vii) a high growth rate in the volume of traffic obtaining *within* the West Rand, principally, however, because of the rapid westward extension of White commuting associated with work areas in Johannesburg;
- (viii) a somewhat lower growth rate in the volume of traffic obtaining *within* the Far East Rand, which is presumably to be linked with a lower volume and tempo of industrialization than is being experienced on the East Rand, and with a lower volume and tempo of external commuting than is taking place on the West Rand;
- (ix) in general, a rapid lengthening of commuting distances (at least as far as the White population is concerned) and a rapid rise in industrial traffic, because of the transformation in the Witwatersrand's space economy from mining to metropolitan functions, and the region's resulting advance into the secondary industrial phase of urbanization; and
- (x) in particular, an accelerating concentration of road traffic in and around the region's urban nodes, which reaches its peak in Johannesburg, the nucleus of the metropolitan core, where the daily volume of traffic entering and leaving its (old) municipal area has risen to 345 000 vehicles on average (excluding buses), and where well over 400 000 vehicles now cross the boundaries of its central business district every day.²⁸

160. *Clearly, the problems facing the development of*

²⁸ Information supplied by the Forward Planning Branch, City Engineer's Department, Johannesburg City Council, 1973.

the Witwatersrand's road transportation network vary enormously as between Johannesburg - the apex of the region's traffic hierarchy - the East Rand, and the two peripheral zones. If the principal object of the network is to support the region's rapid industrial and commercial progress during its present, secondary industrial phase of urbanization, it is imperative that, for metropolitan and sub-regional planning purposes, the different, changing pressures being brought to bear on the network from zone to zone should be capable of the fullest analysis, and of firm functional association with those widening spatial variations in economic and residential growth in which they undoubtedly find their origins. This conclusion not only implies an urgent need for appropriate statistical data on the journey to work, industrial and commercial traffic, and trips made for purposes of shopping, recreation and education, by rail as well as by road. It also implies that, in metropolitan planning, particular attention should be paid to (i) major structural changes being made in the transportation network itself (such as the present building of a freeway system and the proposed introduction of an underground railway for Johannesburg), (ii) the rôle of public passenger transport systems in the movement of people and goods (especially the non-White population of Johannesburg and the East Rand), and (iii) the rising, changing ownership of motor vehicles by the Witwatersrand's White, Bantu, Asian and Coloured populations (which, nationally, is reaching saturation level in the case of the White population, but has full scope for wide expansion in the case of the other race groups and could, therefore, significantly influence future metropolitan traffic patterns).

TABLE 14.

ELECTRICITY CONSUMPTION, 1955 - 1972: THE WITWATERSRAND AND CONSTITUENT ZONES
(in millions of units - kWh)

Zone and Category	1955		1960		1970		1972	
	Number	%	Number	%	Number	%	Number	%
Witwatersrand								
Mining	3 156,3	56,0	2 978,1	45,4	2 136,7	21,8	1 837,2	16,7
Municipal and Industrial	2 234,9	39,7	3 234,9	49,4	7 146,3	72,9	8 550,8	77,8
S.A.R.*	243,9	4,3	341,8	5,2	523,6	5,3	602,8	5,5
T o t a l	5 635,1	100,0	6 554,8	100,0	9 806,6	100,0	10 990,8	100,0
Inner Zone								
Mining	1 081,6	19,2	924,2	14,1	548,9	5,6	429,3	3,9
Municipal and Industrial	1 444,8	25,6	2 051,7	31,3	4 299,9	43,9	5 140,0	46,8
S.A.R.*	145,2	2,6	245,1	3,7	320,6	3,3	367,7	3,4
T o t a l	2 671,6	47,4	3 221,0	49,1	5 169,4	52,7	5 937,0	54,0
Outer Zone								
Mining	2 074,7	36,8	2 053,9	31,3	1 587,8	16,2	1 407,9	12,8
Municipal and Industrial	790,1	14,0	1 183,2	18,1	2 846,4	29,0	3 410,8	31,0
S.A.R.*	98,7	1,8	96,7	1,5	203,0	2,1	235,1	2,1
T o t a l	2 963,5	52,6	3 333,8	50,9	4 637,2	47,3	5 053,8	46,0
Johannesburg								
Mining	485,0	8,6	401,7	6,1	257,5	2,6	159,5	1,5
Municipal and Industrial	1 095,5	19,4	1 510,0	23,0	2 803,5	28,6	3 417,5	31,1
S.A.R.*	70,8	1,3	128,9	2,0	113,9	1,2	144,6	1,3
T o t a l	1 651,3	29,3	2 040,6	31,1	3 174,9	32,4	3 721,6	33,9
West Rand								
Mining	792,0	14,1	762,1	11,6	559,7	5,7	554,1	5,0
Municipal and Industrial	136,8	2,4	336,8	5,1	867,2	8,8	1 071,3	9,8
S.A.R.*	68,1	1,2	99,7	1,5	161,9	1,7	156,5	1,4
T o t a l	996,9	17,7	1 198,6	18,3	1 588,8	16,2	1 781,9	16,2
East Rand**								
Mining	811,5	14,4	793,7	12,1	678,0	6,9	641,9	5,8
Municipal and Industrial	817,0	14,5	1 194,1	18,2	2 700,4	27,5	3 137,3	28,5
S.A.R.*	63,9	1,1	87,6	1,3	203,6	2,1	233,3	2,1
T o t a l	1 692,4	30,0	2 075,4	31,7	3 582,0	36,5	4 012,5	36,5
Far East Rand**								
Mining	1 484,3	26,3	1 392,0	21,2	872,7	8,9	662,1	6,0
Municipal and Industrial	209,7	3,7	270,3	4,1	872,9	8,9	1 044,4	9,5
S.A.R.*	19,9	0,4	28,1	0,4	79,0	0,8	89,4	0,8
T o t a l	1 713,9	30,4	1 690,4	25,8	1 824,6	18,6	1 795,9	16,3

* South African Railways.

** Brakpan is included in both the East Rand and the Far East Rand.

Sources: Electricity Supply Commission and Electricity Department, Johannesburg City Council.

TABLE 35.

GROWTH RATES OF ELECTRICITY CONSUMPTION; THE WITWATERSRAND
AND INNER AND OUTER METROPOLITAN ZONES, 1955 - 1972

Region or Zone	1955 - 1960			1960 - 1970			1970 - 1972			1955 - 1972		
	Primary (Mining)	Secondary and Tertiary*	Total	Primary (Mining)	Secondary and Tertiary*	Total	Primary (Mining)	Secondary and Tertiary*	Total	Primary (Mining)	Secondary and Tertiary*	Total
	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.
Witwatersrand	-1,2	7,6	3,1	-3,4	7,9	4,2	-7,8	9,2	5,9	-3,2	8,0	4,1
Inner Zone	-3,2	7,6	3,8	-5,3	7,3	4,9	-6,2	9,2	7,1	-5,6	7,6	4,8
Outer Zone	-0,2	7,6	2,4	-2,7	9,1	3,4	-6,2	9,4	4,4	-2,3	8,7	3,2

* Municipal, industrial and S.A.R. consumption.

Source: Table 34.

TABLE 36.

ELECTRICITY CONSUMPTION AS A PERCENTAGE OF TOTAL
METROPOLITAN CONSUMPTION, 1955 AND 1972

Zone and Year	Primary (Mining)	Secondary and Tertiary*	Total	Secondary and Tertiary as a Percentage of Total Secondary and Tertiary
<u>Inner Zone</u>				
1955	19,2	28,2	47,4	64,1
1972	3,9	50,1	54,0	60,2
<u>Outer Zone</u>				
1955	36,8	15,8	52,6	35,9
1972	12,8	33,2	46,0	39,8
<u>Johannesburg</u>				
1955	8,6	20,7	29,3	47,1
1972	1,5	32,4	33,9	38,9
<u>West Rand</u>				
1955	14,1	3,6	17,7	8,3
1972	5,0	11,2	16,2	13,4
<u>East Rand</u>				
1955	14,4	15,6	30,0	35,5
1972	5,8	30,7	36,5	36,8
<u>Far East Rand</u>				
1955	26,3	4,1	30,4	9,3
1972	6,0	10,3	16,3	12,4

* Including consumption by domestic households as well as by secondary industry, commerce, transport and public and private services.

Source: Table 34.

TABLE 37.

WATER CONSUMPTION, 1955/56 - 1972/73; THE WITWATERSRAND AND CONSTITUENT ZONES
(in megalitres per day)

Zone and Category	1955/56		1960/61		1970/71		1972/73	
	Number	%	Number	%	Number	%	Number	%
Witwatersrand								
Mining	172,933	35,9	162,348	27,9			67,819	7,7
Municipal and Other	308,868	64,1	418,521	72,1	665,895		813,400	92,3
T o t a l	481,801	100,0	580,869	100,0			881,219	100,0
Inner Zone								
Mining	56,216	11,7	51,369	8,8			26,691	3,0
Municipal and Other	232,379	48,2	311,096	53,6	484,766		597,400	67,8
T o t a l	288,595	59,9	362,465	62,4			624,091	70,8
Outer Zone								
Mining	116,717	24,2	110,979	19,1			41,128	4,7
Municipal and Other	76,489	15,9	107,425	18,5	181,129		216,000	24,5
T o t a l	193,206	40,1	218,404	37,6			257,128	29,2
Johannesburg								
Mining	29,158	6,1	25,048	4,3			15,176	1,7
Municipal and Other	199,848	41,5	265,045	45,6	392,461		478,200	54,3
T o t a l	229,006	47,5	290,093	49,9			493,376	56,0
West Rand								
Mining	45,588	9,5	46,647	8,0			22,562	2,6
Municipal and Other	26,345	5,5	34,277	5,9	49,256		64,100	7,3
T o t a l	71,933	14,9	80,924	13,9			86,662	9,8
East Rand*								
Mining	53,512	11,1	45,947	7,9			20,117	2,3
Municipal and Other	61,550	12,8	89,713	15,4	168,221		208,900	23,7
T o t a l	115,062	23,9	135,660	23,3			229,017	26,0
Far East Rand*								
Mining	67,123	13,9	64,336	11,1			17,219	2,0
Municipal and Other	26,353	5,5	36,164	6,2	64,960		72,600	8,2
T o t a l	93,476	19,4	100,500	17,3			89,819	10,2

* Brakpan is included in both the East Rand and the Far East Rand.

Source: Rand Water Board.

TABLE 38.

GROWTH RATES OF WATER CONSUMPTION; THE WITWATERSRAND AND
INNER AND OUTER METROPOLITAN ZONES, 1955 - 1972

Region or Zone	1955 - 1960			1960 - 1970			1970 - 1972			1955 - 1972		
	Primary (Mining)	Secondary and Tertiary*	Total	Primary (Mining)	Secondary and Tertiary*	Total	Primary (Mining)	Secondary and Tertiary*	Total	Primary (Mining)	Secondary and Tertiary*	Total
	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.	% p.a.
Witwatersrand	-1,3	6,2	3,8		4,8			10,6		-5,7	5,9	3,6
Inner Zone	-2,1	6,0	4,6		4,6			11,0		-4,2	5,7	4,7
Outer Zone	-1,0	7,0	2,5		5,3			9,2		-6,3	6,3	1,7

* Municipal and Other.

Source: Table 37.

TABLE 39.

WATER CONSUMPTION AS A PERCENTAGE OF TOTAL
METROPOLITAN CONSUMPTION, 1955 AND 1972

Zone and Year	Primary (Mining)	Secondary and Tertiary*	Total	Secondary and Tertiary as a Percentage of Total Secondary and Tertiary
Inner Zone				
1955	11,7	48,2	59,9	75,2
1972	3,0	67,8	70,8	73,4
Outer Zone				
1955	24,2	15,9	40,1	24,8
1972	4,7	24,5	29,2	26,6
Johannesburg				
1955	6,1	41,5	47,5	64,7
1972	1,7	54,3	56,0	58,8
West Rand				
1955	9,5	5,5	14,9	8,5
1972	2,6	7,3	9,8	7,9
East Rand				
1955	11,1	12,8	23,9	19,9
1972	2,3	23,7	26,0	25,7
Far East Rand				
1955	13,9	5,5	19,4	8,5
1972	2,0	8,2	10,2	8,9

* Municipal and Other, i.e. consumption by secondary industry, commerce, transport, public and private services and domestic households.

Source: Table 37.

TABLE 40.

CORDON ROAD TRAFFIC VOLUMES, JOHANNESBURG (OLD) MUNICIPAL AREA, 1954 - 1972

(Number of vehicles entering Johannesburg between 7 a.m. and 7 p.m. daily, rounded to the nearest '00 and excluding buses)

Cordon Side*	1954		1968			1972			1954 - 1972
	Number	%	Number	%	Growth Rate p.a.	Number	%	Growth Rate % p.a.	Growth Rate % p.a.
Western	4 900	15,4	16 800	14,6	9,2	26 600	15,5	12,2	9,9
Northern	8 200	25,7	38 400	33,3	11,7	59 500	34,6	11,6	11,6
Eastern (and South Eastern)	14 700	46,1	40 000	34,7	7,4	57 500	33,4	9,5	7,9
Southern (and South Western)	4 100	12,8	20 100	17,4	12,1	28 400	16,5	9,0	11,4
T o t a l	31 900	100,0	115 300	100,0	9,6	172 000	100,0	10,5	9,8

* As shown in Figure 12.

Sources: Forward Planning Branch, City Engineer's Department, Johannesburg (for 1972 volumes).
Greater Johannesburg Area Transportation Study, Miscellaneous Traffic Volumes,
Forward Planning Branch, City Engineer's Department, Johannesburg, June 1971.

TABLE 41.

MOTOR VEHICLES* LICENSED, THE WITWATERSRAND
AND CONSTITUENT ZONES, 1954 AND 1971

Region or Zone	1954		1971		Increase 1954 - 71		Growth Rate Per Annum
	Number	%	Number	%	Number	%	%
Witwatersrand	188 596	100,0	663 044	100,0	474 448	251,57	7,7
Inner Zone	139 254	73,84	466 694	70,39	327 440	235,14	7,4
Outer Zone	49 342	26,16	196 350	29,61	147 008	297,94	9,0
Johannesburg	114 636	60,78	351 369	52,99	236 733	206,51	6,8
West Rand	20 361	10,80	77 242	11,65	56 881	279,36	8,2
East Rand**	40 592	21,52	194 333	29,31	153 741	378,75	9,7
Far East Rand**	19 829	10,51	58 100	8,76	38 271	193,01	6,5

* Including all types of motor vehicles and not only private cars.

** Brakpan registrations are included in both the East Rand and the Far East Rand.

Sources: Official South African Municipal Year Books, 1954-55 and 1971-72.
Various Municipal Authorities.

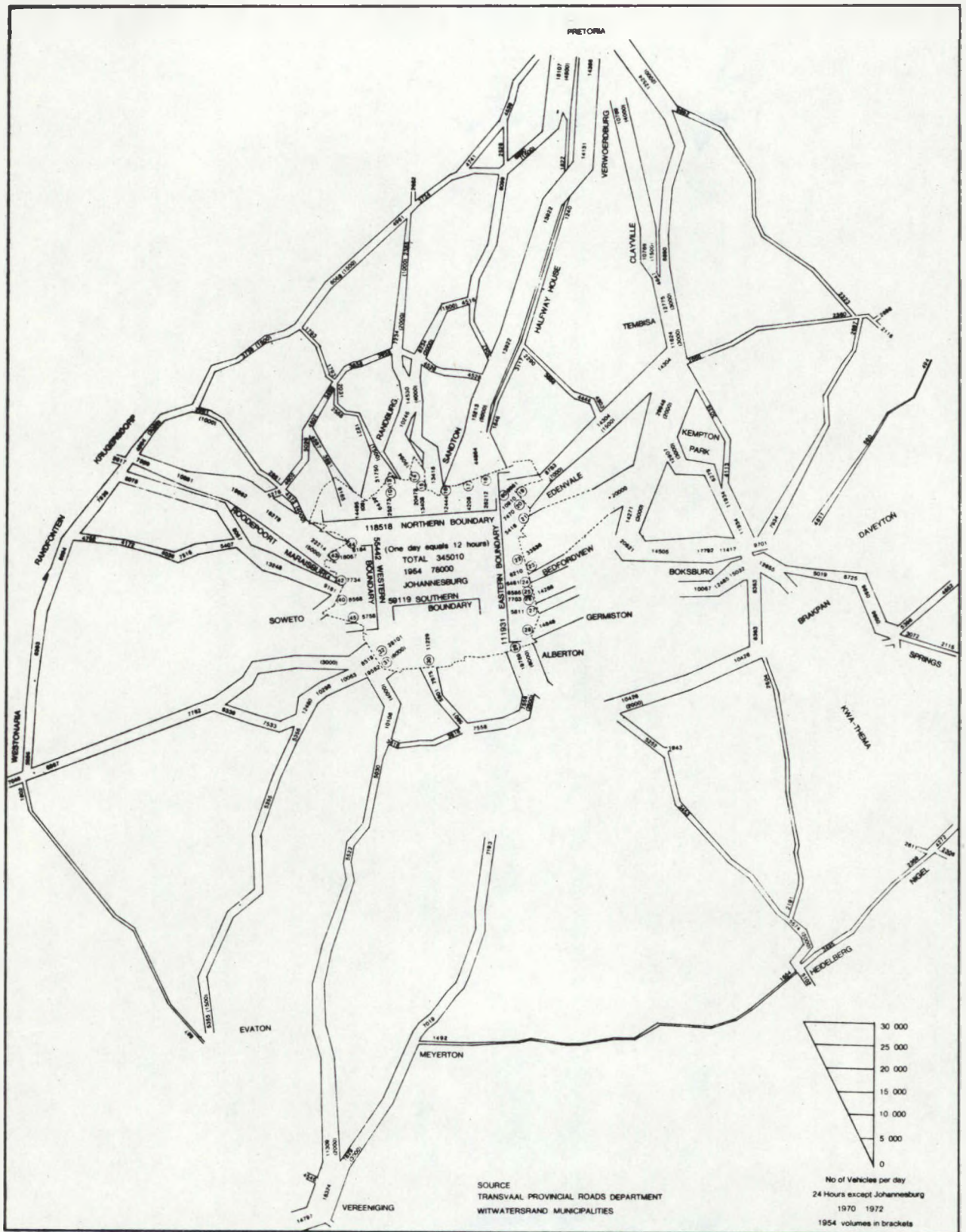


Figure 12.

The Southern Transvaal: Road Traffic Volumes, 1971-72

CHAPTER 7.SUMMARY AND CONCLUSIONSChapter 1: The Metropolitan Concept

161. The object of this second report is to attempt for the Witwatersrand itself a spatial, social and economic analysis which is essentially similar to that undertaken by the first report for the Southern Transvaal, but in finer detail.¹ It approaches this task by way of the concept of a *metropolitan region*, defined as being primarily a region of intense movement of people, goods and services between residential areas and industrial and commercial centres. Because the essential purpose of a metropolitan region is to serve the needs of industry and commerce, and because its existence and structure are largely functions of communications, it is a nodal region comprising (i) a dominant metropolitan hub; (ii) an inner metropolitan zone, having a close, daily contact with the hub and extending for some ten to fifteen miles in all directions from it; and (iii) an outer metropolitan zone, having a less intimate contact with the hub and extending still further afield, towards a broad transitional boundary which forms a recognizable commuting, marketing and service watershed. As a metropolitan region matures, a suburbanization of population and, later, economic activities develops, so that, within the broad primary framework of inner and outer zones, social and economic subsidiary zones arise, which exert a growing secondary influence on patterns of land use and communications.

162. *As this concept is one of hierarchical systems of movement between work areas and residential areas, it*

¹See *First Report: The Southern Transvaal*, op.cit., p.3.

permits the spatial analysis of urban complexes in economic, social and physical terms within the parameters of traffic flows between origins and destinations. It is thus possible, within a metropolitan framework of systems of movement, to divide the present report into three separate but closely interwoven parts. The first part deals with the sectoral and zonal development of the metropolitan economy. The second part will cover the Witwatersrand's demographic and physical development. The third part will be concerned with possible future planning strategies.

163. Use of the concept also permits direct comparisons to be made with the results of metropolitan research and analysis undertaken in the 1950s for planning purposes,² as illustrated physically in Figures 1 and 2. These summarize the broad functional structure of the Witwatersrand in 1955 and 1973, according to major areas of work and residence, and provide an essential background to the economic enquiry to be made in this part of the second report. However, the figures are unable to reflect the multiplying economic and transport links which have increasingly bound together these major functional land uses into a coalescent metropolitan region, nor can they reflect the hierarchical relationships being forged between the latter's urban centres. It is these dynamic elements of growth and change which form the subject matter of the following chapters.

²L.P. Green, *The Future Development of Johannesburg*, op.cit; T.J.D. Fair et al, *A Planning Survey of the Southern Transvaal*, op.cit; and *Report of the Witwatersrand Interim Planning Committee*, op.cit.

Chapter 2: The Metropolitan Framework

164. In spite of a serious lack of up-to-date information, particularly in connection with the journey to work, it is possible to define the broad metropolitan structure of the Witwatersrand as it exists today in terms of the movement of people, goods and services. This framework, which forms the foundation for the present regional analysis of the Witwatersrand, is reflected in Figures 4 and 6 and consists of the following systems:

- (i) within the Southern Transvaal megalopolitan region, a first-order system of movement which defines the limits of the Witwatersrand metropolitan region, which stretches from Randfontein in the West to Nigel in the east and from Halfway House in the north to Grasmere and Ennerdale in the south, and which focuses upon Johannesburg, its commercial, industrial and service hub;
- (ii) two second-order systems, comprising (a) a strongly-knit inner metropolitan zone centred also on Johannesburg and stretching from the north-eastern areas of Krugersdorp in the west to Germiston and Alberton in the east,³ and (b) a more loosely-knit outer metropolitan zone covering the remainder of the metropolitan region but also focused on the central hub; and
- (iii) a subsidiary hierarchy of four third-order systems, comprising (a) a central Johannesburg

³This inner zone having moved westwards since 1954, when it stretched from Roodepoort in the west to Benoni in the east, and thus also included Boksburg and Kempton Park but completely excluded Krugersdorp.

zone, which is a dominant and very strong system of movement extending over the municipal areas of Johannesburg itself (including Soweto), Randburg, Sandton, Edenvale and Bedfordview; (b) a West Rand zone, which is a sub-dominant and relatively weak system coinciding with the municipal areas of Randfontein and Krugersdorp, and the magisterial district of Roodepoort; (c) an East Rand zone, which is a relatively strong and complex system ranking higher than the West Rand but subordinate to and closely linked with Johannesburg, and which covers the magisterial districts of Germiston, Alberton, Kempton Park, Boksburg, Benoni and Brakpan; and (d) a Far East Rand zone, which is a peripheral and lower-ranking system covering the magisterial districts of Springs and Brakpan,⁴ and the municipal area of Nigel.

165. This hierarchy of systems of movement is defined in terms of inter-town road traffic statistics of 1961, the journey to work of White workers by road and rail to Johannesburg in 1965-1966 (supplemented by various town planning surveys of 1970-71), and the Government-regulated movements of Bantu workers between places of residence and employment. Although the completion of the freeway network now under construction (in connection with which impact studies are being undertaken by the Urban and Regional Research Unit), and the sub-regional reorganization of the administration of Bantu affairs on the Witwatersrand, will both exert an impact on these systems which has yet to be determined, they are most

⁴Because of its dormitory nature and watershed situation as regards commuting traffic, Brakpan is included in *both* the East Rand and Far East Rand subsidiary zones.

unlikely to invalidate the latter's hierarchical tendencies. They are more likely only to modify the systems' spatial extents and the volumes and orientations of their traffic flows. *During the current industrial phase of urbanization on the Witwatersrand, the metropolitan framework will undoubtedly remain that of a first-order, region-wide system of movement, which embraces a second-order system of inner and outer metropolitan zones, and an underlying third-order system of subsidiary zones which is itself hierarchical in character and centres on the metropolitan core.*

Chapter 3: The Economic Base

166. If a metropolitan region is viewed as a producer trading with the rest of the economy, its earning power - and therefore its prosperity - may be seen to depend upon its ability to export goods and services to beyond its borders, and to specialize in those exports in which it has a comparative advantage. The region's external earning capacity may thus be defined as its economic base, and the activities contributing to that base may be defined as "basic" to the metropolitan economy. These contributions may be determined in terms of net "surplus" workers as defined in the First Report.⁵

167. Analysis of trends in the economic base of the Witwatersrand between 1951 and 1970, which are illustrated in Figure 7, reveals fundamental structural changes which are both sectoral and spatial in character. *Sectorally*, whereas in 1951 at least 63% of the region's net external capacity⁶ depends on mining, 25% on secondary industry and

⁵*First Report: The Southern Transvaal, op.cit., ch. 3.*

⁶Omitting services, as a disproportionately large number of domestic servants are employed in Johannesburg in 1951.

6% on commerce (including finance and transport), by 1970 mining has ceased to be a basic activity, 54% of the region's net external earning capacity is now accounted for by secondary industry, 32% by commerce (including finance and transport), and 14% by public and private services. The total net external earning capacity of the Witwatersrand has risen by 20%, in spite of the serious decline in the export-oriented mining sector. *Spatially*, whereas in 1951 some 66% of the region's net external earning capacity is generated in its inner metropolitan zone, consisting of the magisterial districts of Johannesburg, Germiston, Alberton and Roodepoort, by 1970 no less than 80% is being generated in this zone. The latter *increases* its net external earning capacity by 45%; the outer metropolitan zone *decreases* its net external earning capacity by 68%.

168. *The principal result of these structural changes in the economic base is a shift in the prime responsibility for the Witwatersrand's continued growth from a single sector - mining - which is ubiquitous throughout the region in 1951, to a number of sectors - both secondary and tertiary - which are overwhelmingly concentrated in its inner metropolitan zone by 1970. This sectoral and spatial shift is typical of metropolitan regions, and inevitably raises complex problems of metropolitan planning and administration to which there can be no simple solution.*

169. Analysis of trends in the economic bases of the subsidiary metropolitan zones confirms these general conclusions, and reveals external trading reasons from zone to zone for a growing interdependence between the region's several parts, in social and physical as well as economic terms. In 1951, the Johannesburg zone's economic base is composed proportionately of secondary

industry (37%), commerce⁷ (32%) and services (31%); by 1970, a decisive change has occurred and it now consists proportionately of commerce (45%), secondary industry (34%) and services (21%). As a result, external earning capacity has grown by no less than 61%. In complete contrast, the economic bases of the peripheral West Rand and Far East Rand zones, which are composed of mining alone in 1951, continue to depend on this sector in 1970 for 67% and 60% of total capacity respectively; and, in spite of rising contributions from secondary industry (18%) and services (15%) on the West Rand, and from secondary industry (40%) and commerce (marginal) on the Far East Rand, external earning capacity has fallen by as much as 61% and 66% respectively. Meanwhile, the East Rand zone's total external earning capacity remains virtually stationary between 1951 and 1970, while a radical structural change occurs in its economic base, which switches from mining (72%) and secondary industry (28%), to secondary industry only. In spite of this very strong growth in manufacturing, neither commerce nor services generates a net export capacity, and both remain locally underdeveloped on the East Rand.

170. The prosperity of the West Rand and Far East Rand zones does not appear to have been impaired by the serious erosion of their economic bases. In so far as their economies have been integrated into that of the maturing metropolitan region as a whole, their progress is less dependent on the development of their own, local economic bases than on the development of the overall economic base of the wider region of which they now form part.

⁷Throughout this paragraph, commerce includes finance and transport.

The above analysis shows that the development of the economic base of the wider Witwatersrand region has come to depend increasingly upon the external earning capacity of the latter's central, Johannesburg zone. A prime task of metropolitan planning must thus be to help to promote the interests of this core zone.

171. The growing integration of the Witwatersrand's subsidiary metropolitan zones is manifested in rising inter-zonal commercial, financial, service and industrial transactions, and in daily commuting, which are all functions of the structural changes in their exporting economic bases. For example, as the peripheral West Rand has developed relatively little secondary industry to provide exports to Johannesburg in exchange for imports of goods and services, it daily sends to the latter vast numbers of workers in secondary and tertiary occupations. To a lesser degree, the peripheral Far East Rand, which has experienced a greater development of secondary industry, also takes part in this daily exchange of labour for goods and services. The more centrally located East Rand, apart from exporting every day an even greater number of workers to the metropolitan core, and receiving from it an even heavier commercial and service traffic, vies with Johannesburg in generating a rising inter-zonal industrial traffic. *It is from this growing basic economic specialization and sectoral interdependence that the mounting problems of metropolitan planning are largely originating; and it is because of the spatial and inter-zonal nature of this growth that these problems are assuming a typical metropolitan form.*

Chapter 4: Economic Development

172. While the economic development of the

Witwatersrand is basically a function of its external earning power, not only do its basic activities need the growing support of non-basic, non-export activities, but both kinds of activities generate the region's wealth, the non-basic in fact contribute much more than the basic to regional gross geographic product (G.G.P.), and the region's evolution as an urban complex is fundamentally dependent upon their total combined effect over time. This effect, which has spatial as well as sectoral aspects, is thus of great significance for urban and regional planning; but its full ramifications may be uncovered only by means of an analysis of the region's economic development as a whole.

173. As shown in Table 24 and Figure 8, between 1954/55 and 1970/71, the wealth produced annually by the Witwatersrand (measured in terms of G.G.P. *at constant prices*) rises from R1 202 million to R1 933 million, or by 61%. During this time, the sectoral transformation from dependence on mining to dependence on secondary and tertiary activities, at first places a considerable strain on the region's economy. From 1954/55 to 1963/64, the annual regional G.G.P. per head (at constant prices) rises from R653 to R657, as against comparable annual national figures of R313 and R350. Between 1963/64 and 1970/71, however, the region's G.G.P. per head (at constant prices) rises to R733 per annum, as against a comparable national figure of R405, *indicating that the overall structural change in the Witwatersrand's economy has been accomplished, that its overall economic development has passed into the secondary industrial stage, and that its overall urbanization has entered upon a truly metropolitan phase.*

174. The rate and degree of economic change, however, varies significantly from zone to zone. As indicated in Figure 9, for all practical purposes, by 1954/55 the inner metropolitan zone has already effected the transition from

a high dependence on the primary sector for the generation of its wealth. It has been led in this advance by Johannesburg, the metropolitan core, which continues to bring the greatest influence to bear upon the inner zone's economic development up to 1970/71, although from 1963/64 onwards the East Rand begins to exert a rising influence through changes taking place in Germiston and Alberton. The East Rand itself follows Johannesburg's lead, and its momentum of growth and change, already accelerating in the early 1950s, quickens appreciably in the next decade, spearheaded by swift progress in manufacturing industries. Unlike all other zones, however, the tertiary sector of its economy continues to contribute less than the secondary sector to its G.G.P. By contrast, both the West Rand and Far East Rand, which do not begin a fundamental economic change until the late 1950s, have yet to achieve a take-off into the secondary industrial stage of development. In both cases, although the Far East Rand undoubtedly experiences the greater secondary advance after 1963/64, it is the tertiary sector which has so far made most progress.

175. In the result, there is a growing concentration of productive activity and economic wealth in and around the metropolitan core. *At constant prices*, annual G.G.P. per head rises in Johannesburg from R685 in 1954/55 to R787 in 1970/71, or by 15%; on the East Rand it rises from R578 to R636, or by 12%; on the West Rand it rises from R592 to R618, or by 10%; and on the Far West Rand, where it is especially boosted by mining production, it rises from R643 to R720, or by 12%. The comparable statistics for the Witwatersrand as a whole are a G.G.P. per head of R652 in 1954/55 and of R733 in 1970/71, yielding an overall increase of 12%. Only the Johannesburg zone has a higher G.G.P. per head in 1970/71, and yields a higher rate of increase between these years.

176. One essential reason for this differential economic growth from zone to zone is an expansion of financial activities and public and private services in Johannesburg. By 1963/64, this zone is already rapidly developing such supporting economic functions for the West Rand and the Far East Rand, as well as for the East Rand, where they are particularly deficient locally because of the latter's specialization on manufacturing. At the same time, Johannesburg continues to provide region-wide commercial and transport services at a level commensurate with growing metropolitan needs, and the headquarters of most of the existing or new major businesses involved in this expansion are located in the metropolitan core. Thus, for instance, pressure on space in the city's central business district builds up rapidly, leading to a quickening extension northwards into Braamfontein in the 1960s; the construction of new urban motorways is begun in the late 1950s, to relieve difficulties of central access; and the volume of traffic crossing the municipal boundaries rises from 78 000 vehicles a day in 1954 to over 180 000 by 1964. *Undoubtedly, the resulting problems of planning and administration in Johannesburg are fundamentally a consequence of the rise of a metropolitan region on the Witwatersrand, and do not originate from economic changes that are confined to within its own city limits.*

177. In addition, except for the Far East Rand, where the primary sector continues to make a significant contribution to its wealth,⁸ *the above statistics of G.G.P. from zone to zone clearly reflect the establishment of a new regional hierarchy of productive capacities by*

⁸The recent substantial rise in the price of gold may well lead to a new lease of life for gold mining on the West Rand as well as on the Far East Rand, however. See *Financial Gazette*, Johannesburg, June 22, 1973.

1970/71, which reaches its apex in the metropolitan core and tends to fall progressively towards the periphery. As the contribution of the primary sector to the Far East Rand's G.G.P. is likely to continue to decline relatively (in spite of new mining activity arising from the increase in the price of gold), the overall metropolitan structure of the Witwatersrand's economy will undoubtedly be fully established in the very near future, on both a sectoral and spatial basis; and, in consequence, urbanization throughout its zones will in economic terms soon be wholly metropolitan in character.

178. It follows from the analysis of Chapters 4 and 5, that it is essential for the future development of the Witwatersrand to be planned on a truly metropolitan scale. It is essential that the planning of the development of land uses for secondary and tertiary economic activities (and for allied residential and communication purposes), of requisite physical infrastructure, and of complementary means of transportation, should no longer be undertaken on a lesser, town or city scale. At a minimum, planning on the Witwatersrand needs to be undertaken at the level of the subsidiary metropolitan zones; and, even so, it needs to be undertaken within the framework of firm, overall metropolitan guidelines formulated for the entire region as a fully-integrated, urban complex. The economic bases of the towns originally created and located for mining purposes are now motivated by secondary industry and tertiary services which form integral, linked parts of a hierarchical metropolitan economy, upon the onward development of which their own future growth vitally depends. Without courting failure, it is not possible to plan the future development of the Reef towns except as part and parcel of the future development of the Witwatersrand metropolitan region as a whole.

Chapter 5: Employment

179. For many practical purposes, the changing impact of economic development on trends in the growth and distribution of population and land uses, for both residence and work, may best be analysed and quantified by way of employment effects. As the First Report concludes,⁹ in connection with tendencies in urbanization in the Southern Transvaal, "the key elements are trends in White and Bantu population growth rates which are closely associated with trends in White and Bantu employment opportunities".

180. Although published employment statistics are not available for 1951, are not given on a metropolitan basis, cannot be aggregated for metropolitan zones in 1970, omit pockets of Coloured and Asian workers in that year, except in the case of the industrial censuses always refer to place of residence instead of place of work, and in the case of the industrial censuses cover only White, Bantu and total workers, it is, nevertheless, possible to arrive at reasonable estimates of employment¹⁰ by metropolitan region and zone, and by major economic activity, for the years 1951, 1960 and 1970, although only for Whites, Bantu and all races combined. The results are summarized in Tables 32 and 33, and Figures 10 and 11. Total employment on the Witwatersrand between 1951 and 1970 rises from 971 580 to 1 211 290 workers, at rates of 0,7% per annum up to 1960, and of 1,5% per annum thereafter. Employment in the primary sector (agriculture and mining) falls progressively from 32% to 10% of the regional total; in the secondary sector (manufacturing, construction, and electricity, gas and water) it rises from 24% to 37%; and in the tertiary

⁹ *First Report: The Southern Transvaal*, op.cit., p.62.

¹⁰ Used in Chapter 3 for economic base analysis and in Chapter 4 to help estimate G.G.P. in 1970/71 by sector, region and zone.

sector (commerce,¹¹ transport, and public and private services) it rises from 43% to 53%. Most significantly, employment in manufacturing, commerce and transport combined rises from 37% to 57% of the regional total, and grows at a rate of 5,1% per annum after 1960.

181. These statistics confirm that, in two decades, *the Witwatersrand's economy switches irreversibly from domination by a single, primary activity that is place-bound, is not of necessity progressively urban-forming, and has little scope or need for major technological innovation - to domination by secondary and tertiary activities that are mainly foot-loose and agglomerating, have the fullest scope and need for technological innovation, and are prime movers in a take-off into the secondary industrial phase of urbanization leading to metropolitan status.*

182. This economic transformation has had more disturbing repercussions on Bantu employment than on White employment and, *via* employment effects, on Bantu urbanization than on White urbanization. Already, by 1951 less than 14% of the region's White workers are employed in the primary sector and, *in economic terms*, White urbanization has already entered on the secondary industrial phase of its evolution. By 1970, with commerce and transport alone accounting for 42% of White employment, and the primary sector for not more than 3%, *in economic terms*, White urbanization is still in its secondary industrial phase although it is beginning to cross the threshold of the post-industrial phase. In contrast, 41% of the region's Bantu workers are employed in the primary sector in 1951, and the First Report gives good grounds for classifying Bantu employment on the mines as being essentially

¹¹Throughout this chapter, commerce includes finance.

non-urban.¹² Moreover, no great change takes place in the sectoral distribution of Bantu work opportunities until after 1960. By 1970, however, manufacturing, commerce and transport together account for 47% of all Bantu workers, and, *in economic terms*, Bantu urbanization has itself swiftly entered upon the secondary industrial phase. *There is no doubt, therefore, that one of the cardinal implications for metropolitan planning today lies in the fact that the sectoral transformation in the Witwatersrand's economy holds far greater connotations for Bantu urbanization than for White urbanization.*

183. Moreover, while it is true that (i) the overall growth in Bantu employment (and population) takes place considerably more slowly on the Witwatersrand than in South Africa as a whole, (ii) the region's overall ratio between White and Bantu employment changes from 28:69 in 1951 to 34:61 in 1970, in favour of White employment, and (iii) in commerce, White employment grows faster than Bantu employment between 1951 and 1970; nevertheless, in manufacturing, Bantu employment grows faster than White employment, and the ratio of White to Bantu employment in manufacturing, commerce and transport combined changes from 46:48 to 43:50, in favour of Bantu employment. *These three activities are the principal modernizing factors in the region's current urbanization.*

184. Because of the centripetal tendencies towards agglomeration inhering in manufacturing, commerce and transport, by 1970 the inner metropolitan zone accounts for nearly 73% of all work opportunities on the Witwatersrand as against 68% in 1951, and for 27% of White work opportunities as against 23% in 1951. Moreover, it continues to account for 42% of Bantu work opportunities,

¹²*First Report: The Southern Transvaal, op.cit., p.29.*

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in spite of a steep decline of employment in the primary sector. At the metropolitan core, the Johannesburg zone necessarily experiences the most wide-ranging employment effects. Local work opportunities rise from 51% to 58% of the regional total; White opportunities rise from 18% to 23% of that total; Bantu opportunities also rise, from 31% to 32%; and commerce alone accounts for 45% of the increase in all work opportunities occurring in this zone after 1960.

185. By contrast, local work opportunities on the West Rand fall from 12% to 10% of the regional total, because White opportunities remain stationary at 2% and Bantu opportunities fall from 10% to 7%. On the Far East Rand, local work opportunities fall even more sharply, from 17% to 9% of the regional total. In both cases, a severe contraction in mining employment is the principal cause, and an expansion of manufacturing, commercial and transport work opportunities from 2% to 4% of the regional total in each zone is insufficient to offset the loss in the primary sector.¹³ Employment in the East Rand zone is more resilient. Here, local work opportunities continue to account for between 25% and 26% of the regional total, in spite of a contraction in primary sector employment comparable to that of the Far East Rand's. Work opportunities in secondary industry rise from 7% to over 13% of the regional total, White opportunities rise from 6% to 7%, and Bantu opportunities decrease only from 19% to 17%.

186. *It follows that, of great importance to urbanization, the basic sectoral changes in the Witwatersrand's economy have resulted in centralizing*

¹³Local work opportunities in manufacturing, commerce and transport combined begin to grow faster on the Far East Rand than on the West Rand after 1960.

employment effects, and in the progressive creation of most new work opportunities for all race groups in and around the metropolitan core. By 1970, the Johannesburg zone is alone generating more work opportunities for both White and Bantu employees than the rest of the Witwatersrand; the East Rand is generating more work opportunities for these two groups than the West Rand and Far East Rand combined. In the modernizing spheres of manufacturing, commerce and transport, not only is the Johannesburg zone creating one-third more work opportunities than all three other zones taken together, but during the last two decades it has raised its share of these opportunities from one-quarter to over one-third of the entire metropolitan total.

187. *It also follows that the resulting problems of urbanization now escalating in the Johannesburg zone are different in kind and degree from those facing even the East Rand.* On the one hand, the rapid expansion in the zone's White work opportunities has resulted in a complementary rapid expansion of commuting from beyond its borders. On the other hand, the economic transformation of the Witwatersrand is exerting its most disturbing effects on the zone's growing Bantu population. As this population is drawn increasingly into commercial and financial activities which reach their peak of intensity in the city's C.B.D., serious problems of congested traffic and transportation (especially at peak hours), of pressures upon limited space by competing land uses, and of increasingly costly provision of physical infrastructure and environmental services, which have already been created mainly by growth and change in the White population, are being exacerbated. Moreover, as the Bantu population has lower standards of living and income than the White, an increasing emphasis is being placed on *public* rather than *private* development of transport, land uses, housing, health, education and urban facilities of all kinds. By contrast, in the rest of the Witwatersrand, the

Bantu population is being drawn into secondary industry rather than tertiary activities, which is far less concentrated in its location and has planned mass transport connections with Bantu residential areas (which are far smaller than Soweto).

188. *The consequences for metropolitan planning of the current economic development of the Witwatersrand are, therefore, of a different nature and order in and around its metropolitan core than in its more peripheral areas. They are more complex, urgent and sophisticated on the centrally located East Rand, than on the West Rand or Far East Rand, where, in economic terms, urbanization has advanced less further into its secondary industrial phase. They are, perhaps, tending to accumulate faster on the Far East Rand than the West Rand, now that the former is beginning to emerge as an imminent growth point in the outer metropolitan zone.*

Chapter 6: Supporting Economic Infrastructure

189. On the one hand, the development of economic infrastructure is a response to growth and change in the Witwatersrand's economy which, without the support of complementary networks of communications, power supplies, water supplies, drains and sewers, must come to a standstill. On the other hand, in so far as the response to the need for economic infrastructure is adequately met, growth and change in its supporting networks provide sensitive indicators of the sectoral and spatial development of that economy. In this chapter, attention is focused on power supplies, water supplies and road traffic (rail traffic, and the physical extension of infrastructure including drainage and sewerage, will be analysed in Part Two).

190. Power and Water Supplies. In spite of a lack of appropriate data, it is possible to show in Tables 34 to 36 that an overall increase of 95,3% in the Witwatersrand's electric power consumption between 1955 and 1972, results from a 41,8% fall in demand by the primary sector (mining) and a 269,3% rise in demand by the secondary and tertiary sectors combined (including domestic household consumption). Moreover, *the tempo of the secondary and tertiary sectors' combined demand is accelerating, in response to the quickening tempo of structural economic change. Because this structural change is spatial as well as sectoral, however, the overall rise in power consumption is occurring principally in the inner metropolitan zone, and especially in the Johannesburg and East Rand subsidiary zones.* However, the rate of growth in consumption by the secondary and tertiary sectors combined tends to be higher outside the Johannesburg zone than within it. It is probable that this contrasting trend results from an increasing emphasis in Johannesburg on tertiary consumption relative to manufacturing and domestic consumption, from an increasing emphasis on manufacturing elsewhere (especially on the East Rand), and from a relative deconcentration of domestic power requirements from the metropolitan core (associated with a relative deconcentration of White population).

191. *These several tendencies in the growth and distribution of power consumption do not raise serious problems of overall supply, however, in so far as ESCOM has already established the elements of a national grid. A similar conclusion is to be drawn in connection with growth and change in the Witwatersrand's overall water demands, as national and regional requirements are now being met by means of a grid which integrates a number of river basins. Nevertheless, intra-metropolitan problems remain in connection with the sub-regional planning of water supplies, for which appropriate data are again lacking. As in the case of power and as reflected in Tables 37 to 39, an*

overall rise in water consumption of 82,9% between 1955 and 1972, results from a 60,8% decline in primary (mining) demand and a 163,3% rise in the demand of the secondary and tertiary sectors combined (including domestic household needs). Furthermore, *water consumption in the inner metropolitan zone increases relatively to that of the outer zone, and to a greater degree than in the case of power consumption. Indeed, Johannesburg's aggregate demand for water rises to 56% of the regional total by 1972. The explanation of these contrasting trends may well be that domestic household demand is the more significant factor in variations in water consumption, while manufacturing demand is the more significant factor in variations in electric power consumption. Hypotheses such as these should be capable of empirical testing, and attempts should thus be made to improve statistical information about water and power supplies specifically for metropolitan and sub-regional planning purposes.*

192. Road Traffic. Problems resulting from a dearth of suitable regional and sub-regional data also arise in connection with road traffic. Nevertheless, given the minor part played by extra-metropolitan traffic volumes, the most significant features of the Witwatersrand's road transportation network - as reflected in Tables 40 and 41 and Figure 12 - appear to be as follows:

- (i) a high and accelerating overall rate of growth in the volume of traffic entering Johannesburg from the rest of the metropolitan region, which averages 9,6% a year between 1954 and 1968, and 10% a year thereafter, so that the inflow volume rises from 31 900 vehicles a 12-hour day in 1954 to 172 000 in 1972;

- (ii) a relative decline in the volume of traffic entering from the East Rand and Far East Rand - from 46% to 33% of the total inflow - although there has been a rise in the growth rate since 1968, presumably associated with an increasing industrial traffic;
- (iii) a sustained high rate of growth in the volume of traffic entering from the White dormitories of Randburg and Sandton in the north, which expands from 26% to 36% of the total inflow;
- (iv) at first, a high rate of growth in the volume of traffic entering from the south (especially Soweto), which, however, declines after 1968 and reduces the southern contribution to the total inflow from 17% to 16%, and presumably reflects mainly the lower income-levels of the Bantu population and a more adequate provision of public transport facilities;
- (v) after 1968, a high rate of growth in the volume of traffic entering from the West Rand, which rises to 15% of the total inflow by 1972 and consists overwhelmingly of White commuters;
- (vi) a high growth rate in the volume of traffic circulating *within* the East Rand zone, presumably associated with expansion of its White population, a rising *internal* commuting and an accelerating industrial traffic;
- (vii) a high growth rate in the volume of traffic obtaining *within* the West Rand, mainly because of the extension of White commuting associated with work in Johannesburg;
- (viii) a somewhat lower growth rate in the volume of traffic obtaining *within* the Far East Rand,

presumably linked with a lower rate of industrialization than on the East Rand, and a lower volume of external commuting than on the West Rand;

- (ix) in general, a rapid lengthening of White commuting distances, and a rapid rise in industrial traffic, associated with the structural change in the Witwatersrand's economy; and
- (x) in particular, an accelerating concentration of road traffic in and around the region's urban nodes, which reaches its peak in Johannesburg, where well over 400 000 vehicles now cross the boundaries of its central business district every day.

193. *Clearly, the problems facing the development of the Witwatersrand's road transportation network vary enormously as between Johannesburg - the apex of the region's traffic hierarchy - the East Rand and the two peripheral zones. If the principal object of the network is to support the region's rapid industrial and commercial progress during its present, secondary industrial phase of urbanization, it is imperative that, for metropolitan and sub-regional planning purposes, the different, changing pressures being brought to bear on the network from zone to zone should be capable of the fullest analysis, and of firm functional association with those widening spatial variations in economic and residential growth in which they undoubtedly find their origins. This conclusion implies an urgent need for appropriate statistical data, and that, in research and analysis for metropolitan planning, particular attention should be paid to (i) major structural changes being made in the transportation network itself, such as the present building of freeways and the proposed underground railway for Johannesburg; (ii) the rôle of*

public transport systems in the movement of people and goods, especially of the non-White population of Johannesburg and the East Rand; and (iii) the differential, changing ownership of motor vehicles by the region's White, Bantu, Asian and Coloured populations, which could significantly affect future traffic patterns.

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